RK Vision Academy

Grade 10

Mathematics

Previous Year Questions With Solutions

2023 - 25

PH NO: 99626 87633
Rkvisionacademy.com
RK Vision Academy for IIT-JEE & NEET

Sl. No	Set	Page No.
	Year 2023	
1	Set 1	01
2	Set 2	31
3	Set 3	60
4	Set 4	88
5	Set 5	128
6	Compartment Exam	160
	Year 2024	
7	Set 1	188
8	Set 2	211
9	Set 3	242
10	Set 4	272
11	Set 5	300
12	Compartment Exam	327
	Year 2025	
13	Set 1	357
14	Set 2	387
15	Set 3	416
16	Set 4	447
17	Set 5	471
18	Set 6	497
19	Compartment Exam	526

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***38*** *questions.* ***All*** *questions are compulsory.*

(ii) *This Question Paper is divided into* ***FIVE*** *Sections –* ***Section A, B, C, D*** *and* ***E****.*

(iii) *In Section–****A*** *question number* ***1*** *to* ***18*** *are Multiple Choice Questions (MCQs) and question number* ***19*** *&* ***20*** *are Assertion-Reason based questions of* ***1*** *mark each.*

(iv) *In Section–****B*** *question number* ***21*** *to* ***25*** *are Very Short-Answer-I (SA-I) type questions of* ***2*** *marks each.*

(v) *In Section–****C*** *question number* ***26*** *to* ***31*** *are Short Answer-II (SA-II) type questions carrying* ***3*** *marks each.*

(vi) *In Section–****D*** *question number* ***32*** *to* ***35*** *are Long Answer (LA) type questions carrying* ***5*** *marks each.*

(vii) *In Section–****E*** *question number* ***36*** *to* ***38*** *are Case Study / Passage based integrated units of assessment questions carrying* ***4*** *marks each. Internal choice is provided in* ***2*** *marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section–****B****, 2 questions in Section–****C****, 2 questions in Section–****D*** *and 3 question in Section–****E****.*

(ix) *Draw neat figures wherever required. Take* $\pi = \frac{22}{7}$ *wherever required if not stated.*

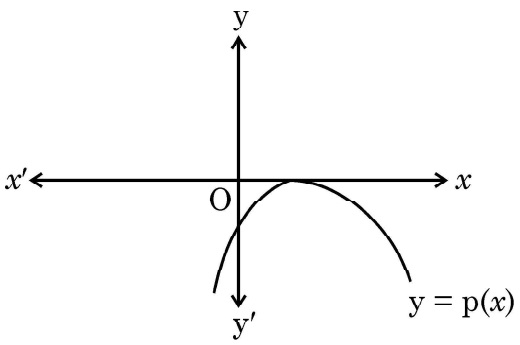
(x) *Use of calculator is NOT allowed.*

SECTION – A

(Multiple Choice Questions)

Each question is of **1** mark.

1. The graph of y = p(x) is given, for a polynomial p(x). The number of zeroes of p(x) from the graph is



(A) 3 (B) 1

(C) 2 (D) 0

2. The value of k for which the pair of equations kx = y + 2 and 6x = 2y + 3 has infinitely many solutions,

(A) is k = 3 (B) does not exist

(C) is k = –3 (D) is k = 4

3. If p – 1, p + 1 and 2p + 3 are in A.P., then the value of p is

(A) –2 (B) 4

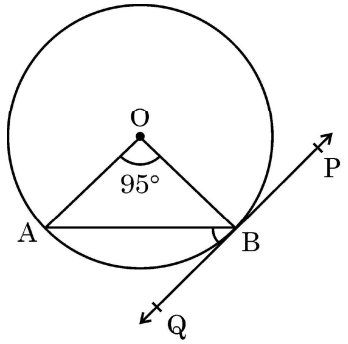
(C) 0 (D) 2

4. In what ratio, does x-axis divide the line segment joining the points A(3, 6) and B(–12, –3) ?

(A) 1 : 2 (B) 1 : 4

(C) 4 : 1 (D) 2 : 1

5. In the given figure, PQ is tangent to the circle centred at O. If $\angle AOB = 95^\circ$, then the measure of $\angle ABQ$ will be



(A) 47.5° (B) 42.5°
(C) 85° (D) 95°

6. If $2 \tan A = 3$, then the value of $\frac{4 \sin A + 3 \cos A}{4 \sin A - 3 \cos A}$ is

(A) $\frac{7}{\sqrt{13}}$ (B) $\frac{1}{\sqrt{13}}$
(C) 3 (D) does not exist

7. If α, β are the zeroes of a polynomial $p(x) = x^2 + x - 1$, then $\frac{1}{\alpha} + \frac{1}{\beta}$ equals to

(A) 1 (B) 2
(C) –1 (D) $\frac{-1}{2}$

8. The least positive value of k, for which the quadratic equation $2x^2 + kx - 4 = 0$ has rational roots, is

(A) $\pm 2\sqrt{2}$ (B) 2
(C) ± 2 (D) $\sqrt{2}$

9. $\left[\frac{3}{4}\tan^2 30^\circ - \sec^2 45^\circ + \sin^2 60^\circ\right]$ is equal to

(A) –1 (B) $\frac{5}{6}$
(C) $\frac{-3}{2}$ (D) $\frac{1}{6}$

10. Curved surface area of a cylinder of height 5 cm is 94.2 cm^2. Radius of the cylinder is (Take $\pi = 3.14$)

(A) 2 cm (B) 3 cm
(C) 2.9 cm (D) 6 cm

11. The distribution below gives the marks obtained by 80 students on a test :

Marks	Less than 10	Less than 20	Less than 30	Less than 40	Less than 50	Less than 60
Number of Students	3	12	27	57	75	80

The modal class of this distribution is :

(A) 10 – 20 (B) 20 – 30

(C) 30 – 40 (D) 50 – 60

12. The curved surface area of a cone having height 24 cm and radius 7 cm, is

(A) 528 cm^2 (B) 1056 cm^2

(C) 550 cm^2 (D) 500 cm^2

13. The distance between the points $(0, 2\sqrt{5})$ and $(-2\sqrt{5}, 0)$ is

(A) $2\sqrt{10}$ units (B) $4\sqrt{10}$ units

(C) $2\sqrt{20}$ units (D) 0

14. Which of the following is a quadratic polynomial having zeroes $\frac{-2}{3}$ and $\frac{2}{3}$?

(A) $4x^2 - 9$ (B) $\frac{4}{9}(9x^2 + 4)$

(C) $x^2 + \frac{9}{4}$ (D) $5(9x^2 - 4)$

15. If the value of each observation of a statistical data is increased by 3, then the mean of the data

(A) remains unchanged (B) increases by 3

(C) increases by 6 (D) increases by 3n

16. Probability of happening of an event is denoted by p and probability of non-happening of the event is denoted by q. Relation between p and q is

(A) p + q = 1 (B) p = 1, q = 1

(C) p = q – 1 (D) p + q + 1 = 0

17. A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, how many tickets has she bought ?

(A) 40 (B) 240

(C) 480 (D) 750

18. In a group of 20 people, 5 can't swim. If one person is selected at random, then the probability that he/she can swim, is

(A) $\frac{3}{4}$ (B) $\frac{1}{3}$

(C) 1 (D) $\frac{1}{4}$

Assertion-Reason Type Questions

In Question **19** and **20**, an **Assertion (A)** statement is followed by a statement of **Reason (R)**. Select the correct option out of the following :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true but Reason (R) is false.

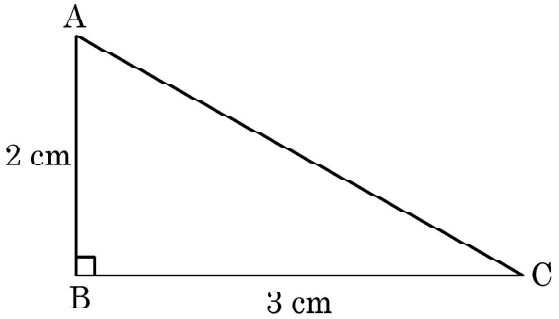
(D) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A) :** Point P(0, 2) is the point of intersection of y-axis with the line $3x + 2y = 4$.

Reason (R) : The distance of point P(0, 2) from x-axis is 2 units.

20. **Assertion (A) :** The perimeter of ΔABC is a rational number.

Reason (R) : The sum of the squares of two rational numbers is always rational.



SECTION – B

(This section comprises of Very Short Answer (SA-I) type questions. Every question is of 2 marks.)

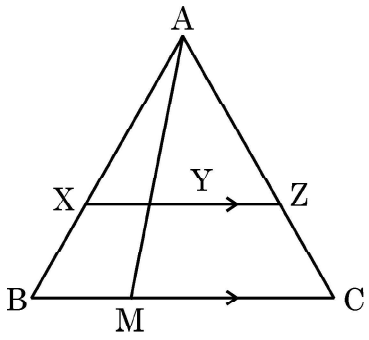
21. (a) Solve the pair of equations $x = 3$ and $y = -4$ graphically.

OR

(b) Using graphical method, find whether following system of linear equations is consistent or not :

$x = 0$ and $y = -7$

22. In the given figure, XZ is parallel to BC. AZ = 3 cm, ZC = 2 cm, BM = 3 cm and MC = 5 cm. Find the length of XY.



23. (a) If $\sin\theta + \cos\theta = \sqrt{3}$, then find the value of $\sin\theta \cdot \cos\theta$.

OR

(b) If $\sin\alpha = \frac{1}{\sqrt{2}}$ and $\cot\beta = \sqrt{3}$, then find the value of $\text{cosec}\,\alpha + \text{cosec}\,\beta$.

24. Find the greatest number which divides 85 and 72 leaving remainders 1 and 2 respectively.

25. A bag contains 4 red, 3 blue and 2 yellow balls. One ball is drawn at random from the bag. Find the probability that drawn ball is (i) red (ii) yellow.

SECTION – C

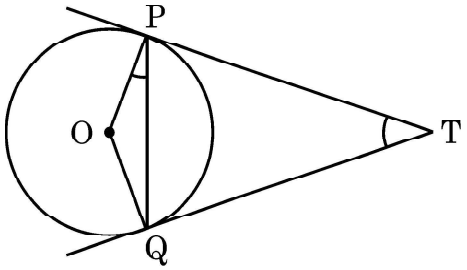
(This section comprises of Short Answer (SA-II) type questions of 3 marks each.)

26. Half of the difference between two numbers is 2. The sum of the greater number and twice the smaller number is 13. Find the numbers.

27. Prove that $\sqrt{5}$ is an irrational number.

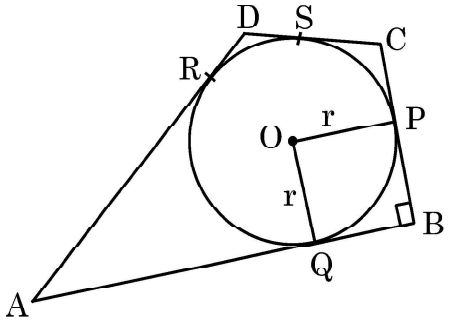
28. If (–5, 3) and (5, 3) are two vertices of an equilateral triangle, then find co-ordinates of the third vertex, given that origin lies inside the triangle. (Take $\sqrt{3}$ = 1.7)

29. (a) Two tangents TP and TQ are drawn to a circle with centre O from an external point T. Prove that $\angle PTQ = 2\angle OPQ$.



OR

(b) In the given figure, a circle is inscribed in a quadrilateral ABCD in which $\angle B = 90^\circ$. If AD = 17 cm, AB = 20 cm and DS = 3 cm, then find the radius of the circle.

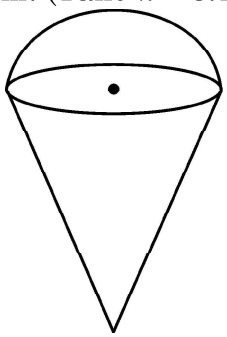


30. Prove that : $\dfrac{\tan\theta + \sec\theta - 1}{\tan\theta - \sec\theta + 1} = \dfrac{1 + \sin\theta}{\cos\theta}$

31. (a) A room is in the form of cylinder surmounted by a hemi-spherical dome. The base radius of hemisphere is one-half the height of cylindrical part. Find total height of the room if it contains $\left(\frac{1408}{21}\right)$ m^3 of air. $\left(\text{Take } \pi = \frac{22}{7}\right)$

OR

(b) An empty cone is of radius 3 cm and height 12 cm. Ice-cream is filled in it so that lower part of the cone which is $\left(\frac{1}{6}\right)^{th}$ of the volume of the cone is unfilled but hemisphere is formed on the top. Find volume of the ice-cream. (Take $\pi = 3.14$)



SECTION – D

(This section comprises of Long Answer (LA) type questions of 5 marks each.)

32. If a line is drawn parallel to one side of a triangle to intersect the other two sides at distinct points, prove that the other two sides are divided in the same ratio.

33. (a) The angle of elevation of the top of a tower 24 m high from the foot of another tower in the same plane is 60°. The angle of elevation of the top of second tower from the foot of the first tower is 30°. Find the distance between two towers and the height of the other tower. Also, find the length of the wire attached to the tops of both the towers.

OR

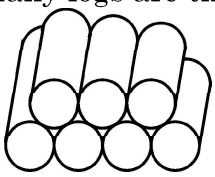
(b) A spherical balloon of radius r subtends an angle of 60° at the eye of an observer. If the angle of elevation of its centre is 45° from the same point, then prove that height of the centre of the balloon is $\sqrt{2}$ times its radius.

34. A chord of a circle of radius 14 cm subtends an angle of 60° at the centre. Find the area of the corresponding minor segment of the circle. Also find the area of the major segment of the circle.

35. (a) The ratio of the 11^{th} term to 17^{th} term of an A.P. is 3 : 4. Find the ratio of 5^{th} term to 21^{st} term of the same A.P. Also, find the ratio of the sum of first 5 terms to that of first 21 terms.

OR

(b) 250 logs are stacked in the following manner :
22 logs in the bottom row, 21 in the next row, 20 in the row next to it and so on (as shown by an example). In how many rows, are the 250 logs placed and how many logs are there in the top row ?



(Example)

SECTION – E

(In this section, there are 3 case study/passage based questions. Each question is of 4 marks.)

Case Study

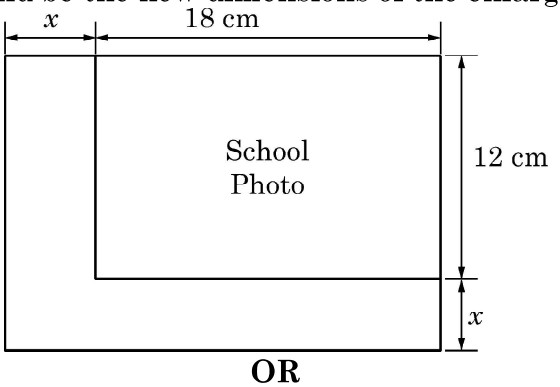
36. While designing the school year book, a teacher asked the student that the length and width of a particular photo is increased by x units each to double the area of the photo. The original photo is 18 cm long and 12 cm wide.

Based on the above information, answer the following questions :

(I) Write an algebraic equation depicting the above information. **1**

(II) Write the corresponding quadratic equation in standard form. **1**

(III) What should be the new dimensions of the enlarged photo ? **2**



OR

Can any rational value of x make the new area equal to 220 cm^2 ?

37. India meteorological department observes seasonal and annual rainfall every year in different sub-divisions of our country.

It helps them to compare and analyse the results. The table given below shows sub-division wise seasonal (monsoon) rainfall (mm) in 2018 :

Rainfall (mm)	Number of Sub-divisions
200-400	2
400-600	4
600-800	7
800-1000	4
1000-1200	2
1200-1400	3
1400-1600	1
1600-1800	1

Based on the above information, answer the following questions :

(I) Write the modal class. **1**

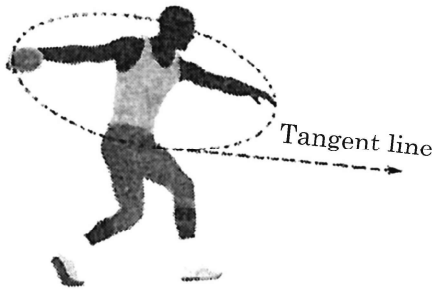
(II) Find the median of the given data. **2**

OR

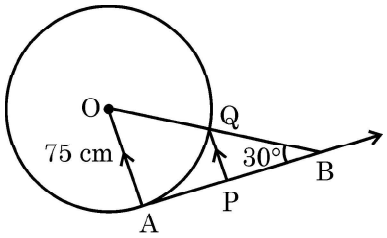
Find the mean rainfall in this season.

(III) If sub-division having at least 1000 mm rainfall during monsoon season, is considered good rainfall sub-division, then how many sub-divisions had good rainfall ? **1**

38. The discus throw is an event in which an athlete attempts to throw a discus. The athlete spins anti-clockwise around one and a half times through a circle, then releases the throw. When released, the discus travels along tangent to the circular spin orbit.



In the given figure, AB is one such tangent to a circle of radius 75 cm. Point O is centre of the circle and $\angle ABO = 30^{\circ}$. PQ is parallel to OA.



Based on above information :

(a) find the length of AB. **1**

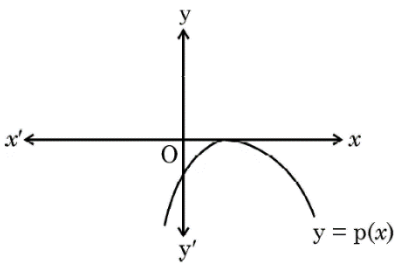
(b) find the length of OB. **1**

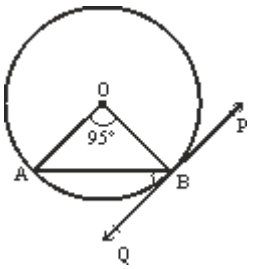
(c) find the length of AP. **2**

OR

find the length of PQ.

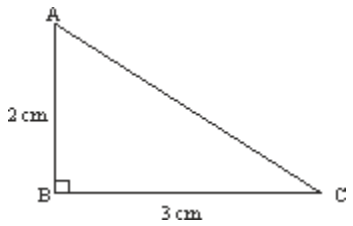
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/1/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each	
1.	The graph of $y = p(x)$ is given, for a polynomial $p(x)$. The number of zeroes of p(x) from the graph is (A) 3 (B) 1 (C) 2 (D) 0  	
Sol.	(B) 1	1
2.	The value of k for which the pair of equations $kx = y + 2$ and $6x = 2y + 3$ has infinitely many solutions, (A) is $k = 3$ (B) does not exist (C) is $k = -3$ (D) is $k = 4$	
Sol.	(B) does not exist	1
3.	If $p-1$, $p + 1$ and $2p + 3$ are in A.P., then the value of p is (A) -2 (B) 4 (C) 0 (D) 2	
Sol.	(C) 0	1
4.	In what ratio, does x-axis divide the line segment joining the points $A(3, 6)$ and $b(-12, -3)$? (A) 1:2 (B) 1:4 (C) 4:1 (D) 2:1	

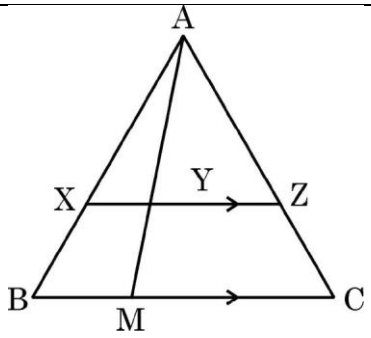
Sol.	(D) 2 : 1	1
5.	In the given figure, PQ is tangent to the circle centred at O. If $\angle AOB = 95^\circ$, then the measure of $\angle ABQ$ will be  (A) 47.5° (B) 42.5° (C) 85° (D) 95°	
Sol.	(A) 47.5°	1
6.	If $2\tan A = 3$, then the value of $\frac{4\sin A + 3\cos A}{4\sin A - 3\cos A}$ is (A) $\frac{7}{\sqrt{13}}$ (B) $\frac{1}{\sqrt{13}}$ (C) 3 (D) does not exist	
Sol.	(C) 3	1
7.	If α, β are the zeroes of a polynomial $p(x) = x^2 + x - 1$, then $\frac{1}{\alpha} + \frac{1}{\beta}$ equals to (A) 1 (B) 2 (C) -1 (D) $\frac{-1}{2}$	
Sol.	(A) 1	1
8.	The least positive value of k, for which the quadratic equation $2x^2 + kx - 4 = 0$ has rational roots, is (A) $\pm 2\sqrt{2}$ (B) 2 (C) ± 2 (D) $\sqrt{2}$	
Sol.	(B) 2	1
9.	$\left[\frac{3}{4}\tan^2 30^0 - \sec^2 45^0 + \sin^2 60^0\right]$ is equal to (A) -1 (B) $\frac{5}{6}$ (C) $\frac{-3}{2}$ (D) $\frac{1}{6}$	
Sol.	(A) – 1	1

10.	Curved surface area of a cylinder of height 5 cm is 94.2 cm^2. Radius of the cylinder is (Take π = 3.14) (A) 2 cm (B) 3 cm (C) 2.9 cm (D) 6 cm	
Sol.	(B) 3	1
11.	The distribution below gives the marks obtained by 80 students on a test : Marks: Less than 10 | Less than 20 | Less than 30 | Less than 40 | Less than 50 | Less than 60 Number of Students: 3 | 12 | 27 | 57 | 75 | 80 The modal class of this distribution is : (A) 10-20 (B) 20-30 (C) 30-40 (D) 50-60	
Sol.	(C) 30 – 40	1
12.	The curved surface area of a cone having height 24 cm and radius 7 cm, is (A) 528 cm^2 (B) 1056 cm^2 (C) 550 cm^2 (D) 500 cm^2	
Sol.	(C)550cm^2	1
13.	The distance between the points $(0,2\sqrt{5})$ and $(-2\sqrt{5},0)$ is (A) $2\sqrt{10}$ units (B) $4\sqrt{10}$units (C) $2\sqrt{20}$ units (D) 0	
Sol.	(A) $2\sqrt{10}$ units	1
14.	Which of the following is a quadratic polynomial having zeroes $\frac{-2}{3}$ and $\frac{2}{3}$? (A) $4x^2-9$ (B) $\frac{4}{9}(9x^2+4)$ (C) $x^2+\frac{9}{4}$ (D) $5(9x^2-4)$	
Sol.	(D) 5 $(9x^2 – 4)$	1
15.	If the value of each observation of a statistical data is increased by 3, then the mean of the data (A) remains unchanged (B) increases by 3 (C) increases by 6 (D) increases by 3n	
Sol.	(B) increases by 3	1

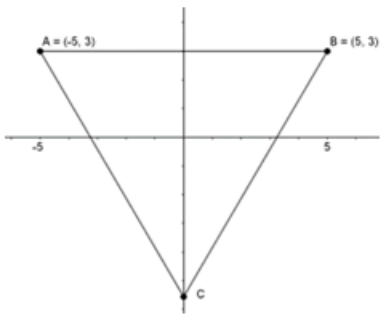
16.	Probability of happening of an event is denoted by p and probability of non-happening of the event is denoted by q. Relation between p and q is (A) $p+q=1$ (B) $p=1, q=1$ (C) $p=q-1$ (D) $p+q+1=0$	
Sol.	(A) p + q = 1	1
17.	A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, how many tickets has she bought? (A) 40 (B) 240 (C) 480 (D) 750	
Sol.	(C) 480	1
18.	In a group of 20 people, 5 can't swim. If one person is selected at random, then the probability that he/she can swim, is (A) $\frac{3}{4}$ (B) $\frac{1}{3}$ (C) 1 (D) $\frac{1}{4}$	
Sol.	(A) 3/4	1
	Assertion-Reason Type Questions In Question **19** and **20**, an **Assertion (A)** statement is followed by a statement of **Reason (R)**. Select the correct option out of the following : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A). (C) Assertion (A) is true but Reason (R) is false. (D) Assertion (A) is false but Reason (R) is true.	
19.	Assertion (A): Point $P(0, 2)$ is the point of intersection of *y*-axis with the line $3x + 2y = 4$. Reason (R): The distance of point $P(0, 2)$ from *x*-axis is 2 units.	
Sol.	(B) Both Assertion (A) and Reason (R) are correct but Reason (R) is not the correct explanation of Assertion (A)	1

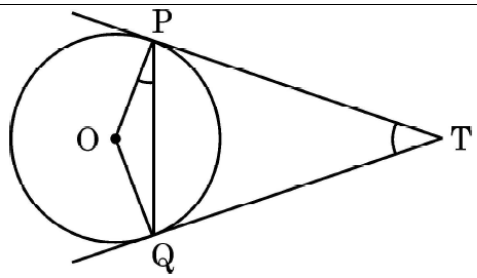
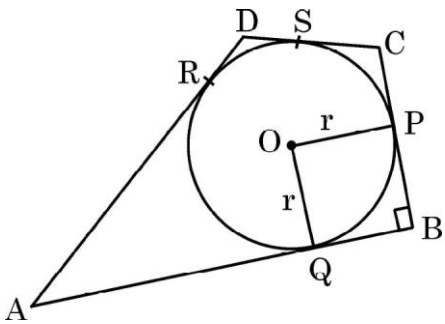
20.	Assertion (A): The perimeter of ΔABC is a rational number. Reason (R): The sum of the squares of two rational numbers is always rational.  	
Sol.	(D) Assertion (A) is false but Reason (R) is true	1

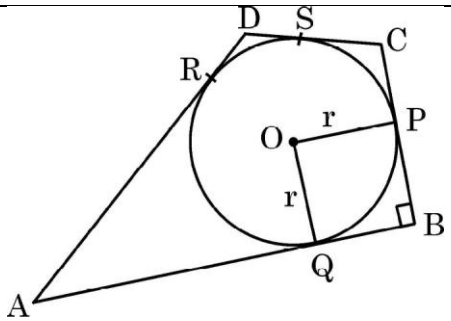
	SECTION B This section comprises of Very Short Answer (VSA) type questions of 2 marks each.	
21(a).	Solve the pair of equations $x = 3$ and $y = -4$ graphically.	
Sol.	Correct graph of both the equations. Solution of equation is x = 3, y = – 4	1 1
	OR	
21(b).	Using graphical method, find whether following system of linear equations is consistent or not: $x = 0$ and $y = -7$	
Sol.	Correct graph of y = – 7 and x = 0 As y = – 7 is intersecting x = 0 at (0, – 7) So, system of equations is consistent	1 1
22.	In the given figure, XZ is parallel to BC. AZ = 3 cm, ZC = 2 cm, BM =3 cm and MC = 5 cm. Find the length of XY.	

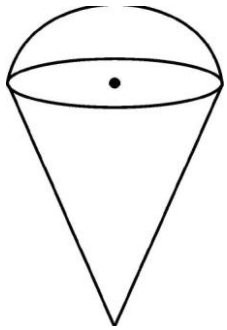
		
Sol.	As $XZ \parallel BC$ Therefore $\frac{AX}{XB} = \frac{3}{2} = \frac{AZ}{ZC}$ – (i) Δ AXY ~ Δ ABM $\Rightarrow \frac{AX}{AB} = \frac{XY}{BM}$ or $\frac{3}{5} = \frac{XY}{3}$ $\Rightarrow XY = \frac{9}{5}$ or 1·8 cm	½ ½ ½ ½
23(a).	If $sin\theta + cos\theta = \sqrt{3}$, then find the value of $sin\theta \cdot cos\theta$.	
Sol.	$\sin\theta + \cos\theta = \sqrt{3}$ squaring both sides $\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = 3$ $\Rightarrow 1 + 2\sin\theta\cos\theta = 3$ $\Rightarrow \sin\theta\cos\theta = 1$	1 ½ ½
	OR	
23(b).	If $\sin\alpha = \frac{1}{\sqrt{2}}$ and $\cot\beta = \sqrt{3}$, then find the value of $\text{cosec}\alpha + \text{cosec}\beta$	

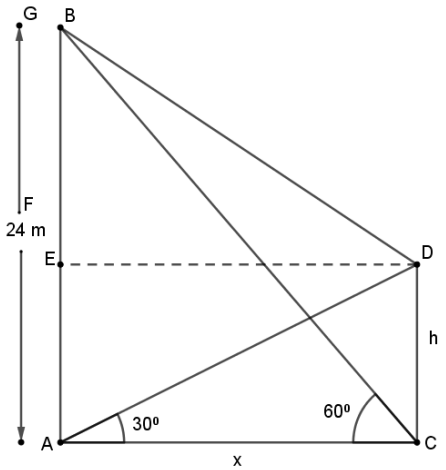
Sol.	$\text{cosec}\ \alpha = \frac{1}{\sin\ \alpha} = \sqrt{2}$ $\text{cosec}\ \beta = \sqrt{1 + \cot^2\ \beta} = \sqrt{1+3} = 2$ $\therefore$ cosec α + cosec $\beta = \sqrt{2} + 2$ or $\sqrt{2}\ (\sqrt{2} + 1)$	½ 1 ½
24.	Find the greatest number which divides 85 and 72 leaving remainders 1 and 2 respectively.	
Sol.	We have to find HCF of 85 – 1 = 84 and 72 – 2 = 70. HCF of 84 and 70 = 14	1 1
25.	A bag contains 4 red, 3 blue and 2 yellow balls. One ball is drawn at random from the bag. Find the probability that drawn ball is (i) red (ii) yellow.	
Sol.	Total No of Balls=9 (i) P(drawn ball is red) = $\frac{4}{9}$ (ii) P(drawn ball is yellow) = $\frac{2}{9}$	 1 1
	SECTION C This section comprises of Short Answer (SA) type questions of 3 marks each.	
26.	Half of the difference between two numbers is 2. The sum of the greater number and twice the smaller number is 13. Find the numbers.	
Sol.	Let the numbers be x and y, x > y Therefore $\frac{1}{2}$ (x – y) = 2 — (i) and 2y + x = 13 — (ii) Solving equations (i) and (ii) x = 7, y = 3	 1 1 1

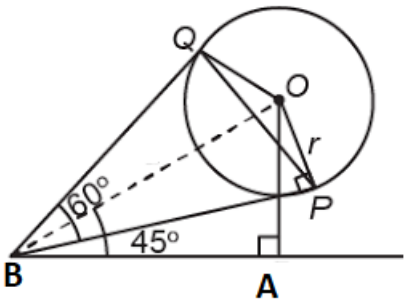
27.	Prove that $\sqrt{5}$ is an irrational number.	
Sol.	Let $\sqrt{5}$ be a rational number. $\therefore \sqrt{5} = \frac{p}{q}$, where q≠0 and let p & q be co-primes. $5q^2 = p^2 \Longrightarrow p^2$ is divisible by 5 $\Longrightarrow$ p is divisible by 5 $\Longrightarrow$ p = 5a, where 'a' is some integer ----- (i) $25a^2 = 5q^2 \Longrightarrow q^2 = 5a^2 \Longrightarrow q^2$ is divisible by 5 $\Longrightarrow$ q is divisible by 5 $\Longrightarrow$ q = 5b, where 'b' is some integer ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are co-primes. $\therefore \sqrt{5}$ is an irrational number.	½ 1 ½ 1
28.	If $(-5,3)$ and $(5,3)$ are two vertices of an equilateral triangle, then find coordinates of the third vertex, given that origin lies inside the triangle. (Take $\sqrt{3} = 1.7$)	
Sol.	 Let the third vertex be (x,y) A (-5,3) B(5,3) C(x,y) AB=10=AC $AC^2=100$ $(-5-x)^2+(3-y)^2 = (5-x)^2+(3-y)^2$ $20x = 0$ $x=0$ $(3-y)^2=75$ $3-y = \pm 5\sqrt{3}$ $y=3-5\sqrt{3}$ $y= -5.5$ The coordinates of the third vertex are (0,-5.5)	1 1 ½ ½
29(a).	Two tangents TP and TQ are drawn to a circle with centre O from an external point T. Prove that $\angle PTQ = 2\angle OPQ$.	

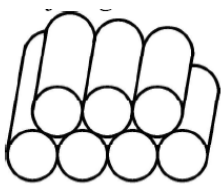
		
Sol.	TP = TQ $\Rightarrow \angle$ TPQ = $\angle$ TQP Let $\angle$ PTQ be θ $\Rightarrow \angle$ TPQ = $\angle$ TQP = $\frac{180° - \theta}{2} = 90° - \frac{\theta}{2}$ Now $\angle$ OPT = 90° $\Rightarrow \angle$OPQ = $90° - (90° - \frac{\theta}{2}) = \frac{\theta}{2}$ $\angle$ PTQ = 2 $\angle$ OPQ	1 1 1
	OR	
29(b).	In the given figure, a circle is inscribed in a quadrilateral ABCD in which $\angle B = 90^0$. If AD=17 cm, AB = 20 cm and DS = 3 cm, then find the radius of the circle. 	

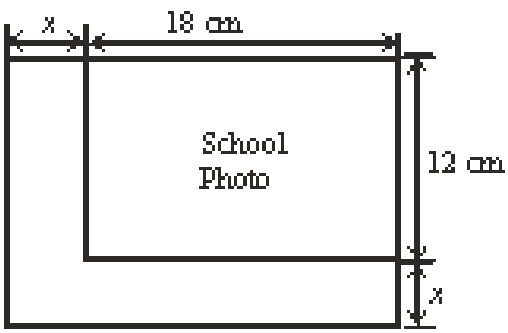
Sol.	 DR = DS = 3 cm ∴ AR = AD – DR = 17 – 3 = 14 cm ⇒ AQ = AR = 14 cm ∴ QB = AB – AQ = 20 – 14 = 6 cm Since QB = OP = r ∴ radius = 6 cm	 ½ 1 ½ ½ ½
30.	Prove that: $\frac{\tan\theta+\sec\theta-1}{\tan\theta-\sec\theta+1}=\frac{1+\sin\theta}{\cos\theta}$	
Sol.	LHS= $\frac{(tan\ \theta+sec\ \theta)-(sec^2\theta-tan^2\theta)}{tan\ \theta-sec\ \theta+1}$ $=\frac{(tan\ \theta+sec\ \theta)(1-sec\ \theta+tan\ \theta)}{tan\ \theta-sec\ \theta+1}$ $=tan\theta+sec\theta$ $=\frac{1+sin\ \theta}{cos\ \theta}$ = RHS	1 **1** ½ ½
31(a).	A room is in the form of cylinder surmounted by a hemi-spherical dome. The base radius of hemisphere is one-half the height of cylindrical part. Find total height of the room if it contains $\left(\frac{1408}{21}\right)m^3$ of air. Take $\left(\pi=\frac{22}{7}\right)$	

Sol.	Let h be height of cylindrical part and r be radius of hemisphere Volume of room $= 2\pi r^3 + \frac{2}{3}\pi r^3 = \frac{1408}{21}$ $\Rightarrow$r = 2 Therefore, h=4 Height of the room is = 6m	½ 1 ½ ½ ½
	OR	
31(b).	An empty cone is of radius 3 cm and height 12 cm. Ice-cream is filled in it so that lower part of the cone which is $\left(\frac{1}{6}\right)^{th}$ of the volume of the cone is unfilled but hemisphere is formed on the top. Find volume of the ice-cream. (Take π = 3.14) 	
Sol.	Volume of the cone = $= \frac{1}{3} \times \pi \times 9 \times 12 = 36\pi cm^3$ Volume of ice-cream in the cone = $\frac{5}{6} \times 36 \times \pi = 30\pi cm^3$ Volume of ice-cream on top = $\frac{2}{3} \times 27 \times \pi = 18\pi cm^3$ Total volume of the ice-cream = $(30\pi + 18\pi) = 48\pi cm^3$ $= 48 \times 3.14 = 150.72 cm^3$	1 ½ 1 ½
	SECTION D This section comprises of Long Answer (LA) type questions of 5 marks each.	

32.	If a line is drawn parallel to one side of a triangle to intersect the other two sides at distinct points, prove that the other two sides are divided in the same ratio.	
Sol.	Correct Given, to prove, figure, construction Correct proof	2 3
33(a).	The angle of elevation of the top of a tower 24 m high from the foot of another tower in the same plane is 60^0. The angle of elevation of the top of second tower from the foot of the first tower is 30^0. Find the distance between two towers and the height of the other tower. Also, find the length of the wire attached to the tops of both the towers.	
Sol.	 Let AB and CD be the given towers. $\tan 30° = \frac{1}{\sqrt{3}} = \frac{h}{x} \Rightarrow x = h\sqrt{3}$ __ (i) $\tan 60° = \sqrt{3} = \frac{24}{x} \Rightarrow x = \frac{24}{\sqrt{3}}$ or $8\sqrt{3}$ __ (ii) using (i) and (ii) $x = 8\sqrt{3}$ and $h = 8$ length of wire = $\sqrt{BE^2 + x^2} = \sqrt{256 + 192} = \sqrt{448}$ m = $8\sqrt{7}$ m	1 mark for correct figure 1 1 $\frac{1}{2}+\frac{1}{2}$ 1

	OR	
33(b).	A spherical balloon of radius r subtends an angle of 60^0 at the eye of an observer. If the angle of elevation of its centre is 45^0 from the same point, then prove that height of the centre of the balloon is $\sqrt{2}$ times its radius.	
Sol.	 Let Point B represents observer. $\therefore$ $\angle$ QBP = 60°; $\angle$ ABO = 45° Using geometry $\angle$ PBO = $\frac{1}{2}\times 60° = 30°$ Now, $\frac{r}{OB} = \sin 30° = \frac{1}{2} \Rightarrow OB = 2r$ — (i) Also $\frac{OA}{OB} = \sin 45° = \frac{1}{\sqrt{2}} \Rightarrow OB = OA\ \sqrt{2}$ (ii) Using (i) and (ii) OA = $\sqrt{2}$ r or height of center of balloon = $\sqrt{2}$ r units	1 mark for correct figure 1 1 1 1
34.	A chord of a circle of radius 14 cm subtends an angle of 60^0 at the centre. Find the area of the corresponding minor segment of the circle. Also find the area of the major segment of the circle.	
Sol.	Area of minor segment $= \frac{22}{7}\times 14\times 14\times \frac{60}{360} - \frac{1}{2}\times 14\times 14\times \frac{\sqrt{3}}{2}$ $= \left(\frac{308}{3} - 49\sqrt{3}\right) cm^2$ or $17.9 cm^2$	1+1 1

	Area of major segment $= \frac{22}{7} \times 14 \times 14 - \left(\frac{308}{3} - 49\sqrt{3}\right)$ $= 616 - \frac{308}{3} + 49\sqrt{3}$ $= \left(\frac{1540}{3} + 49\sqrt{3}\right) cm^2$ or 598.1cm^2	1 1
35(a).	The ratio of the 11th term to 17th term of an A.P. is 3:4. Find the ratio of 5th term to 21st term of the same A.P. Also, find the ratio of the sum of first 5 terms to that of first 21 terms.	
Sol.	Given $\frac{a + 10d}{a + 16d} = \frac{3}{4}$ $\Rightarrow 4a + 40d = 3a + 48d$ $\Rightarrow a = 8d$ (i) therefore $\frac{a_5}{a_{21}} = \frac{a + 4d}{a + 20d} = \frac{3}{7}$ using(i) $a_5 : a_{21} = 3 : 7$ $\frac{s_5}{s_{21}} = \frac{\frac{5}{2}(2a + 4d)}{\frac{21}{2}(2a + 20d)} = \frac{5 \times 20d}{21 \times 36d} = \frac{25}{189}$ Therefore, S_5:S_{21}=25:189	1 1 1 2
	OR	
35(b).	250 logs are stacked in the following manner: 22 logs in the bottom row, 21 in the next row, 20 in the row next to it and so on (as shown by an example). In how many rows, are the 250 logs placed and how many logs are there in the top row?  (Example)	
Sol.	Let the number of rows be n. A.P. formed is 22, 21, 20, 19, ...	

	Here a = 22, d = – 1 Sn = 250 $\therefore\ 250 = \frac{n}{2}[44 + (n-1)(-1)]$ $\Rightarrow n^2 - 45n + 500 = 0$ $\Rightarrow (n-25)(n-20) = 0$ $n \neq 25\ \therefore\ n = 20$ logs in top row = $a_{20} = 22 + 19(-1) = 3$	1 1 1 1 1
	SECTION E This section comprises of 3 case-study based questions of 4 marks each.	
36.	While designing the school year book, a teacher asked the student that the length and width of a particular photo is increased by x units each to double the area of the photo. The original photo is 18 cm long and 12 cm wide. Based on the above information, answer the following questions: (I) Write an algebraic equation depicting the above information. (II) Write the corresponding quadratic equation in standard form. (III) What should be the new dimensions of the enlarged photo?  OR Can any rational value of x make the new area equal to $220cm^2$	
Sol.	(i) $(18 + x)(12 + x) = 2(18 \times 12)$ (ii) $x^2 + 30x - 216 = 0$ (iii) Solving : $x^2 + 30x - 216 = 0$ $\Rightarrow (x + 36)(x - 6) = 0$ $x \neq -36 \therefore \Rightarrow x = 6.$ new dimensions are 24 cm $\times$ 18 cm	1 1 1 1

	OR (iii) If (18 + x) (12 + x) = 220 then $x^2 + 30x - 4 = 0$ Here D = 900 + 16 = 916 which is not a perfect square. Thus we can't have any such rational value of x.	1 1
37.	India meteorological department observes seasonal and annual rainfall every year in different sub-divisions of our country. It helps them to compare and analyse the results. The table given below shows sub-division wise seasonal (monsoon) rainfall (mm) in 2018: Based on the above information, answer the following questions: (I) Write the modal class. (II) Find the median of the given data.	

Rainfall (mm)	Number of Sub-divisions
200-400	2
400-600	4
600-800	7
800-1000	4
1000-1200	2
1200-1400	3
1400 -1600	1
1600-1800	1

OR

(II) Find the mean rainfall in this season.

(III) If sub-division having at least 1000 mm rainfall during monsoon season, is considered good rainfall sub-division, then how many sub-divisions had good rainfall?

Sol.

(i) Modal Class is 600-800 — 1

(ii) $\frac{N}{2}$ = 12, median class is 600 – 800 — ½

Rainfall	x_i	f_i	cf.
200 – 400	300	2	2
400 – 600	500	4	6
600 – 800	700	7	13
800 – 1000	900	4	17
1000 – 1200	1100	2	19
1200 – 1400	1300	3	22
1400 – 1600	1500	1	23
1600 – 1800	1700	1	24
		24	

½ for correct table

Median = $600 + \frac{200}{7}(12 - 6)$

$= \frac{5400}{7}$ or 771·4 — 1

OR

(ii)

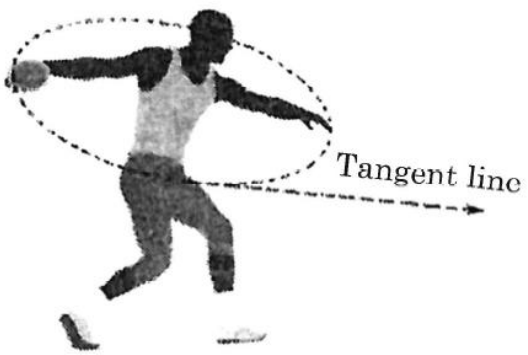
Rainfall	x_i	f_i	$f_i x_i$
200 – 400	300	2	600
400 – 600	500	4	2000

600 – 800	700	7	4900	
800 – 1000	900	4	3600	
1000 – 1200	1100	2	2200	1 for correct table
1200 – 1400	1300	3	3900	
1400 – 1600	1500	1	1500	
1600 – 1800	1700	1	1700	
		24	20400	

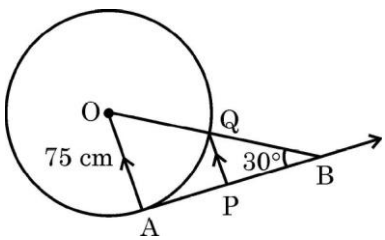
Mean = $\frac{20400}{24}$ = 850 — 1

(iii) Sub-divisions having good rainfall = 2 + 3 + 1 + 1 = 7. — 1

38. The discus throw is an event in which an athlete attempts to throw a discus. The athlete spins anti-clockwise around one and a half times through a circle, then releases the throw. When released, the discus travels along tangent to the circular spin orbit.



In the given figure, AB is one such tangent to a circle of radius 75 cm. Point O is centre of the circle and $\angle ABO = 30^0$. PQ is parallel to OA.



	Based on above information: (a) find the length of AB. (b) find the length of OB. (c) find the length of AP. OR Find the length of PQ	
Sol.	(i)tan 30° = $\frac{1}{\sqrt{3}} = \frac{75}{AB}$ $\Rightarrow$ AB = $75\sqrt{3}$ cm (ii)sin 30° = $\frac{1}{2} = \frac{75}{OB}$ $\Rightarrow$ OB = 150 cm (iii) QB = 150 – 75 = 75 cm $\Rightarrow$ Q is mid point. of OB Since PQ ll AO therefore P is mid point of AB Hence AP = $\frac{75\sqrt{3}}{2}$ cm. OR (iii) QB = 150 – 75 = 75 cm Now, Δ BQP ~ Δ BOA $\Rightarrow \frac{QB}{OB} = \frac{PQ}{OA}$ $\Rightarrow \frac{1}{2} = \frac{PQ}{75}$ $\Rightarrow$ PQ = $\frac{75}{2}$ cm	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 1 $\frac{1}{2}$ 1 $\frac{1}{2}$

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **not** allowed.*

SECTION A

This section comprises multiple choice questions (MCQs) of 1 mark each.

1. Which of the following quadratic equations has sum of its roots as 4 ?

(a) $2x^2 - 4x + 8 = 0$ (b) $-x^2 + 4x + 4 = 0$

(c) $\sqrt{2}\,x^2 - \frac{4}{\sqrt{2}}x + 1 = 0$ (d) $4x^2 - 4x + 4 = 0$

2. What is the length of the arc of the sector of a circle with radius 14 cm and of central angle 90° ?

(a) 22 cm (b) 44 cm

(c) 88 cm (d) 11 cm

3. If $\Delta ABC \sim \Delta PQR$ with $\angle A = 32°$ and $\angle R = 65°$, then the measure of $\angle B$ is :

(a) $32°$ (b) $65°$

(c) $83°$ (d) $97°$

4. If 'p' and 'q' are natural numbers and 'p' is the multiple of 'q', then what is the HCF of 'p' and 'q' ?

(a) pq (b) p

(c) q (d) p + q

5. The coordinates of the vertex A of a rectangle ABCD whose three vertices are given as B(0, 0), C(3, 0) and D(0, 4) are :

(a) (4, 0) (b) (0, 3)

(c) (3, 4) (d) (4, 3)

6. If the pair of equations $3x - y + 8 = 0$ and $6x - ry + 16 = 0$ represent coincident lines, then the value of 'r' is :

(a) $-\frac{1}{2}$ (b) $\frac{1}{2}$

(c) -2 (d) 2

7. A bag contains 100 cards numbered 1 to 100. A card is drawn at random from the bag. What is the probability that the number on the card is a perfect cube ?

(a) $\frac{1}{20}$ (b) $\frac{3}{50}$

(c) $\frac{1}{25}$ (d) $\frac{7}{100}$

8. The pair of equations x = a and y = b graphically represents lines which are :

(a) parallel

(b) intersecting at (b, a)

(c) coincident

(d) intersecting at (a, b)

9. If one zero of the polynomial $6x^2 + 37x - (k - 2)$ is reciprocal of the other, then what is the value of k ?

(a) -4 (b) -6

(c) 6 (d) 4

10. What is the total surface area of a solid hemisphere of diameter 'd' ?

(a) $3\pi d^2$ (b) $2\pi d^2$

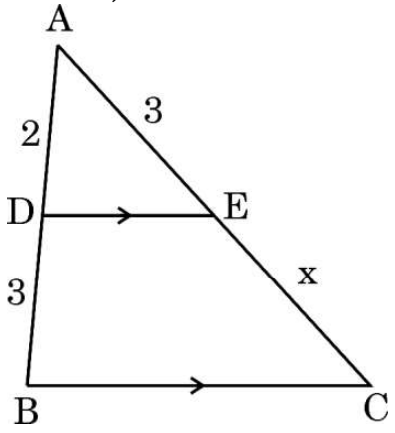
(c) $\frac{1}{2}\pi d^2$ (d) $\frac{3}{4}\pi d^2$

11. If three coins are tossed simultaneously, what is the probability of getting at most one tail ?

(a) $\frac{3}{8}$ (b) $\frac{4}{8}$

(c) $\frac{5}{8}$ (d) $\frac{7}{8}$

12. In the given figure, DE $\parallel$ BC. If AD = 2 units, DB = AE = 3 units and EC = x units, then the value of x is :



(a) 2 (b) 3

(c) 5 (d) $\frac{9}{2}$

13. The hour-hand of a clock is 6 cm long. The angle swept by it between 7:20 a.m. and 7:55 a.m. is :

(a) $\left(\frac{35}{4}\right)^\circ$ (b) $\left(\frac{35}{2}\right)^\circ$

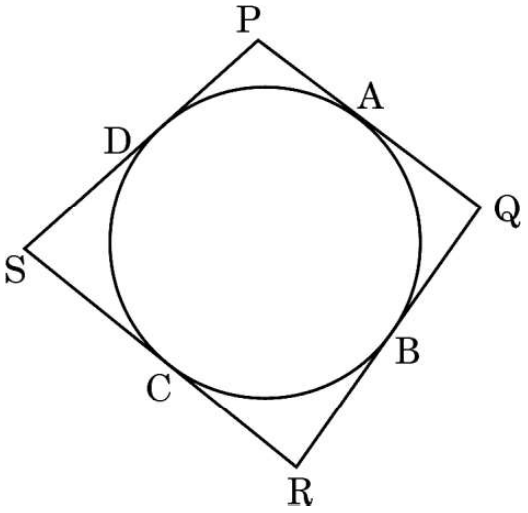
(c) 35° (d) 70°

14. The zeroes of the polynomial $p(x) = x^2 + 4x + 3$ are given by :

(a) 1, 3 (b) $-1, 3$

(c) $1, -3$ (d) $-1, -3$

15. In the given figure, the quadrilateral PQRS circumscribes a circle. Here PA + CS is equal to :



(a) QR (b) PR

(c) PS (d) PQ

16. If α and β are the zeroes of the quadratic polynomial $p(x) = x^2 - ax - b$, then the value of $\alpha^2 + \beta^2$ is :

(a) $a^2 - 2b$ (b) $a^2 + 2b$

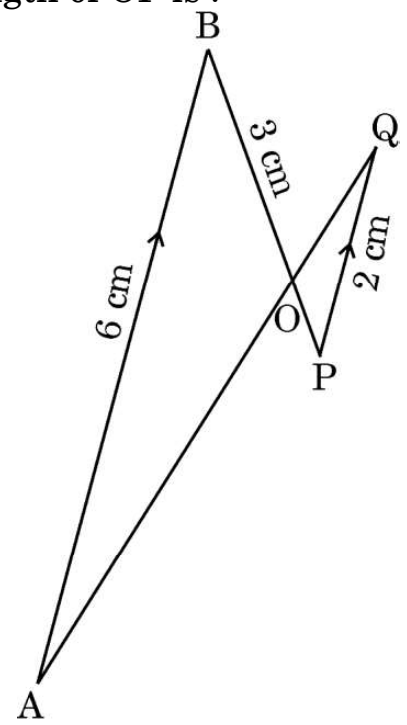
(c) $b^2 - 2a$ (d) $b^2 + 2a$

17. The area of the triangle formed by the line $\frac{x}{a} + \frac{y}{b} = 1$ with the coordinate axes is :

(a) ab (b) $\frac{1}{2}ab$

(c) $\frac{1}{4}ab$ (d) 2ab

18. In the given figure, AB ∥ PQ. If AB = 6 cm, PQ = 2 cm and OB = 3 cm, then the length of OP is :



(a) 9 cm (b) 3 cm

(c) 4 cm (d) 1 cm

*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.*

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* A tangent to a circle is perpendicular to the radius through the point of contact.

Reason (R) : The lengths of tangents drawn from an external point to a circle are equal.

20. *Assertion (A) :* The polynomial $p(x) = x^2 + 3x + 3$ has two real zeroes.

Reason (R): A quadratic polynomial can have at most two real zeroes.

SECTION B

This section comprises very short answer (VSA) type questions of 2 marks each.

21. Prove that $2 + \sqrt{3}$ is an irrational number, given that $\sqrt{3}$ is an irrational number.

22. (a) If $4\cot^2 45° - \sec^2 60° + \sin^2 60° + p = \frac{3}{4}$, then find the value of p.

OR

(b) If $\cos A + \cos^2 A = 1$, then find the value of $\sin^2 A + \sin^4 A$.

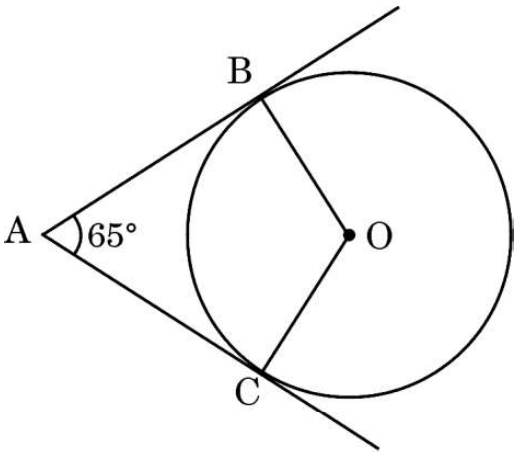
23. Show that the points $(-2, 3)$, $(8, 3)$ and $(6, 7)$ are the vertices of a right-angled triangle.

24. (a) The length of the shadow of a tower on the plane ground is $\sqrt{3}$ times the height of the tower. Find the angle of elevation of the sun.

OR

(b) The angle of elevation of the top of a tower from a point on the ground which is 30 m away from the foot of the tower, is 30°. Find the height of the tower.

25. In the given figure, O is the centre of the circle. AB and AC are tangents drawn to the circle from point A. If $\angle BAC = 65°$, then find the measure of $\angle BOC$.



SECTION C

This section comprises of short answer (SA) type questions of 3 marks each.

26. (a) Find by prime factorisation the LCM of the numbers 18180 and 7575. Also, find the HCF of the two numbers.

OR

(b) Three bells ring at intervals of 6, 12 and 18 minutes. If all the three bells rang at 6 a.m., when will they ring together again ?

27. Prove that :

$$\left(\frac{1}{\cos\theta} - \cos\theta\right)\left(\frac{1}{\sin\theta} - \sin\theta\right) = \frac{1}{\tan\theta + \cot\theta}.$$

28. If Q(0, 1) is equidistant from P(5, – 3) and R(x, 6), find the values of x.

29. A car has two wipers which do not overlap. Each wiper has a blade of length 21 cm sweeping through an angle of 120°. Find the total area cleaned at each sweep of the two blades.

30. (a) If the system of linear equations

$2x + 3y = 7$ and $2ax + (a + b)y = 28$

have infinite number of solutions, then find the values of 'a' and 'b'.

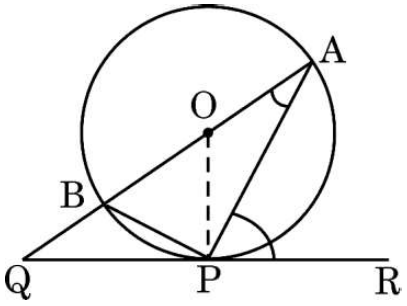
OR

(b) If $217x + 131y = 913$ and

$131x + 217y = 827$,

then solve the equations for the values of x and y.

31. In the given figure, O is the centre of the circle and QPR is a tangent to it at P. Prove that $\angle$ QAP + $\angle$ APR = 90°.



SECTION D

This section comprises long answer (LA) type questions of 5 marks each.

32. How many terms of the arithmetic progression 45, 39, 33, ... must be taken so that their sum is 180 ? Explain the double answer.

33. (a) As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 60°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships.
(Use $\sqrt{3}$ = 1·73)

OR

(b) From a point on the ground, the angle of elevation of the bottom and top of a transmission tower fixed at the top of 30 m high building are 30° and 60°, respectively. Find the height of the transmission tower. (Use $\sqrt{3}$ = 1·73)

34. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mean and median of the following data.

Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency (periods)	7	14	13	12	20	11	15	8

35. (a) Sides AB and BC and median AD of a triangle ABC are respectively proportional to sides PQ and QR and median PM of Δ PQR. Show that Δ ABC ~ Δ PQR.

OR

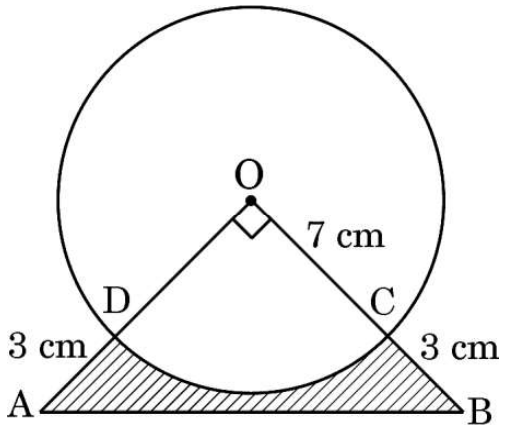
(b) Through the mid-point M of the side CD of a parallelogram ABCD, the line BM is drawn intersecting AC in L and AD (produced) in E. Prove that EL = 2BL.

SECTION E

This section comprises 3 case study based questions of 4 marks each.

Case Study – 1

36. In an annual day function of a school, the organizers wanted to give a cash prize along with a memento to their best students. Each memento is made as shown in the figure and its base ABCD is shown from the front side. The rate of silver plating is ₹ 20 per cm^2.



Based on the above, answer the following questions :

(i) What is the area of the quadrant ODCO ? *1*

(ii) Find the area of Δ AOB. *1*

(iii) (a) What is the total cost of silver plating the shaded part ABCD ? *2*

OR

(iii) (b) What is the length of arc CD ? *2*

Case Study – 2

37. In a coffee shop, coffee is served in two types of cups. One is cylindrical in shape with diameter 7 cm and height 14 cm and the other is hemispherical with diameter 21 cm.

Based on the above, answer the following questions :

(i) Find the area of the base of the cylindrical cup. *1*

(ii) (a) What is the capacity of the hemispherical cup ? *2*

OR

(ii) (b) Find the capacity of the cylindrical cup. *2*

(iii) What is the curved surface area of the cylindrical cup ? *1*

Case Study – 3

38. Computer-based learning (CBL) refers to any teaching methodology that makes use of computers for information transmission. At an elementary school level, computer applications can be used to display multimedia lesson plans. A survey was done on 1000 elementary and secondary schools of Assam and they were classified by the number of computers they had.

Number of Computers	1 – 10	11 – 20	21 – 50	51 – 100	101 and more
Number of Schools	250	200	290	180	80

One school is chosen at random. Then :

(i) Find the probability that the school chosen at random has more than 100 computers. *1*

(ii) (a) Find the probability that the school chosen at random has 50 or fewer computers. *2*

OR

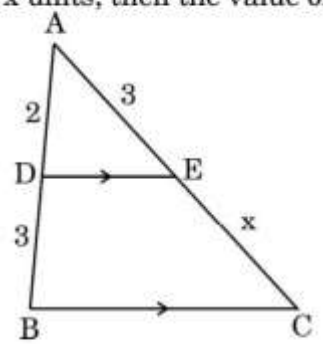
(ii) (b) Find the probability that the school chosen at random has no more than 20 computers. *2*

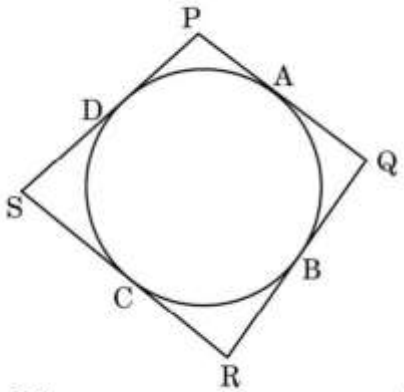
(iii) Find the probability that the school chosen at random has 10 or less than 10 computers. *1*

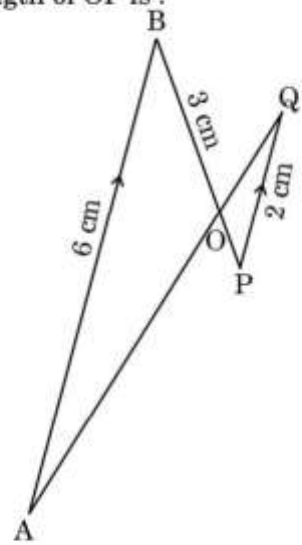
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/2/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each	
1.	Which of the following quadratic equations has sum of its roots as 4 ? (a) $2x^2 - 4x + 8 = 0$ (b) $-x^2 + 4x + 4 = 0$ (c) $\sqrt{2}x^2 - \frac{4}{\sqrt{2}}x + 1 = 0$ (d) $4x^2 - 4x + 4 = 0$	
Sol.	(b) $-x^2 + 4x + 4 = 0$	1
2.	What is the length of the arc of the sector of a circle with radius 14 cm and of central angle 90° ? (a) 22 cm (b) 44 cm (c) 88 cm (d) 11 cm	
Sol.	(a) 22 cm	1
3.	If $\Delta ABC \sim \Delta PQR$ with $\angle A = 32°$ and $\angle R = 65°$, then the measure of $\angle B$ is : (a) 32° (b) 65° (c) 83° (d) 97°	
Sol.	(c) 83°	1
4.	If 'p' and 'q' are natural numbers and 'p' is the multiple of 'q', then what is the HCF of 'p' and 'q' ? (a) pq (b) p (c) q (d) p + q	
Sol.	(c) q	1
5.	The coordinates of the vertex A of a rectangle ABCD whose three vertices are given as B(0, 0), C(3, 0) and D(0, 4) are : (a) (4, 0) (b) (0, 3) (c) (3, 4) (d) (4, 3)	
Sol.	(c) (3, 4)	1

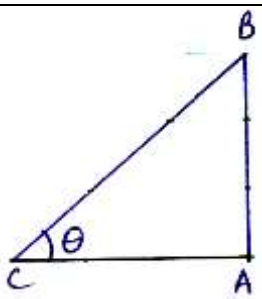
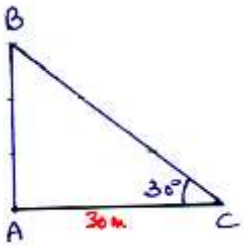
6.	If the pair of equations $3x - y + 8 = 0$ and $6x - ry + 16 = 0$ represent coincident lines, then the value of 'r' is : (a) $-\frac{1}{2}$ (b) $\frac{1}{2}$ (c) -2 (d) 2	
Sol.	(d) 2	1
7.	A bag contains 100 cards numbered 1 to 100. A card is drawn at random from the bag. What is the probability that the number on the card is a perfect cube ? (a) $\frac{1}{20}$ (b) $\frac{3}{50}$ (c) $\frac{1}{25}$ (d) $\frac{7}{100}$	
Sol.	(c) $\frac{1}{25}$	1
8.	The pair of equations x = a and y = b graphically represents lines which are : (a) parallel (b) intersecting at (b, a) (c) coincident (d) intersecting at (a, b)	
Sol.	(d) intersecting at (a, b)	1
9.	If one zero of the polynomial $6x^2 + 37x - (k - 2)$ is reciprocal of the other, then what is the value of k ? (a) -4 (b) -6 (c) 6 (d) 4	
Sol.	(a) – 4	1
10.	What is the total surface area of a solid hemisphere of diameter 'd' ? (a) $3\pi d^2$ (b) $2\pi d^2$ (c) $\frac{1}{2}\pi d^2$ (d) $\frac{3}{4}\pi d^2$	
Sol.	(d) $\frac{3}{4}\pi d^2$	1

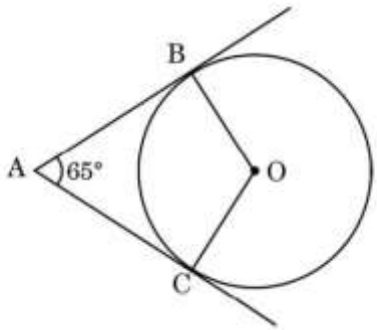
11.	If three coins are tossed simultaneously, what is the probability of getting at most one tail ? (a) $\frac{3}{8}$ (b) $\frac{4}{8}$ (c) $\frac{5}{8}$ (d) $\frac{7}{8}$	
Sol.	(b) $\frac{4}{8}$	1
12.	In the given figure, DE ∥ BC. If AD = 2 units, DB = AE = 3 units and EC = x units, then the value of x is :  (a) 2 (b) 3 (c) 5 (d) $\frac{9}{2}$	
Sol.	(d) $\frac{9}{2}$	1
13.	The hour-hand of a clock is 6 cm long. The angle swept by it between 7:20 a.m. and 7:55 a.m. is : (a) $\left(\frac{35}{4}\right)^\circ$ (b) $\left(\frac{35}{2}\right)^\circ$ (c) 35° (d) 70°	
Sol.	(b) $\left(\frac{35}{2}\right)^\circ$	1
14.	The zeroes of the polynomial $p(x) = x^2 + 4x + 3$ are given by : (a) 1, 3 (b) −1, 3 (c) 1, − 3 (d) −1, − 3	
Sol.	(d) − 1, − 3	1

15.	In the given figure, the quadrilateral PQRS circumscribes a circle. Here PA + CS is equal to :  (a) QR (b) PR (c) PS (d) PQ	
Sol.	(c) PS	1
16.	If α and β are the zeroes of the quadratic polynomial $p(x) = x^2 - ax - b$, then the value of $\alpha^2 + \beta^2$ is : (a) $a^2 - 2b$ (b) $a^2 + 2b$ (c) $b^2 - 2a$ (d) $b^2 + 2a$	
Sol.	(b) $a^2 + 2b$	1
17.	The area of the triangle formed by the line $\frac{x}{a} + \frac{y}{b} = 1$ with the coordinate axes is : (a) ab (b) $\frac{1}{2}ab$ (c) $\frac{1}{4}ab$ (d) 2ab	
Sol.	(b) $\frac{1}{2}$ ab	1

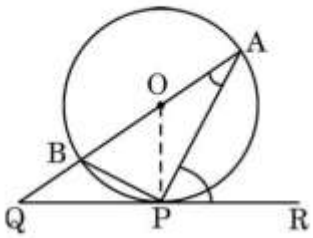
18.	In the given figure, AB ∥ PQ. If AB = 6 cm, PQ = 2 cm and OB = 3 cm, then the length of OP is :  (a) 9 cm (b) 3 cm (c) 4 cm (d) 1 cm	
Sol.	(d) 1 cm	1
	*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.* (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* A tangent to a circle is perpendicular to the radius through the point of contact. *Reason (R) :* The lengths of tangents drawn from an external point to a circle are equal.	
Sol.	(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).	1
20.	*Assertion (A) :* The polynomial $p(x) = x^2 + 3x + 3$ has two real zeroes. *Reason (R):* A quadratic polynomial can have at most two real zeroes.	
Sol.	(d) Assertion (A) is false, but Reason (R) is true.	1

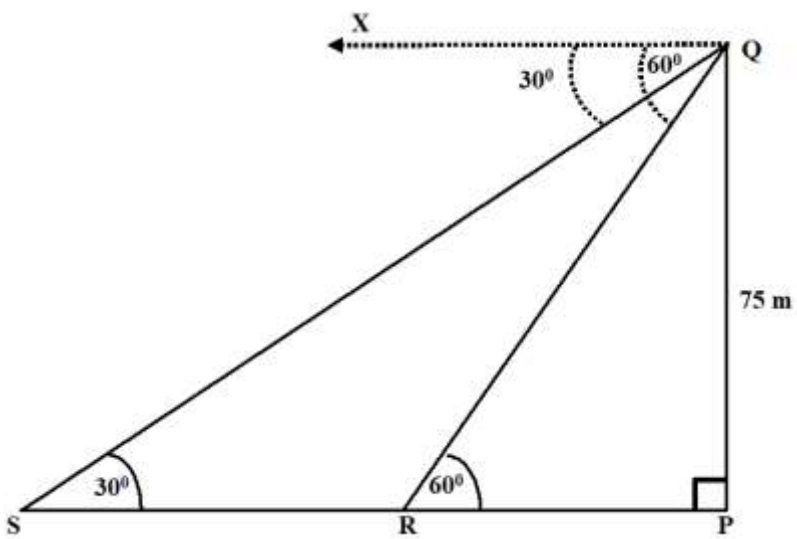
	SECTION B This section comprises of Very Short Answer (VSA) type questions of 2 marks each.	
21.	**Prove that $2 + \sqrt{3}$ is an irrational number, given that $\sqrt{3}$ is an irrational number.**	
Sol.	Let us assume that $2 + \sqrt{3}$ is rational Let $2 + \sqrt{3} = \frac{p}{q}$; $q \neq 0$ and p, q are integers $\Rightarrow \sqrt{3} = \frac{p - 2q}{q}$ p and q are integers, $\therefore$ $p - 2q$ is an integer $\Rightarrow \frac{p - 2q}{q}$ is a rational number $\Rightarrow \sqrt{3}$ is a rational number which contradicts our assumption that $\sqrt{3}$ is an irrational number. $\Rightarrow 2 + \sqrt{3}$ is an irrational number	 ½ ½ ½ ½
22(a).	**If $4\cot^2 45° - \sec^2 60° + \sin^2 60° + p = \frac{3}{4}$, then find the value of p.**	
Sol.	$4\cot^2 45° - \sec^2 60° + \sin^2 60° + p = \frac{3}{4}$ $\Rightarrow 4(1)^2 - (2)^2 + \left(\frac{\sqrt{3}}{2}\right)^2 + p = \frac{3}{4}$ $\Rightarrow 4 - 4 + \frac{3}{4} + p = \frac{3}{4}$ $\Rightarrow p = 0$	 1 ½ ½
	OR	
22(b).	**If $\cos A + \cos^2 A = 1$, then find the value of $\sin^2 A + \sin^4 A$.**	
Sol.	$\cos A + \cos^2 A = 1 \Rightarrow \cos A = 1 - \cos^2 A = \sin^2 A$ $\therefore \sin^2 A + \sin^4 A = \cos A + \cos^2 A$ ($\because \sin^2 A = \cos A$) $= 1$	1 1
23.	**Show that the points $(-2, 3)$, $(8, 3)$ and $(6, 7)$ are the vertices of a right-angled triangle.**	
Sol.	Let the given points be A $(-2, 3)$, B $(8, 3)$ and C $(6, 7)$ Then, AB = 10, BC = $\sqrt{4 + 16} = \sqrt{20}$, AC = $\sqrt{64 + 16} = \sqrt{80}$	 1 ½

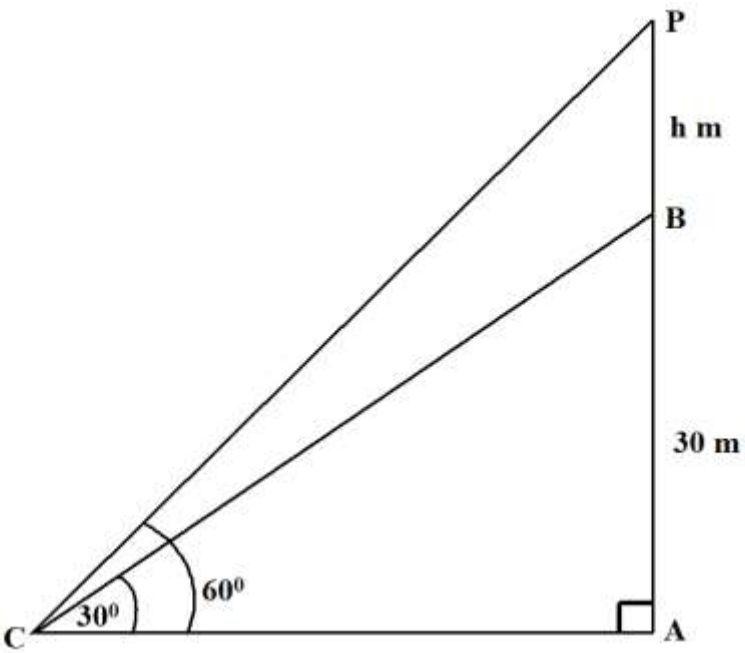
	$\therefore AB^2 = BC^2 + AC^2$ $\therefore$ the given points are the vertices of a right angled triangle.	½
24(a).	The length of the shadow of a tower on the plane ground is $\sqrt{3}$ times the height of the tower. Find the angle of elevation of the sun.	
Sol.	 Let AB be the tower of height 'h'. $\therefore AC = \sqrt{3}\ h$ In ΔABC, $\tan\theta = \frac{AB}{AC} = \frac{h}{\sqrt{3}\ h}$ $\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$ $\Rightarrow \theta = 30°$	1 ½ ½
	OR	
24(b).	The angle of elevation of the top of a tower from a point on the ground which is 30 m away from the foot of the tower, is 30°. Find the height of the tower.	
Sol.	 Height of tower = AB In ΔABC, $\tan 30° = \frac{AB}{30}$ $\Rightarrow AB = \frac{30}{\sqrt{3}} = 10\sqrt{3}$ $\therefore$ Height of Tower is $10\sqrt{3}$ m	1 1

25.	In the given figure, O is the centre of the circle. AB and AC are tangents drawn to the circle from point A. If $\angle BAC = 65°$, then find the measure of $\angle BOC$.  	
Sol.	$\angle BAC + \angle BOC = 180°$ $\Rightarrow \angle BOC = 180° - 65°$ $\Rightarrow \angle BOC = 115°$	1 1
	SECTION C This section comprises of Short Answer (SA) type questions of 3 marks each.	
26(a).	Find by prime factorisation the LCM of the numbers 18180 and 7575. Also, find the HCF of the two numbers.	
Sol.	$18180 = 2^2 \times 3^2 \times 5 \times 101$ $7575 = 3 \times 5^2 \times 101$ $LCM = 2^2 \times 3^2 \times 5^2 \times 101 = 90900$ $HCF = 3 \times 5 \times 101 = 1515$	½ ½ 1 1
	OR	
26(b).	Three bells ring at intervals of 6, 12 and 18 minutes. If all the three bells rang at 6 a.m., when will they ring together again ?	
Sol.	LCM of 6, 12, 18 = 36 So, all the three bells ring together after 36 minutes at 6 : 36 AM	2 1
27.	Prove that : $\left(\frac{1}{\cos\theta} - \cos\theta\right)\left(\frac{1}{\sin\theta} - \sin\theta\right) = \frac{1}{\tan\theta + \cot\theta}$.	
Sol.	LHS = $\left(\frac{1}{cos\ \theta} - cos\ \theta\right)\left(\frac{1}{sin\ \theta} - sin\ \theta\right)$	

	$= \left(\frac{1 - \cos^2 \theta}{\cos \theta}\right)\left(\frac{1 - \sin^2 \theta}{\sin \theta}\right)$ $= \frac{\sin^2 \theta}{\cos \theta} \times \frac{\cos^2 \theta}{\sin \theta}$ $= \sin \theta \cos \theta$ RHS $= \frac{1}{\tan \theta + \cot \theta} = \frac{1}{\frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta}}$ $= \frac{\cos \theta \sin \theta}{\sin^2 \theta + \cos^2 \theta}$ $= \sin \theta \cos \theta$ $\therefore$ LHS = RHS	½ 1 ½ 1
28.	If Q(0, 1) is equidistant from P(5, – 3) and R(x, 6), find the values of x.	
Sol.	PQ = QR $\Rightarrow$ $PQ^2 = QR^2$ $(5 - 0)^2 + (-3 - 1)^2 = (x - 0)^2 + (6 - 1)^2$ $\Rightarrow 25 + 16 = x^2 + 25$ $\Rightarrow x^2 = 16$ $\Rightarrow x = 4, x = -4$	1 1 ½ + ½
29.	A car has two wipers which do not overlap. Each wiper has a blade of length 21 cm sweeping through an angle of 120°. Find the total area cleaned at each sweep of the two blades.	
Sol.	Area cleaned by 1 blade $= \frac{22}{7} \times 21 \times 21 \times \frac{120^\circ}{360^\circ}$ $= 462$ $\Rightarrow$ Total area cleaned = 2 × 462 = 924 $\therefore$ Total area cleaned is 924 cm^2	1½ 1 ½
30 (a).	If the system of linear equations $2x + 3y = 7$ and $2ax + (a + b)y = 28$ have infinite number of solutions, then find the values of 'a' and 'b'.	
Sol.	system has infinite number of solutions $\therefore \frac{2}{2a} = \frac{3}{a + b} = \frac{7}{28}$ $\Rightarrow \frac{1}{a} = \frac{1}{4} \Rightarrow a = 4$ and a + b = 12 $\Rightarrow$ b = 8	1 1 1
	OR	

30(b).	If $217x + 131y = 913$ and $131x + 217y = 827$, then solve the equations for the values of x and y.	
Sol.	$\left.\begin{matrix}217x + 131y = 913 \\ 131x + 217y = 827\end{matrix}\right]$ Adding $348 (x + y) = 1740$ $x + y = 5$ Subtracting, $86 (x – y) = 86$ $x – y = 1$ $\Rightarrow x = 3, y = 2$	 1 1 ½ + ½
31.	In the given figure, O is the centre of the circle and QPR is a tangent to it at P. Prove that $\angle QAP + \angle APR = 90°$.  	
Sol.	OA = OP $\therefore$ In Δ OAP, $\angle OPA = \angle OAP$ ... (i) $\Rightarrow \angle OPA + \angle APR = 90°$ $\Rightarrow \angle OAP + \angle APR = 90°$ Using (i) $\Rightarrow \angle QAP + \angle APR = 90°$	 1 1 ½ ½
	SECTION D This section comprises of Long Answer (LA) type questions of 5 marks each.	
32.	How many terms of the arithmetic progression 45, 39, 33, ... must be taken so that their sum is 180 ? Explain the double answer.	
Sol.	45, 39, 33, ... $a = 45, d = – 6$ $S_n = 180$ $180 = \frac{n}{2} [2 \times 45 + (n – 1) (– 6)]$ $\Rightarrow 180 = \frac{n}{2} [90 – 6n + 6]$	 ½ 1

	$\Rightarrow 360 = 96n - 6n^2$ $\Rightarrow 6n^2 - 96n + 360 = 0$ $\Rightarrow n^2 - 16n + 60 = 0 \Rightarrow (n - 10)(n - 6) = 0$ $n - 10 = 0, n - 6 = 0 \Rightarrow n = 10, 6$ We get two values of 'n' as sum of 7^{th} term to 10^{th} term is zero as some terms are negative and some are positive.	1 1 1 ½
33(a).	As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 60°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships. (Use $\sqrt{3} = 1{\cdot}73$)	
Sol.	 PQ = Height of Light house = 75 m $\angle XQS = \angle QSP = 30°$ $\angle XQR = \angle QRP = 60°$ R and S are position of ships. In Δ PQR, $\frac{75}{PR} = \tan 60° = \sqrt{3} \Rightarrow PR = \frac{75}{\sqrt{3}} = 25\sqrt{3}$ In Δ PQS, $\frac{75}{PS} = \tan 30°$ $\Rightarrow PS = 75\sqrt{3}$	1 for correct figure 1½ 1

	∴ Distance between the ships, RS = PS – PR $= 75\sqrt{3} - 25\sqrt{3} = 50\sqrt{3}$ $= 50 \times 1{\cdot}73 = 86{\cdot}5$ ∴ Distance between the ships is 86.5 m	1 ½
	OR	
33(b).	From a point on the ground, the angle of elevation of the bottom and top of a transmission tower fixed at the top of 30 m high building are 30° and 60°, respectively. Find the height of the transmission tower. (Use $\sqrt{3} = 1{\cdot}73$)	
Sol.	 Height of building AB = 30 m BP = transmission tower = h(say) ∠ ACB = 30°, ∠ ACP = 60° In Δ ABC, $\tan 30^\circ = \frac{AB}{AC}$ $\Rightarrow \frac{1}{\sqrt{3}} = \frac{30}{AC} \Rightarrow AC = 30\sqrt{3}$ In Δ APC, $\tan 60^\circ = \frac{AP}{AC}$	1 for correct figure 1½

$\sqrt{3} = \dfrac{30 + h}{30\sqrt{3}} \Rightarrow 30\sqrt{3} \times \sqrt{3} = 30 + h$ — 1½

$\Rightarrow h = 30\,(3 - 1)$

$\Rightarrow h = 60$ — 1

$\therefore$ Height of transmission tower = 60 m

34. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mean and median of the following data.

Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency (periods)	7	14	13	12	20	11	15	8

Sol.

Number of cars	x_i	f_i	$x_i f_i$	c.f.
0 – 10	5	7	35	7
10 – 20	15	14	210	21
20 – 30	25	13	325	34
30 – 40	35	12	420	46
40 – 50	45	20	900	66
50 – 60	55	11	605	77
60 – 70	65	15	975	92
70 – 80	75	8	600	100
Total		100	4070	

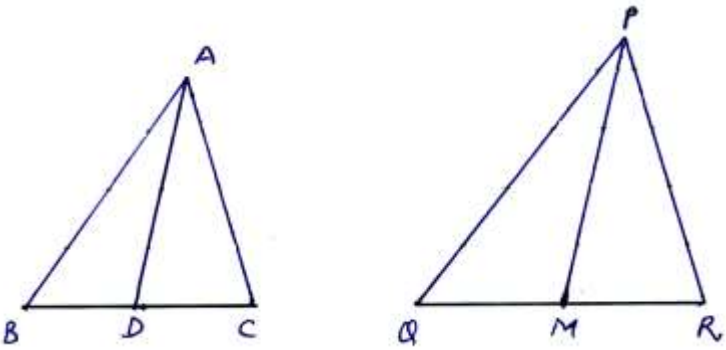
Correct table — 2

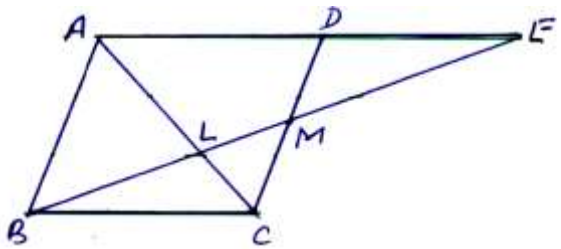
Mean $= \dfrac{\sum x_i f_i}{\sum f_i} = \dfrac{4070}{100} = 40{\cdot}7$ — 1

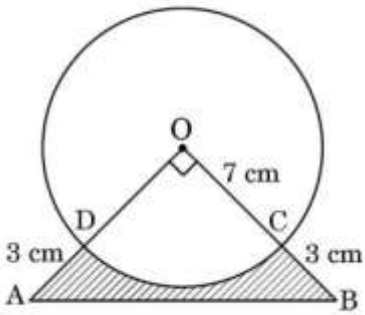
Median class : 40 – 50 — ½

Median $= 40 + \dfrac{50 - 46}{20} \times 10 = 42$ — 1½

35(a). Sides AB and BC and median AD of a triangle ABC are respectively proportional to sides PQ and QR and median PM of Δ PQR. Show that Δ ABC ~ Δ PQR.

Sol.	 In Δ ABC and Δ PQR $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$ $\frac{AB}{PQ} = \frac{2\,BD}{2\,QM} = \frac{AD}{PM}$ (∵ D is midpoint of BC and M is midpoint of QR) $\frac{AB}{PQ} = \frac{BD}{QM} = \frac{AD}{PM} \Rightarrow \Delta ABD \sim \Delta PQM$ $\Rightarrow \angle B = \angle Q$ — (i) Now, In Δ ABC and Δ PQR $\frac{AB}{PQ} = \frac{BC}{QR}$ (given) $\angle B = \angle Q$ from (i) $\therefore$ Δ ABC ~ Δ PQR	1 for correct figure 1 1 ½ ½ 1
	OR	
35(b).	Through the mid-point M of the side CD of a parallelogram ABCD, the line BM is drawn intersecting AC in L and AD (produced) in E. Prove that EL = 2BL.	

Sol.		1 for correct figure
	In Δ BMC and Δ EMD	
	MC = MD	
	∠ CMB = ∠ EMD	
	∠ MBC = ∠ MED	
	∴ Δ BMC ≅ Δ EMD	1
	⇒ BC = DE	
	But AD = BC	
	∴ AD = DE	
	⇒ AE = 2 BC	1
	Δ AEL ~ Δ CBL	½
	$\therefore \frac{EL}{BL} = \frac{AE}{BC}$	
	$\Longrightarrow \frac{EL}{BL} = \frac{2BC}{BC}$	½
	$\Longrightarrow \frac{EL}{BL} = 2$	
	⇒ EL = 2 BL	1

	SECTION E This section comprises of 3 case-study based questions of 4 marks each.	
36.	**Case Study – 1** In an annual day function of a school, the organizers wanted to give a cash prize along with a memento to their best students. Each memento is made as shown in the figure and its base ABCD is shown from the front side. The rate of silver plating is ₹ 20 per cm^2.  Based on the above, answer the following questions : (i) What is the area of the quadrant ODCO ? (ii) Find the area of Δ AOB. (iii) (a) What is the total cost of silver plating the shaded part ABCD ? **OR** (iii) (b) What is the length of arc CD ?	
Sol.	(i)Area of sector ODCO $= \frac{22}{7} \times 7 \times 7 \times \frac{90}{360} = \frac{77}{2}$ or 38·5 ∴ Area of sector ODCO is $\frac{77}{2}$ or 38·5 cm^2 (ii) ar (Δ AOB) = $\frac{1}{2} \times 10 \times 10 = 50$ ∴ ar (Δ AOB) is 50 cm^2 (iii) (a) Required cost = (50 – 38·5) × 20 = 230 ∴ required cost is ₹ 230. OR (iii) (b) Length of arc CD = $\frac{90}{360} \times 2 \times \frac{22}{7} \times 7$ = 11 ∴ Length of arc CD is 11 cm.	½ + ½ 1 1 1 1 1

37.	**Case Study – 2** In a coffee shop, coffee is served in two types of cups. One is cylindrical i shape with diameter 7 cm and height 14 cm and the other i hemispherical with diameter 21 cm. Based on the above, answer the following questions : (i) Find the area of the base of the cylindrical cup. (ii) (a) What is the capacity of the hemispherical cup ? **OR** (ii) (b) Find the capacity of the cylindrical cup. (iii) What is the curved surface area of the cylindrical cup ?	
Sol.	(i) Area of base of the cylindrical cup = $\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = \frac{77}{2}$ or 38.5 ∴ Area of base of the cylindrical cup is $\frac{77}{2}$ or 38.5 cm^2 (ii) (a) Capacity of hemispherical cup = $\frac{2}{3} \times \frac{22}{7} \times \frac{21}{2} \times \frac{21}{2} \times \frac{21}{2}$ $= \frac{4851}{2}$ or 2425.5 ∴ Capacity of hemispherical cup is $\frac{4851}{2}$ cm^3 or 2425.5 cm^3 OR (ii) (b) Capacity of cylindrical cup = $\frac{22}{7} \times (7)^2 \times 14$ $= 539$ ∴ Capacity of cylindrical cup is 539 cm^3 (iii) External Curved surface area of cylindrical cup = $2 \times \frac{22}{7} \times \frac{7}{2} \times 14 = 308$ ∴ External Curved surface area of cylindrical cup is 308 cm^2	1 1 1 1 1 1

38.

Case Study – 3

Computer-based learning (CBL) refers to any teaching methodology that makes use of computers for information transmission. At an elementary school level, computer applications can be used to display multimedia lesson plans. A survey was done on 1000 elementary and secondary schools of Assam and they were classified by the number of computers they had.

Number of Computers	1 – 10	11 – 20	21 – 50	51 – 100	101 and more
Number of Schools	250	200	290	180	80

One school is chosen at random. Then :

(i) Find the probability that the school chosen at random has more than 100 computers.

(ii) (a) Find the probability that the school chosen at random has 50 or fewer computers.

OR

(ii) (b) Find the probability that the school chosen at random has no more than 20 computers.

(iii) Find the probability that the school chosen at random has 10 or less than 10 computers.

Sol.

(i) P (more than 100 computers) = $\frac{80}{1000}$ or 0·08 — 1

(ii)(a) 50 or fewer computers = 250 + 200 + 290 = 740 — 1

Required probability = $\frac{740}{1000}$ or 0·74 — 1

OR

(ii)(b) No more than 20 computers = 250 + 200 = 450 — 1

Required probability = $\frac{450}{1000}$ or 0·45 — 1

(iii) P (10 or less than 10 computer) = $\frac{250}{1000}$ or 0·25 — 1

GENERAL INSTRUCTIONS :

Read the following instructions carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are compulsory.*

(ii) *Question paper is divided into **FIVE** sections – **Section A, B, C, D** and **E**.*

(iii) *In **section A** – question number **1** to **18** are multiple choice questions (MCQs) and question number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **section B –** question number **21** to **25** are Very Short Answer (VSA) type questions of **2** marks each.*

(v) *In **section C** – question number **26** to **31** are Short Answer (SA) type questions carrying **3** marks each.*

(vi) *In **section D** – question number **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.*

(vii) *In **section E** – question number **36** to **38** are **case based integrated units** of assessment questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section **B**, 2 questions in Section **C**, 2 questions in Section **D** and 3 questions in Section **E**.*

(ix) *Draw neat figures wherever required. Take $\pi = 22/7$ wherever required if not stated.*

(x) *Use of calculators is **NOT allowed.***

SECTION - A

Section - A consists of Multiple Choice type questions of 1 mark each.

1. The ratio of HCF to LCM of the least composite number and the least prime number is : **1**

(a) 1:2 (b) 2:1 (c) 1:1 (d) 1:3

2. The roots of the equation $x^2 + 3x - 10 = 0$ are : **1**

(a) 2, –5 (b) –2, 5 (c) 2, 5 (d) –2, –5

3. The next term of the A.P. : $\sqrt{6}$, $\sqrt{24}$, $\sqrt{54}$ is : **1**

(a) $\sqrt{60}$ (b) $\sqrt{96}$ (c) $\sqrt{72}$ (d) $\sqrt{216}$

4. The distance of the point (–1, 7) from x-axis is : **1**

(a) –1 (b) 7 (c) 6 (d) $\sqrt{50}$

5. What is the area of a semi-circle of diameter 'd' ? **1**

(a) $\frac{1}{16}\pi d^2$ (b) $\frac{1}{4}\pi d^2$ (c) $\frac{1}{8}\pi d^2$ (d) $\frac{1}{2}\pi d^2$

6. The empirical relation between the mode, median and mean of a distribution is : **1**

(a) Mode = 3 Median – 2 Mean (b) Mode = 3 Mean – 2 Median

(c) Mode = 2 Median – 3 Mean (d) Mode = 2 Mean – 3 Median

7. The pair of linear equations $2x = 5y + 6$ and $15y = 6x - 18$ represents two lines which are : **1**

(a) intersecting (b) parallel

(c) coincident (d) either intersecting or parallel

8. If α, β are zeroes of the polynomial x^2-1, then value of $(\alpha + \beta)$ is : **1**

(a) 2 (b) 1 (c) -1 (d) 0

9. If a pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then sun's elevation is : **1**

(a) 60^o (b) 45^o (c) 30^o (d) 90^o

10. $\sec\theta$ when expressed in terms of $\cot\theta$, is equal to : **1**

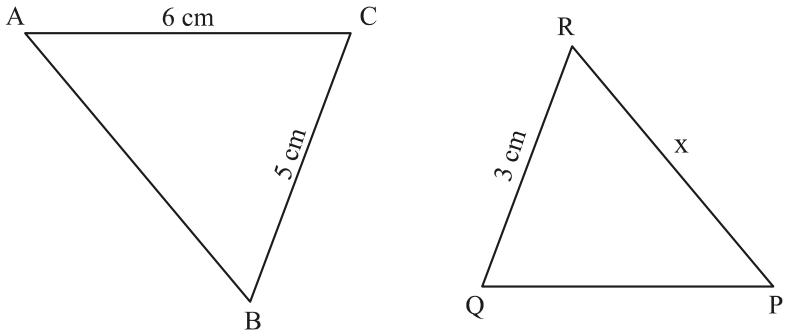
(a) $\frac{1+\cot^2\theta}{\cot\theta}$ (b) $\sqrt{1+\cot^2\theta}$

(c) $\frac{\sqrt{1+\cot^2\theta}}{\cot\theta}$ (d) $\frac{\sqrt{1-\cot^2\theta}}{\cot\theta}$

11. Two dice are thrown together. The probability of getting the difference of numbers on their upper faces equals to 3 is : **1**

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$ (c) $\frac{1}{6}$ (d) $\frac{1}{12}$

12.



In the given figure, $\Delta ABC \sim \Delta QPR$. If AC = 6 cm, BC = 5 cm, QR = 3 cm and PR = x; then the value of x is : **1**

(a) 3.6 cm (b) 2.5 cm (c) 10 cm (d) 3.2 cm

13. The distance of the point (– 6, 8) from origin is : **1**

(a) 6 (b) – 6 (c) 8 (d) 10

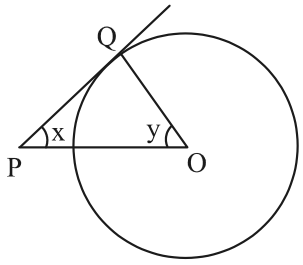
14. In the given figure, PQ is a tangent to the circle with centre O. If $\angle OPQ = x$, $\angle POQ = y$, then $x + y$ is : **1**

(a) 45^o

(b) 90^o

(c) 60^o

(d) 180^o



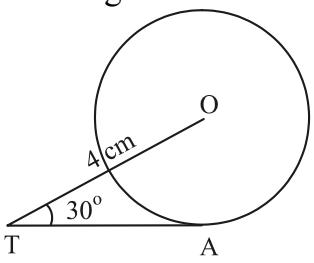
15. In the given figure, TA is a tangent to the circle with centre O such that OT = 4 cm, $\angle OTA = 30^o$, then length of TA is : **1**

(a) $2\sqrt{3}$ cm

(b) 2 cm

(c) $2\sqrt{2}$ cm

(d) $\sqrt{3}$ cm



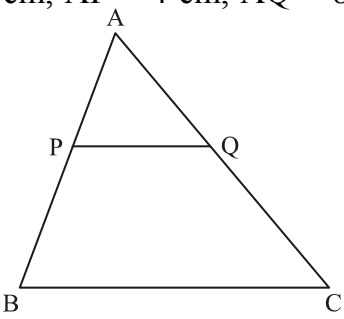
16. In Δ ABC, PQ || BC. If PB = 6 cm, AP = 4 cm, AQ = 8 cm, find the length of AC. **1**

(a) 12 cm

(b) 20 cm

(c) 6 cm

(d) 14 cm



17. If α, β are the zeroes of the polynomial $p(x) = 4x^2 - 3x - 7$, then $\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$ is equal to : **1**

(a) $\frac{7}{3}$ (b) $\frac{-7}{3}$ (c) $\frac{3}{7}$ (d) $\frac{-3}{7}$

18. A card is drawn at random from a well-shuffled pack of 52 cards. The probability that the card drawn is not an ace is : **1**

(a) $\frac{1}{13}$ (b) $\frac{9}{13}$ (c) $\frac{4}{13}$ (d) $\frac{12}{13}$

DIRECTIONS : In the question number **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option out of the following :

19. **Assertion (A) :** The probability that a leap year has 53 Sundays is $\frac{2}{7}$.

Reason (R) : The probability that a non-leap year has 53 Sundays is $\frac{5}{7}$. **1**

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

20. **Assertion (A) :** a, b, c are in A.P. if and only if $2b = a + c$.
Reason (R) : The sum of first n odd natural numbers is n^2. **1**

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

SECTION – B

Section - B consists of Very Short Answer (VSA) type questions of 2 marks each.

21. Two numbers are in the ratio 2 : 3 and their LCM is 180. What is the HCF of these numbers ? **2**

22. If one zero of the polynomial $p(x) = 6x^2 + 37x – (k – 2)$ is reciprocal of the other, then find the value of k. **2**

23. **(A)** Find the sum and product of the roots of the quadratic equation $2x^2 – 9x + 4 = 0$. **2**

OR

(B) Find the discriminant of the quadratic equation $4x^2 – 5 = 0$ and hence comment on the nature of roots of the equation. **2**

24. If a fair coin is tossed twice, find the probability of getting 'atmost one head'. **2**

25. **(A)** Evaluate $\frac{5\cos^2 60^o + 4\sec^2 30^o – \tan^2 45^o}{\sin^2 30^o + \cos^2 30^o}$ **2**

OR

(B) If A and B are acute angles such that $\sin (A – B) = 0$ and $2 \cos (A + B) – 1 = 0$, then find angles A and B. **2**

SECTION – C

Section - C consists of Short Answer (SA) type questions of 3 marks each.

26. **(A)** How many terms are there in an A.P. whose first and fifth terms are – 14 and 2, respectively and the last term is 62. **3**

OR

(B) Which term of the A.P. : 65, 61, 57, 53, ... is the first negative term ? **3**

27. Prove that $\sqrt{5}$ is an irrational number. **3**

28. Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line-segment joining the points of contact at the centre. **3**

29. **(A)** Prove that $\frac{\sin A - 2\sin^3 A}{2\cos^3 A - \cos A} = \tan A$ **3**

OR

(B) Prove that sec A (1 – sin A) (sec A + tan A) = 1. **3**

30. Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle. **3**

31. Find the value of 'p' for which the quadratic equation $px(x - 2) + 6 = 0$ has two equal real roots. **3**

SECTION – D

Section - D consists of Long Answer (LA) type questions of 5 marks each.

32. **(A)** A straight highway leads to the foot of a tower. A man standing on the top of the 75 m high tower observes two cars at angles of depression of 30^o and 60^o, which are approaching the foot of the tower. If one car is exactly behind the other on the same side of the tower, find the distance between the two cars. (use $\sqrt{3} = 1.73$) **5**

OR

(B) From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60^o and the angle of depression of its foot is 30^o. Determine the height of the tower. **5**

33. **(A)** D is a point on the side BC of a triangle ABC such that $\angle ADC = \angle BAC$, prove that $CA^2 = CB.CD$ **5**

OR

(B) If AD and PM are medians of triangles ABC and PQR, respectively where $\Delta ABC \sim \Delta PQR$, prove that $\frac{AB}{PQ} = \frac{AD}{PM}$. **5**

34. A student was asked to make a model shaped like a cylinder with two cones attached to its ends by using a thin aluminium sheet. The diameter of the model is 3 cm and its total length is 12 cm. If each cone has a height of 2 cm, find the volume of air contained in the model. **5**

35. The monthly expenditure on milk in 200 families of a Housing Society is given below :

Monthly Expenditure (in ₹)	**1000-1500**	**1500-2000**	**2000-2500**	**2500-3000**	**3000-3500**	**3500-4000**	**4000-4500**	**4500-5000**
Number of families	**24**	**40**	**33**	***x***	**30**	**22**	**16**	**7**

Find the value of *x* and also, find the median and mean expenditure on milk. **5**

SECTION – E

Section – E consists of three Case Study Based questions of 4 marks each.

36. Two schools 'P' and 'Q' decided to award prizes to their students for two games of Hockey ₹ x per student and Cricket ₹ y per student. School 'P' decided to award a total of ₹ 9,500 for the two games to 5 and 4 students respectively; while school 'Q' decided to award ₹ 7,370 for the two games to 4 and 3 students respectively.

Based on the above information, answer the following questions :

(i) Represent the following information algebraically (in terms of x and y). **1**

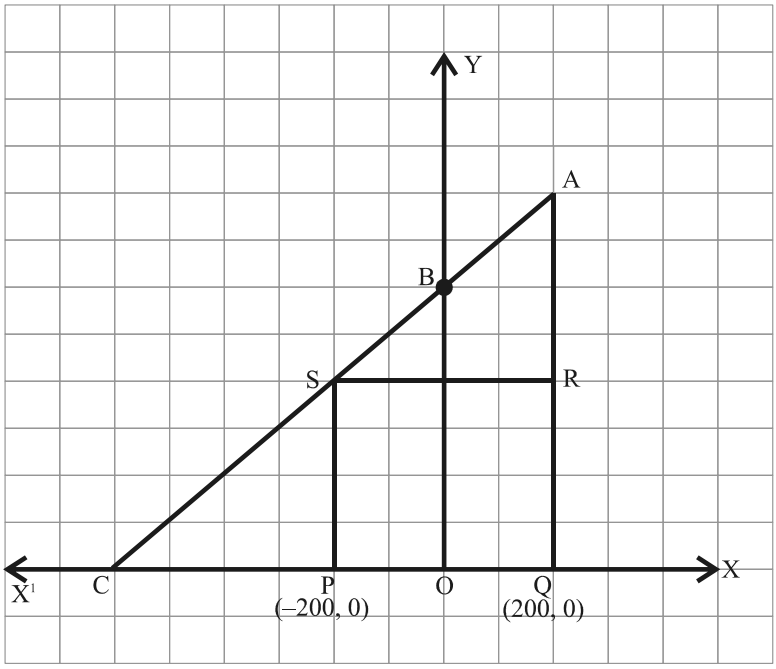
(ii) (a) What is the prize amount for hockey ? **2**

OR

(b) Prize amount on which game is more and by how much ? **2**

(iii) What will be the total prize amount if there are 2 students each from two games ? **1**

37. Jagdish has a field which is in the shape of a right angled triangle AQC. He wants to leave a space in the form of a square PQRS inside the field for growing wheat and the remaining for growing vegetables (as shown in the figure). In the field, there is a pole marked as O.



Based on the above information, answer the following questions :

(i) Taking O as origin, coordinates of P are (–200, 0) and of Q are (200, 0). PQRS being a square, what are the coordinates of R and S ? **1**

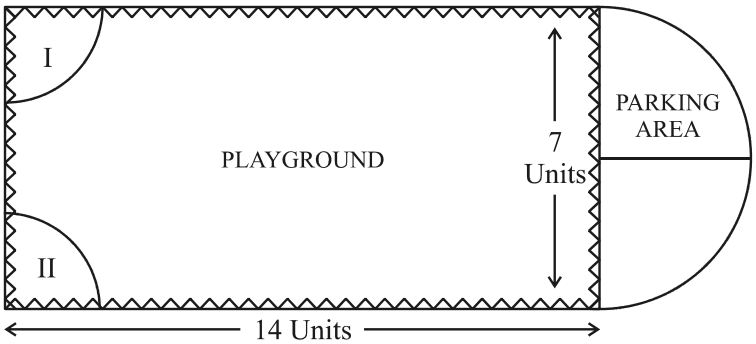
(ii) (a) What is the area of square PQRS ? **2**

OR

(b) What is the length of diagonal PR in square PQRS ? **2**

(iii) If S divides CA in the ratio K:1, what is the value of K, where point A is (200, 800) ? **1**

38. Governing council of a local public development authority of Dehradun decided to build an adventurous playground on the top of a hill, which will have adequate space for parking.



After survey, it was decided to build rectangular playground, with a semi-circular area allotted for parking at one end of the playground. The length and breadth of the rectangular playground are 14 units and 7 units, respectively. There are two quadrants of radius 2 units on one side for special seats.

Based on the above information, answer the following questions :

(i) What is the total perimeter of the parking area ? **1**

(ii) (a) What is the total area of parking and the two quadrants ? **2**

OR

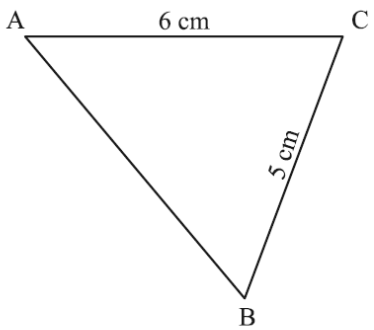
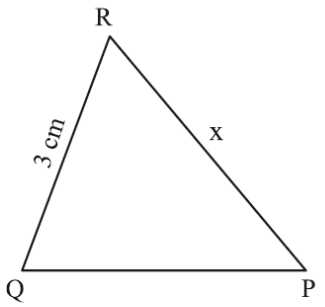
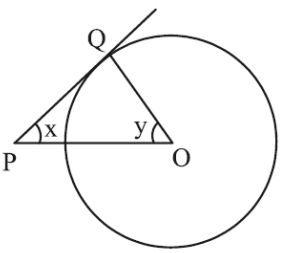
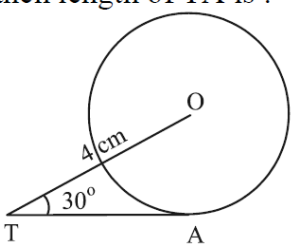
(b) What is the ratio of area of playground to the area of parking area ? **2**

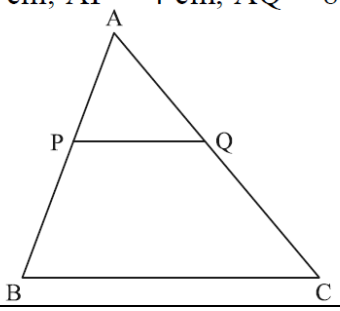
(iii) Find the cost of fencing the playground and parking area at the rate of ₹ 2 per unit. **1**

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/4/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each**	
1.	The ratio of HCF to LCM of the least composite number and the least prime number is : (a) 1:2 (b) 2:1 (c) 1:1 (d) 1:3	
Sol.	(a) 1 : 2	**1**
2.	The roots of the equation $x^2 + 3x - 10 = 0$ are : (a) 2, –5 (b) –2, 5 (c) 2, 5 (d) –2, –5	
Sol.	(a) 2, – 5	**1**
3.	The next term of the A.P. : $\sqrt{6}$, $\sqrt{24}$, $\sqrt{54}$ is : (a) $\sqrt{60}$ (b) $\sqrt{96}$ (c) $\sqrt{72}$ (d) $\sqrt{216}$	
Sol.	(b) $\sqrt{96}$	**1**
4.	The distance of the point (–1, 7) from x-axis is : (a) –1 (b) 7 (c) 6 (d) $\sqrt{50}$	
Sol.	(b) 7	**1**
5.	What is the area of a semi-circle of diameter 'd' ? (a) $\frac{1}{16}\pi d^2$ (b) $\frac{1}{4}\pi d^2$ (c) $\frac{1}{8}\pi d^2$ (d) $\frac{1}{2}\pi d^2$	
Sol.	(c) $\frac{1}{8}\pi d^2$	**1**
6.	The empirical relation between the mode, median and mean of a distribution is : (a) Mode = 3 Median – 2 Mean (b) Mode = 3 Mean – 2 Median (c) Mode = 2 Median – 3 Mean (d) Mode = 2 Mean – 3 Median	

Sol.	(a) Mode = 3 Median – 2 Mean	**1**
7.	The pair of linear equations $2x = 5y + 6$ and $15y = 6x - 18$ represents two lines which are : (a) intersecting (b) parallel (c) coincident (d) either intersecting or parallel	
Sol.	(c) Coincident	**1**
8.	If α, β are zeroes of the polynomial x^2-1, then value of $(\alpha + \beta)$ is : (a) 2 (b) 1 (c) -1 (d) 0	
Sol.	(d) 0	**1**
9.	If a pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then sun's elevation is : (a) 60° (b) 45° (c) 30° (d) 90°	
Sol.	(a) 60°	**1**
10.	$\sec\theta$ when expressed in terms of $\cot\theta$, is equal to : (a) $\frac{1+\cot^2\theta}{\cot\theta}$ (b) $\sqrt{1+\cot^2\theta}$ (c) $\frac{\sqrt{1+\cot^2\theta}}{\cot\theta}$ (d) $\frac{\sqrt{1-\cot^2\theta}}{\cot\theta}$	
Sol.	(c) $\frac{\sqrt{1+\cot^2\theta}}{\cot\theta}$	**1**
11.	Two dice are thrown together. The probability of getting the difference of numbers on their upper faces equals to 3 is : (a) $\frac{1}{9}$ (b) $\frac{2}{9}$ (c) $\frac{1}{6}$ (d) $\frac{1}{12}$	
Sol.	(c) $\frac{1}{6}$	**1**

12.	  In the given figure, $\Delta ABC \sim \Delta QPR$. If AC = 6 cm, BC = 5 cm, QR = 3 cm and PR = x; then the value of x is : (a) 3.6 cm (b) 2.5 cm (c) 10 cm (d) 3.2 cm	
Sol.	(b) 2.5 cm	**1**
13.	The distance of the point (– 6, 8) from origin is : (a) 6 (b) – 6 (c) 8 (d) 10	
Sol.	(d) 10	**1**
14.	In the given figure, PQ is a tangent to the circle with centre O. If $\angle OPQ = x$, $\angle POQ = y$, then x + y is : (a) 45^o (b) 90^o (c) 60^o (d) 180^o 	
Sol.	(b) 90°	**1**
15.	In the given figure, TA is a tangent to the circle with centre O such that OT = 4 cm, $\angle OTA = 30^o$, then length of TA is : (a) $2\sqrt{3}$ cm (b) 2 cm (c) $2\sqrt{2}$ cm (d) $\sqrt{3}$ cm 	
Sol.	(a) $2\sqrt{3}$ cm	**1**

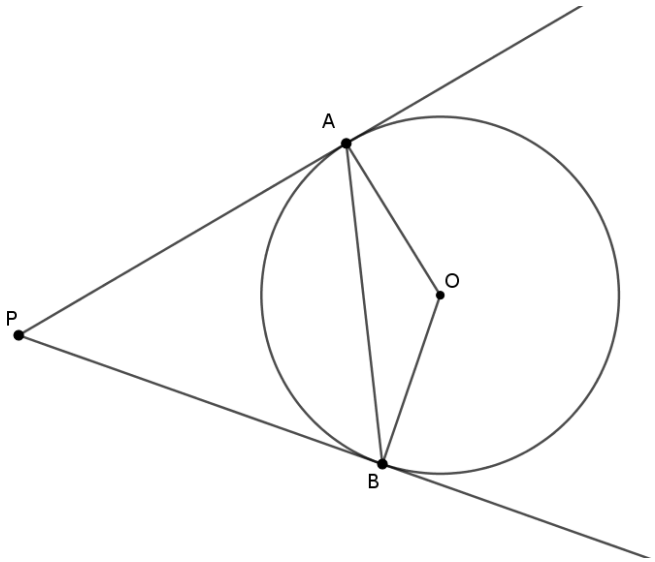
16.	In Δ ABC, PQ $\|\|$ BC. If PB = 6 cm, AP = 4 cm, AQ = 8 cm, find the length of AC. (a) 12 cm (b) 20 cm (c) 6 cm (d) 14 cm  	
Sol.	(b) 20 cm	**1**
17.	If α, β are the zeroes of the polynomial $p(x) = 4x^2 - 3x - 7$, then $\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$ is equal to : (a) $\frac{7}{3}$ (b) $\frac{-7}{3}$ (c) $\frac{3}{7}$ (d) $\frac{-3}{7}$	
Sol.	(d) $-\frac{3}{7}$	**1**
18.	A card is drawn at random from a well-shuffled pack of 52 cards. The probability that the card drawn is not an ace is : (a) $\frac{1}{13}$ (b) $\frac{9}{13}$ (c) $\frac{4}{13}$ (d) $\frac{12}{13}$	
Sol.	(d) $\frac{12}{13}$	**1**
	DIRECTIONS : In the question number **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option out of the following :	

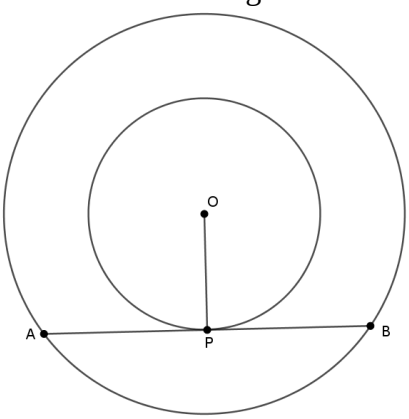
19.	**Assertion (A) :** The probability that a leap year has 53 Sundays is $\frac{2}{7}$. **Reason (R) :** The probability that a non-leap year has 53 Sundays is $\frac{5}{7}$. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true but Reason (R) is false. (d) Assertion (A) is false but Reason (R) is true.	
Sol.	(c) Assertion (A) is true but Reason (R) is false	**1**
20.	**Assertion (A) :** a, b, c are in A.P. if and only if $2b = a + c$. **Reason (R) :** The sum of first n odd natural numbers is n^2. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true but Reason (R) is false. (d) Assertion (A) is false but Reason (R) is true.	
Sol.	(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).	**1**
	SECTION B **This section comprises very short answer (VSA) type questions of 2 marks each.**	
21.	Two numbers are in the ratio 2 : 3 and their LCM is 180. What is the HCF of these numbers ?	
Sol.	Let the numbers be 2x, 3x LCM = $6x = 180 \Rightarrow x = 30$ $\therefore$ Numbers are 60, 90 HCF (60, 90) = 30	**1** **1**
22.	If one zero of the polynomial $p(x) = 6x^2 + 37x - (k - 2)$ is reciprocal of the other, then find the value of k.	

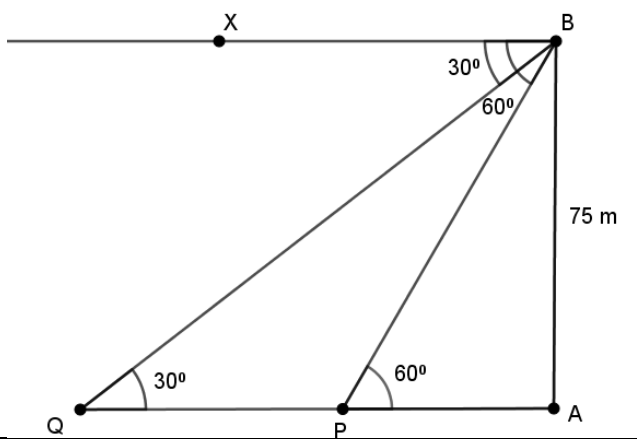
Sol.	$p(x) = 6x^2 + 37x - (k - 2)$ Let the zeroes be α, $\frac{1}{\alpha}$ Product of zeroes = $\alpha \cdot \frac{1}{\alpha} = -\frac{(k-2)}{6}$ $6 = -k + 2 \Rightarrow k = -4$	**$\frac{1}{2}$** **1** **$\frac{1}{2}$**
23(A).	Find the sum and product of the roots of the quadratic equation $2x^2 - 9x + 4 = 0$.	
Sol.	$2x^2 - 9x + 4 = 0$ $a = 2, b = -9, c = 4$ Let α, β be roots of $2x^2 - 9x + 4 = 0$ Sum = $\alpha + \beta = -\frac{b}{a} = \frac{9}{2}$ Product of roots = $\alpha\beta = \frac{c}{a} = \frac{4}{2} = 2$	**1** **1**
	OR	
23(B).	Find the discriminant of the quadratic equation $4x^2 - 5 = 0$ and hence comment on the nature of roots of the equation.	
Sol.	$4x^2 - 5 = 0$ $a = 4, b = 0, c = -5$ Discriminant = $b^2 - 4ac = 0 - 4(4)(-5) = 80 > 0$ $\Rightarrow$ roots are real and distinct.	**$1\frac{1}{2}$** **$\frac{1}{2}$**
24.	If a fair coin is tossed twice, find the probability of getting 'atmost one head'.	

Sol.	Total outcomes are HH, HT, TH, TT Favourable outcomes are HT, TH, TT P (at most one head) = $\frac{3}{4}$	$\frac{1}{2}$ $\frac{1}{2}$ 1
25(A).	Evaluate $\frac{5\cos^2 60^o + 4\sec^2 30^o - \tan^2 45^o}{\sin^2 30^o + \cos^2 30^o}$	
Sol.	$\frac{5\cos^2 60^\circ + 4\sec^2 30^\circ - \tan^2 45^\circ}{\sin^2 30^\circ + \cos^2 30^\circ}$ $= \frac{5(1/2)^2 + 4(2/\sqrt{3})^2 - (1)^2}{1}$ $= \frac{5/4 + 16/3 - 1}{1} = \frac{67}{12}$	$1\frac{1}{2}$ $\frac{1}{2}$
	OR	
25(B).	If A and B are acute angles such that sin (A – B) = 0 and 2 cos (A + B) – 1 = 0, then find angles A and B.	
Sol.	sin (A – B) = 0 $\Rightarrow$ A – B = 0° cos (A + B) = $\frac{1}{2}$ $\Rightarrow$ A + B = 60° $\Rightarrow$ A = 30°, B = 30°	$\frac{1}{2}$ $\frac{1}{2}$ 1
	SECTION C **This section comprises of Short Answer (SA) type questions of 3 marks each.**	
26(A).	How many terms are there in an A.P. whose first and fifth terms are – 14 and 2, respectively and the last term is 62.	

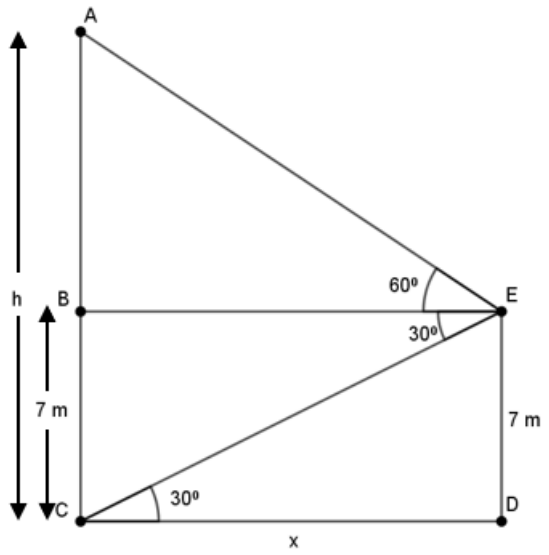
Sol.	$a = -14$, $a_5 = 2 \quad \Rightarrow a + 4d = 2$ $-14 + 4d = 2 \Rightarrow d = 4$ $a_n = 62 \quad \Rightarrow a + (n-1)d = 62$ $-14 + (n-1)4 = 62 \quad \Rightarrow n = 20$	**1** **1** **1**
	OR	
26(B).	Which term of the A.P. : 65, 61, 57, 53, ... is the first negative term ?	
Sol.	65, 61, 57, 53, ... $a = 65, d = -4$ Let a_n be the first negative term $a_n < 0 \Rightarrow a + (n-1)d < 0$ $65 + (n-1)(-4) < 0 \Rightarrow \quad 69 - 4n < 0$ $n > \frac{69}{4}$ $\therefore$ Least positive integral value of n which satisfies $n > \frac{69}{4}$ is 18 $\therefore$ 1^{st} negative term of the AP = 18	 $\frac{1}{2}$ **1** **1** $\frac{1}{2}$
27.	Prove that $\sqrt{5}$ is an irrational number.	
Sol.	Let $\sqrt{5}$ be a rational number. $\therefore \sqrt{5} = \frac{p}{q}$, where $q \neq 0$ and let p & q be co-primes. $5q^2 = p^2 \Rightarrow p^2$ is divisible by $5 \Rightarrow$ p is divisible by 5 $\Rightarrow p = 5a$, where 'a' is some integer ----- (i) $25a^2 = 5q^2 \Rightarrow q^2 = 5a^2 \Rightarrow q^2$ is divisible by $5 \Rightarrow$ q is divisible by 5 $\Rightarrow q = 5b$, where 'b' is some integer ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are co-primes. $\therefore \sqrt{5}$ is an irrational number.	½ 1 ½ 1
28.	Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line-segment joining the points of contact at the centre.	

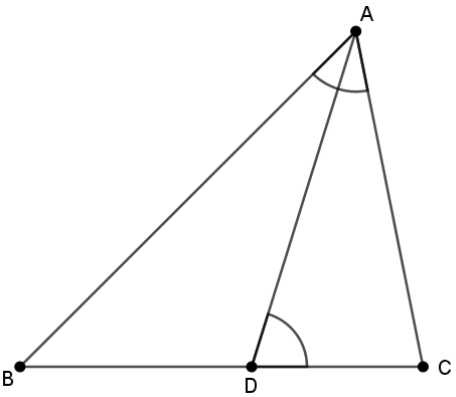
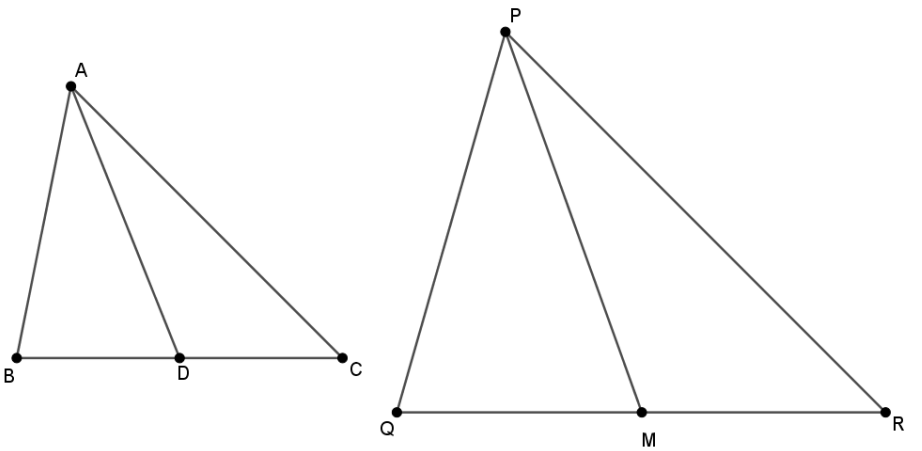
Sol.	PA and PB are tangents drawn from the external point P to the circle with centre O.  In quad. OAPB, $\angle$ OAP + $\angle$ APB + $\angle$ OBP + $\angle$ AOB = 360° 90° + $\angle$ APB + 90° + $\angle$ AOB = 360° (Tangent $\perp$ radius) $\angle$ APB + $\angle$ AOB = 360° – 180° = 180°	**1 mark for correct figure** **1** $\frac{1}{2}$ $\frac{1}{2}$
29(A).	Prove that $\frac{\sin A - 2\sin^3 A}{2\cos^3 A - \cos A} = \tan A$	
Sol.	LHS = $\frac{\sin A - 2\sin^3 A}{2\cos^3 A - \cos A} = \frac{\sin A\,(1 - 2\sin^2 A)}{\cos A\,(2\cos^2 A - 1)}$ $= \frac{\sin A[1 - 2(1 - \cos^2 A)]}{\cos A[2\cos^2 A - 1]} = \frac{\sin A[1 - 2 + 2\cos^2 A]}{\cos A\,[2\cos^2 A - 1]}$ $= \frac{\sin A[2\cos^2 A - 1]}{\cos A\,[2\cos^2 A - 1]} = \tan A = \text{RHS}$	**1** **1** **1**

	OR	
29(B).	Prove that sec A (1 – sin A) (sec A + tan A) = 1.	
Sol.	LHS = sec A (1 – sin A) (sec A + tan A)	
	$= \frac{1}{\cos A}(1 - \sin A)\left(\frac{1}{\cos A} + \frac{\sin A}{\cos A}\right)$	**1**
	$= \frac{1}{\cos A}(1 - \sin A)\frac{(1 + \sin A)}{\cos A}$	**1**
	$= \frac{1 - \sin^2 A}{\cos^2 A} = \frac{\cos^2 A}{\cos^2 A} = 1 = \text{RHS}$	**1**
30.	Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle.	
Sol.	AB is the chord of larger circle touching the smaller circle at P.	
		**$\frac{1}{2}$**
	OA = 5 cm, OP = 3 cm	
	To find AB	
	OP ⊥ AB (radius ⊥ tangent)	
	AB is the chord of larger circle and OP ⊥ AB	
	∴ AP = PB	**1**
	In right-angled Δ AOP, $AP^2 = 5^2 - 3^2 = 16$	
	AP = 4 cm	**1**

	$\therefore$ AB = 2AP = 8 cm	$\frac{1}{2}$
31.	Find the value of 'p' for which the quadratic equation $px(x-2)+6=0$ has two equal real roots.	
Sol.	$px(x-2)+6=0 \quad \Rightarrow px^2-2px+6=0$ $a=p, b=-2p, c=6$ Quadratic equation has equal roots, $\therefore D=0$ $b^2-4ac=0 \quad \Rightarrow 4p^2-24p=0$ $4p(p-6)=0$ $p=0, p=6$ $p=0$ rejected $\therefore p=6$	$\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$
	SECTION D **This section comprises of Long Answer (LA) type questions of 5 marks each.**	
32(A).	A straight highway leads to the foot of a tower. A man standing on the top of the 75 m high tower observes two cars at angles of depression of 30° and 60°, which are approaching the foot of the tower. If one car is exactly behind the other on the same side of the tower, find the distance between the two cars. (use $\sqrt{3}=1.73$)	
Sol.		**1 mark for correct figure**

	AB = Height of tower = 75 m P, Q are positions of cars $\angle$ XBQ = $\angle$ BQA = 30° $\angle$ XBP = $\angle$ BPA = 60° In Δ APB, $\tan 60° = \frac{75}{AP} \Rightarrow AP = \frac{75}{\sqrt{3}} = 25\sqrt{3}$ In Δ AQB, $\tan 30° = \frac{75}{AQ} \Rightarrow AQ = 75\sqrt{3}$ Distance between the cars = PQ = AQ – AP $= 75\sqrt{3} - 25\sqrt{3} = 50\sqrt{3}$ $= 50 \times 1{\cdot}73 = 86{\cdot}5$ m	$1\frac{1}{2}$ $1\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
	OR	
32(B).	From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60^o and the angle of depression of its foot is 30^o. Determine the height of the tower.	

Sol.	 Let AC be h m, BC = DE = 7 m, AB = (h−7) m $\angle AEB = 60^\circ$ and $\angle BEC = 30^\circ$ $\therefore \angle ECD = 30^\circ$ Let CD be x m $\frac{DE}{CD} = \frac{7}{x} = \tan 30° \Longrightarrow x = 7\sqrt{3}$ $\Longrightarrow BE = 7\sqrt{3}$ Again $\frac{AB}{BE} = \tan 60^\circ$ $\Longrightarrow \frac{h-7}{7\sqrt{3}} = \sqrt{3}$ $\Longrightarrow h = 28$ $\therefore$ Height of tower = 28 m	**1 mark for correct figure** **$1\frac{1}{2}$** **1** **1** **$\frac{1}{2}$**
33(A).	D is a point on the side BC of a triangle ABC such that $\angle ADC = \angle BAC$, prove that $CA^2 = CB.CD$	

Sol.	 In Δ ABC, D is a point on side BC such that ∠ ADC = ∠ BAC In Δ CBA and Δ CDA ∠ C = ∠ C (common) ∠ BAC = ∠ ADC (given) ∴ Δ CBA ~ Δ CAD (By AA similarity) ∴ their corresponding sides are proportional $\Rightarrow \frac{CB}{CA} = \frac{CA}{CD} \Rightarrow CA^2 = CB \cdot CD$	**1 mark for correct figure** **1** **1** **1** **1**
	OR	
33(B).	If AD and PM are medians of triangles ABC and PQR, respectively where ΔABC ~ ΔPQR, prove that $\frac{AB}{PQ} = \frac{AD}{PM}$.	
Sol.	 Δ ABC ~ Δ PQR	**1 mark for correct figure**

	AD and AM are medians of Δ ABC and Δ PQR respectively. Δ ABC ~ Δ PQR $\therefore \frac{AB}{PQ} = \frac{BC}{QR}$ $\frac{AB}{PQ} = \frac{2BD}{2QM}$ $\frac{AB}{PQ} = \frac{BD}{QM}$ Also $\angle B = \angle Q$ (Δ ABC ~ Δ PQR) $\Rightarrow$ Δ ABD ~ Δ PQM (SAS similarly) $\Rightarrow \frac{AB}{PQ} = \frac{AD}{PM}$	$1\frac{1}{2}$ $1\frac{1}{2}$ 1
34.	A student was asked to make a model shaped like a cylinder with two cones attached to its ends by using a thin aluminium sheet. The diameter of the model is 3 cm and its total length is 12 cm. If each cone has a height of 2 cm, find the volume of air contained in the model.	
Sol.	Radius of each cone = Radius of cylinder = $\frac{3}{2}$ cm Height of each cone 'H' = 2 cm Height of cylinder 'h' = 12 – 4 = 8 cm Volume of air = Volume of cylinder + Volume of 2 cones $= \pi r^2 h + 2\frac{1}{3}\pi r^2 H$ $= \pi r^2\left(h + \frac{2}{3}H\right) = \frac{22}{7} \times \frac{3}{2} \times \frac{3}{2}\left(8 + \frac{2}{3} \times 2\right)$ $= \frac{22}{7} \times \frac{9}{4} \times \frac{28}{3} = 66\ cm^3$	1 $1\frac{1}{2}+1\frac{1}{2}$ 1

35. The monthly expenditure on milk in 200 families of a Housing Society is given below :

Monthly Expenditure (in ₹)	**1000-1500**	**1500-2000**	**2000-2500**	**2500-3000**	**3000-3500**	**3500-4000**	**4000-4500**	**4500-5000**
Number of families	**24**	**40**	**33**	***x***	**30**	**22**	**16**	**7**

Find the value of x and also, find the median and mean expenditure on milk.

Sol.

Monthly Exp. (in ₹)	x	f_i	c_f	d	$x_i f_i$
1000 – 1500	1250	24	24	– 3	– 72
1500 – 2000	1750	40	64	– 2	– 80
2000 – 2500	2250	33	97	– 1	– 33
2500 – 3000	2750	x=28	125	0	0
3000 – 3500	3250	30	155	1	30
3500 – 4000	3750	22	177	2	44
4000 – 4500	4250	16	193	3	48
4500 – 5000	4750	7	200	4	28
Total					– 35

2 for correct table

$172 + x = 200 \quad \Rightarrow x = 28$

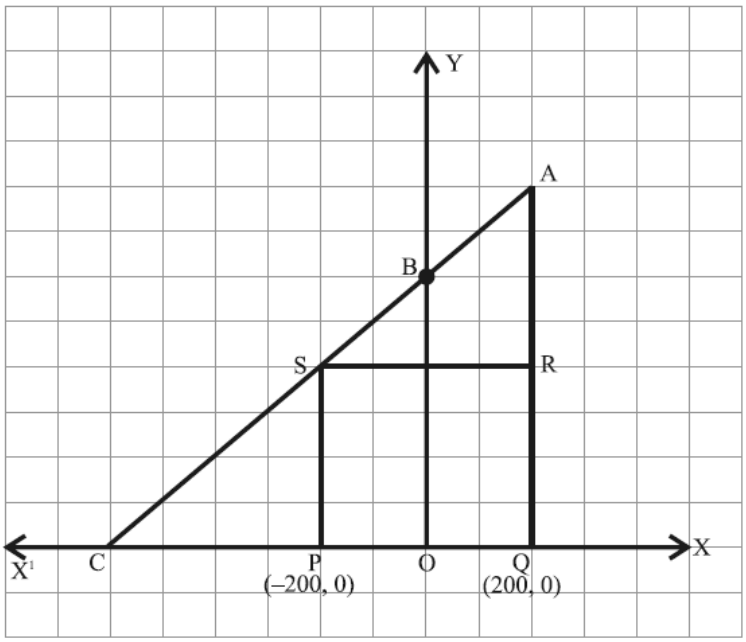
1

l = lower limit of median class = 2500

$\frac{N}{2} = \frac{200}{2} = 100$

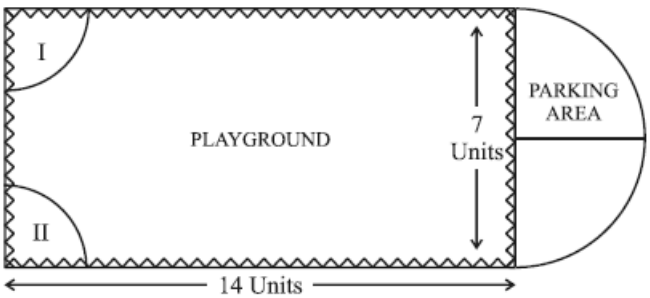
C = 97, f = 28, h = 500

	Median $= l + \dfrac{\frac{N}{2} - C}{f} \times h$ $= 2500 + \dfrac{100 - 97}{28} \times 500$ $= 2500 + \dfrac{3}{28} \times 500 = 2553{\cdot}6$ Median Expenditure = ₹ 2553·6 Mean $= 2750 - \dfrac{35 \times 500}{200} = 2750 - 87{\cdot}5 = 2662{\cdot}5$ Mean Expenditure = ₹ 2662·5	**1** **1**
	SECTION E **This section comprises of 3 case-study based questions of 4 marks each.**	
36.	Two schools 'P' and 'Q' decided to award prizes to their students for two games of Hockey ₹ x per student and Cricket ₹ y per student. School 'P' decided to award a total of ₹ 9,500 for the two games to 5 and 4 students respectively; while school 'Q' decided to award ₹ 7,370 for the two games to 4 and 3 students respectively. Based on the above information, answer the following questions : (i) Represent the following information algebraically (in terms of x and y). (ii) (a) What is the prize amount for hockey ? **OR** (b) Prize amount on which game is more and by how much ? (iii) What will be the total prize amount if there are 2 students each from two games ?	
Sol.	(i) $5x + 4y = 9500$ _____ (1) $4x + 3y = 7370$ _____ (2)	**$\frac{1}{2}$** **$\frac{1}{2}$**

	(ii) (a) Solving (1) and (2), x = 980 ∴ Prize Amount for Hockey = ₹ 980 **OR** (ii) (b) On solving x = 980, y = 1,150 ∴ Prize Amount for Cricket is more by ₹ (1,150 – 980) = ₹ 170 (iii) 2(x + y) = 2(980 + 1150) = 2(2130) = ₹ 4,260	**2** **1** **1** **1**
37.	Jagdish has a field which is in the shape of a right angled triangle AQC. He wants to leave a space in the form of a square PQRS inside the field for growing wheat and the remaining for growing vegetables (as shown in the figure). In the field, there is a pole marked as O.  Based on the above information, answer the following questions : (i) Taking O as origin, coordinates of P are (–200, 0) and of Q are (200, 0). PQRS being a square, what are the coordinates of R and S ?	

	(ii) (a) What is the area of square PQRS ? **OR** (b) What is the length of diagonal PR in square PQRS ? (iii) If S divides CA in the ratio K:1, what is the value of K, where point A is (200, 800) ?	
Sol.	(i) R(200, 400), S(– 200, 400) (ii) (a) side PQ = (200+200) m = 400 m Area of square PQRS = 400 × 400 = 160000 sq. units **OR** (ii) (b) Diagonal PR = $\sqrt{(400)^2 + (400)^2}$ = $\sqrt{3200}$ or $400\sqrt{2}$ (iii) $C(-600,0); A(200,800); S(-200,400)$ S divides CA in the ratio k: 1 $-200 = \frac{k(200)+1(-600)}{k+1}$ $\Rightarrow k = 1$	$\frac{1}{2} + \frac{1}{2}$ **1** **1** **1** **1** **1**

38. Governing council of a local public development authority of Dehradun decided to build an adventurous playground on the top of a hill, which will have adequate space for parking.



After survey, it was decided to build rectangular playground, with a semi-circular area allotted for parking at one end of the playground. The length and breadth of the rectangular playground are 14 units and 7 units, respectively. There are two quadrants of radius 2 units on one side for special seats.

Based on the above information, answer the following questions :

(i) What is the total perimeter of the parking area ?

(ii) (a) What is the total area of parking and the two quadrants ?

OR

(b) What is the ratio of area of playground to the area of parking area ?

(iii) Find the cost of fencing the playground and parking area at the rate of ₹ 2 per unit.

Sol.

(i) Total perimeter = $\pi r + 2r$

$$= \frac{22}{7} \times \frac{7}{2} + 7 = 18 \text{ units} \quad \textbf{1}$$

(ii) (a) Area of parking $= \frac{1}{2}\pi r^2 = \frac{1}{2} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = \frac{77}{4}$ **1**

Area of quadrants $= 2 \cdot \frac{22}{7} \times 2 \times 2 \times \frac{1}{4} = \frac{44}{7}$ **$\frac{1}{2}$**

Total Area $= \frac{77}{4} + \frac{44}{7} = \frac{715}{28}$ or 25·54 sq. units **$\frac{1}{2}$**

	OR	
	(ii) (b) $\frac{\text{Area of playground}}{\text{Area of parking}} = \frac{98}{77/4} = \frac{56}{11} = 56 : 11$	**1+1**
	(iii) Required Perimeter = $2(l + b) + \frac{2\pi r}{2}$	
	$= 2(14 + 7) + \frac{22}{7} \times \frac{7}{2} = 53$ units	$\mathbf{\frac{1}{2}}$
	Cost of fencing = $53 \times 2 =$ ₹ 106	$\mathbf{\frac{1}{2}}$

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A**, **B**, **C**, **D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **not** allowed.*

SECTION A

This section comprises multiple choice questions (MCQs) of 1 mark each.

1. The number of polynomials having zeroes –3 and 5 is :

(a) only one (b) infinite

(c) exactly two (d) at most two

2. The pair of equations $ax + 2y = 9$ and $3x + by = 18$ represent parallel lines, where a, b are integers, if :

(a) $a = b$ (b) $3a = 2b$

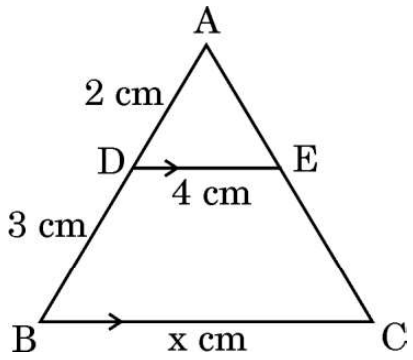
(c) $2a = 3b$ (d) $ab = 6$

3. The common difference of the A.P. whose n^{th} term is given by $a_n = 3n + 7$, is :

(a) 7 (b) 3

(c) 3n (d) 1

4. In the given figure, DE ∥ BC. The value of x is :



(a) 6 (b) 12·5

(c) 8 (d) 10

5. A quadratic equation whose roots are $(2 + \sqrt{3})$ and $(2 - \sqrt{3})$ is :

(a) $x^2 - 4x + 1 = 0$ (b) $x^2 + 4x + 1 = 0$

(c) $4x^2 - 3 = 0$ (d) $x^2 - 1 = 0$

6. If $\tan\theta = \frac{5}{12}$, then the value of $\frac{\sin\theta + \cos\theta}{\sin\theta - \cos\theta}$ is :

(a) $-\frac{17}{7}$ (b) $\frac{17}{7}$

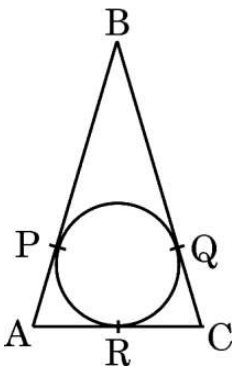
(c) $\frac{17}{13}$ (d) $-\frac{7}{13}$

7. The distance between the points $P\left(-\frac{11}{3}, 5\right)$ and $Q\left(-\frac{2}{3}, 5\right)$ is :

(a) 6 units (b) 4 units

(c) 2 units (d) 3 units

8. In the given figure, AB = BC = 10 cm. If AC = 7 cm, then the length of BP is :



(a) 3·5 cm (b) 7 cm

(c) 6·5 cm (d) 5 cm

9. Water in a river which is 3 m deep and 40 m wide is flowing at the rate of 2 km/h. How much water will fall into the sea in 2 minutes ?

(a) $800\ m^3$ (b) $4000\ m^3$

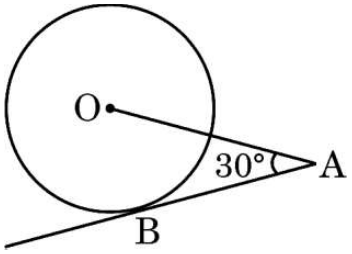
(c) $8000\ m^3$ (d) $2000\ m^3$

10. If the mean and the median of a data are 12 and 15 respectively, then its mode is :

(a) 13·5 (b) 21

(c) 6 (d) 14

11. In the given figure, AB is a tangent to the circle centered at O. If OA = 6 cm and $\angle$ OAB = 30°, then the radius of the circle is :



(a) 3 cm (b) $3\sqrt{3}$ cm

(c) 2 cm (d) $\sqrt{3}$ cm

12. $\left(\frac{2\tan 30°}{1+\tan^2 30°}\right)$ is equal to :

(a) sin 60° (b) cos 60°

(c) tan 60° (d) sin 30°

13. In Δ ABC and Δ DEF, $\frac{AB}{DE}=\frac{BC}{FD}$. Which of the following makes the two triangles similar ?

(a) $\angle A = \angle D$ (b) $\angle B = \angle D$

(c) $\angle B = \angle E$ (d) $\angle A = \angle F$

14. The 11^{th} term from the end of the A.P. : 10, 7, 4, ..., – 62 is :

(a) 25 (b) 16

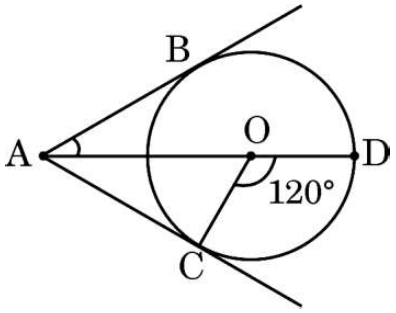
(c) – 32 (d) 0

15. Two coins are tossed together. The probability of getting at least one tail is :

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$

(c) $\frac{3}{4}$ (d) 1

16. In the given figure, AC and AB are tangents to a circle centered at O. If $\angle$ COD = 120°, then $\angle$ BAO is equal to :



(a) 30° (b) 60°

(c) 45° (d) 90°

17. Which of the following numbers ***cannot*** be the probability of happening of an event ?

(a) 0 (b) $\frac{7}{0{\cdot}01}$

(c) 0·07 (d) $\frac{0{\cdot}07}{3}$

18. If every term of the statistical data consisting of n terms is decreased by 2, then the mean of the data :

(a) decreases by 2

(b) remains unchanged

(c) decreases by 2n

(d) decreases by 1

*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.*

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* If the points A(4, 3) and B(x, 5) lie on a circle with centre O(2, 3), then the value of x is 2.

Reason (R) : Centre of a circle is the mid-point of each chord of the circle.

20. *Assertion (A) :* The number 5^n cannot end with the digit 0, where n is a natural number.

Reason (R): Prime factorisation of 5 has only two factors, 1 and 5.

SECTION B

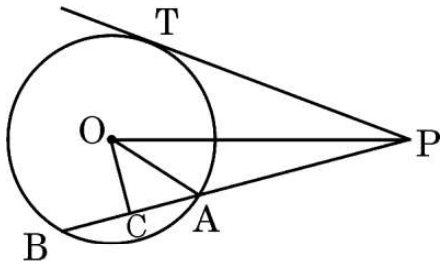
This section comprises very short answer (VSA) type questions of 2 marks each.

21. (a) The line segment joining the points A(4, – 5) and B(4, 5) is divided by the point P such that AP : AB = 2 : 5. Find the coordinates of P.

OR

(b) Point P(x, y) is equidistant from points A(5, 1) and B(1, 5). Prove that x = y.

22. In the given figure, PT is a tangent to the circle centered at O. OC is perpendicular to chord AB. Prove that $PA \cdot PB = PC^2 - AC^2$.



23. Using prime factorisation, find HCF and LCM of 96 and 120.

24. Find the ratio in which y-axis divides the line segment joining the points $(5, -6)$ and $(-1, -4)$.

25. (a) If $a \cos\theta + b \sin\theta = m$ and $a \sin\theta - b \cos\theta = n$, then prove that $a^2 + b^2 = m^2 + n^2$.

OR

(b) Prove that :

$$\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2 \operatorname{cosec} A$$

SECTION C

This section comprises short answer (SA) type questions of 3 marks each.

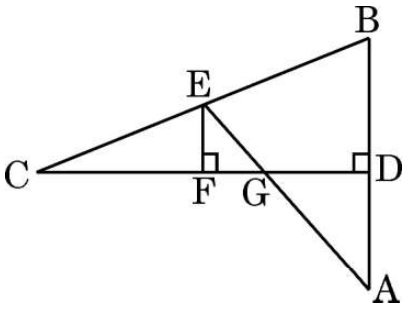
26. (a) Prove that $\sqrt{3}$ is an irrational number.

OR

(b) The traffic lights at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds respectively. If they change simultaneously at 7 a.m., at what time will they change together next ?

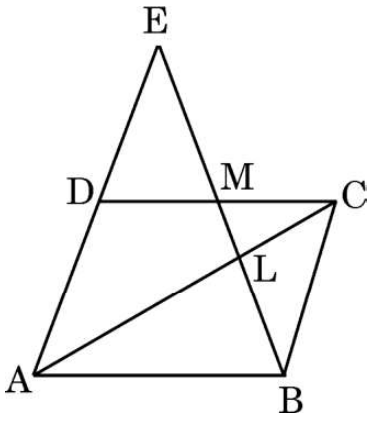
27. If p^{th} term of an A.P. is q and q^{th} term is p, then prove that its n^{th} term is $(p + q - n)$.

28. (a) In the given figure, CD is the perpendicular bisector of AB. EF is perpendicular to CD. AE intersects CD at G. Prove that $\frac{CF}{CD} = \frac{FG}{DG}$.



OR

(b) In the given figure, ABCD is a parallelogram. BE bisects CD at M and intersects AC at L. Prove that EL = 2BL.



29. Two people are 16 km apart on a straight road. They start walking at the same time. If they walk towards each other with different speeds, they will meet in 2 hours. Had they walked in the same direction with same speeds as before, they would have met in 8 hours. Find their walking speeds.

30. Prove that :

$$\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta \operatorname{cosec}\theta$$

31. Find the mean of the following frequency distribution :

Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60
Frequency	14	22	16	6	5	3	4

SECTION D

This section comprises long answer (LA) type questions of 5 marks each.

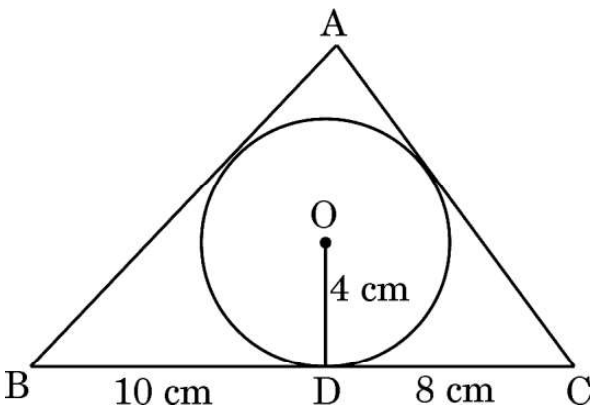
32. One observer estimates the angle of elevation to the basket of a hot air balloon to be 60°, while another observer 100 m away estimates the angle of elevation to be 30°. Find :

(a) The height of the basket from the ground.

(b) The distance of the basket from the first observer's eye.

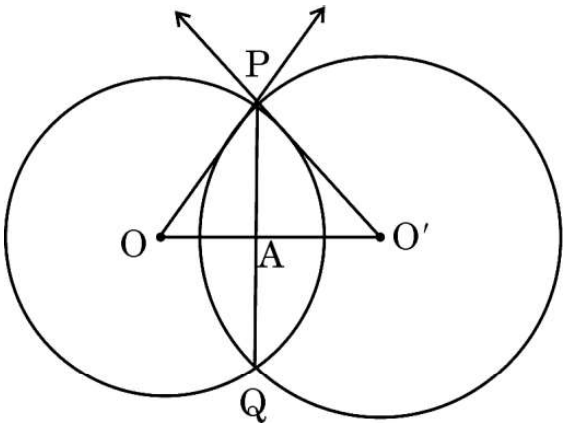
(c) The horizontal distance of the second observer from the basket.

33. (a) A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC are of lengths 10 cm and 8 cm respectively. Find the lengths of the sides AB and AC, if it is given that area Δ ABC = 90 cm^2.



OR

(b) Two circles with centres O and O′ of radii 6 cm and 8 cm, respectively intersect at two points P and Q such that OP and O′P are tangents to the two circles. Find the length of the common chord PQ.



34. (a) A train travels at a certain average speed for a distance of 54 km and then travels a distance of 63 km at an average speed of 6 km/h more than the first speed. If it takes 3 hours to complete the journey, what was its first average speed ?

OR

(b) Two pipes together can fill a tank in $\frac{15}{8}$ hours. The pipe with larger diameter takes 2 hours less than the pipe with smaller diameter to fill the tank separately. Find the time in which each pipe can fill the tank separately.

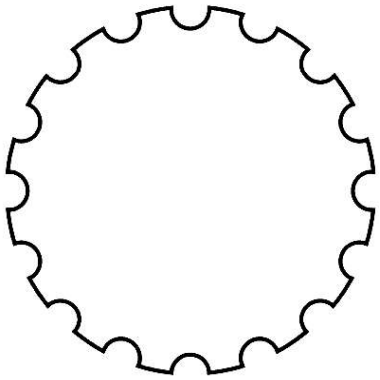
35. A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope. Find the area of that part of the field in which the horse can graze. Also, find the increase in grazing area if length of rope is increased to 10 m. (Use $\pi = 3{\cdot}14$)

SECTION E

This section comprises 3 case study based questions of 4 marks each.

Case Study – 1

36. A golf ball is spherical with about 300 – 500 dimples that help increase its velocity while in play. Golf balls are traditionally white but available in colours also. In the given figure, a golf ball has diameter 4·2 cm and the surface has 315 dimples (hemi-spherical) of radius 2 mm.



Based on the above, answer the following questions :

(i) Find the surface area of one such dimple. *1*

(ii) Find the volume of the material dug out to make one dimple. *1*

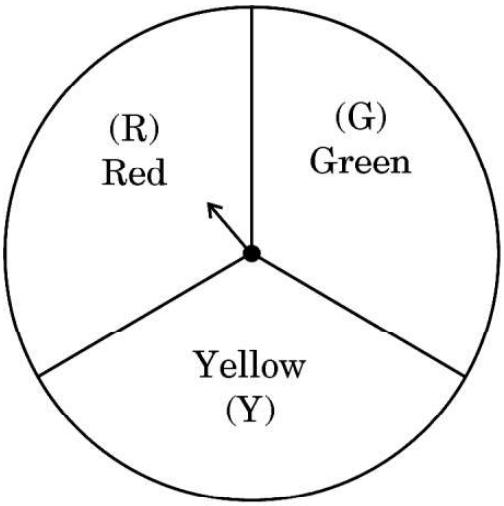
(iii) (a) Find the total surface area exposed to the surroundings. *2*

OR

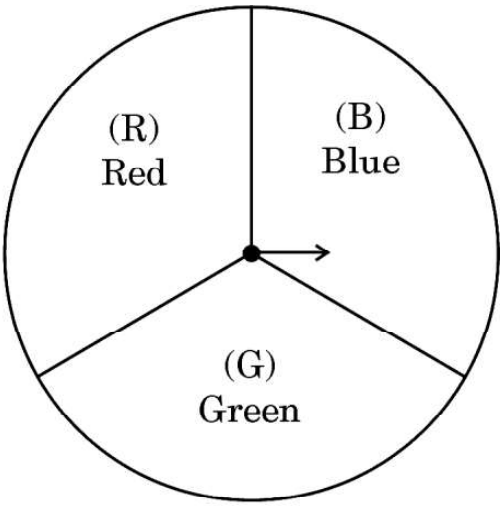
(iii) (b) Find the volume of the golf ball. *2*

Case Study – 2

37. A middle school decided to run the following spinner game as a fund-raiser on Christmas Carnival.



I



II

Making Purple : Spin each spinner once. Blue and red make purple. So, if one spinner shows Red (R) and another Blue (B), then you 'win'. One such outcome is written as 'RB'.

Based on the above, answer the following questions :

(i) List all possible outcomes of the game. *1*

(ii) Find the probability of 'Making Purple'. *1*

(iii) (a) For each win, a participant gets ₹ 10, but if he/she loses, he/she has to pay ₹ 5 to the school.
If 99 participants played, calculate how much fund could the school have collected. *2*

OR

(iii) (b) If the same amount of ₹ 5 has been decided for winning or losing the game, then how much fund had been collected by school ? (Number of participants = 99) *2*

Case Study – 3

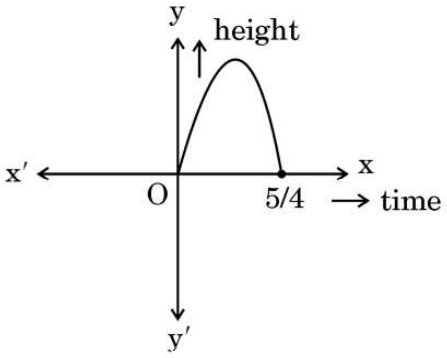
38. In a pool at an aquarium, a dolphin jumps out of the water travelling at 20 cm per second. Its height above water level after t seconds is given by $h = 20t - 16t^2$.

Based on the above, answer the following questions :

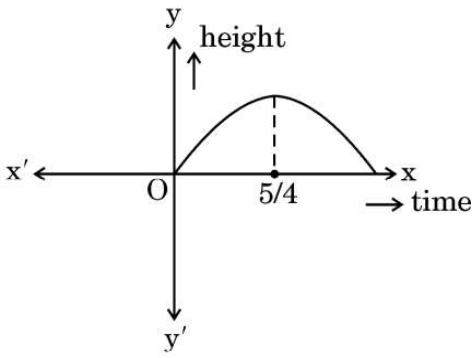
(i) Find zeroes of polynomial $p(t) = 20t - 16t^2$. *1*

(ii) Which of the following types of graph represents p(t) ? *1*

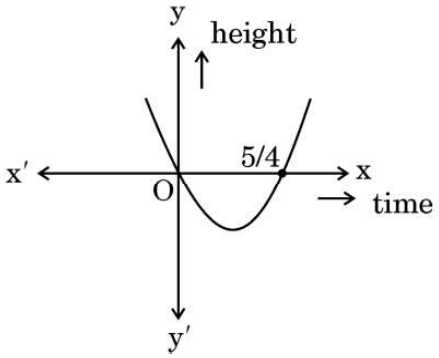
(a)



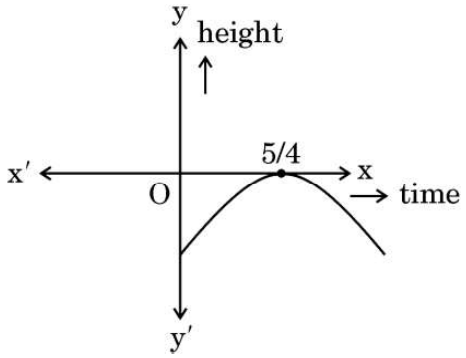
(b)



(c)



(d)



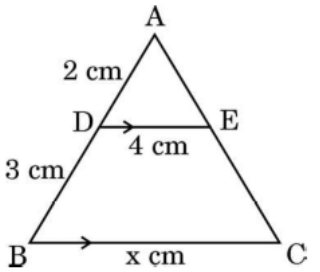
(iii) (a) What would be the value of h at $t = \frac{3}{2}$? Interpret the result. *2*

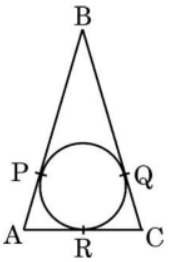
OR

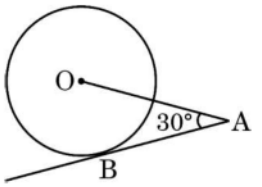
(iii) (b) How much distance has the dolphin covered before hitting the water level again ? *2*

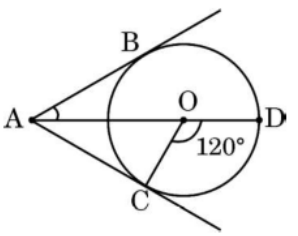
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/5/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each**	
1.	The number of polynomials having zeroes –3 and 5 is : (a) only one (b) infinite (c) exactly two (d) at most two	
Sol.	**(b) Infinite**	**1**
2.	The pair of equations $ax + 2y = 9$ and $3x + by = 18$ represent parallel lines, where a, b are integers, if : (a) $a = b$ (b) $3a = 2b$ (c) $2a = 3b$ (d) $ab = 6$	
Sol.	**(d) ab = 6**	**1**
3.	The common difference of the A.P. whose n^{th} term is given by $a_n = 3n + 7$, is : (a) 7 (b) 3 (c) 3n (d) 1	
Sol.	**(b) 3**	**1**

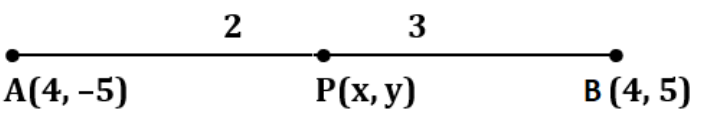
4.	In the given figure, DE ∥ BC. The value of x is :  (a) 6 (b) 12·5 (c) 8 (d) 10	
Sol.	**(d) 10**	**1**
5.	A quadratic equation whose roots are $(2 + \sqrt{3})$ and $(2 - \sqrt{3})$ is : (a) $x^2 - 4x + 1 = 0$ (b) $x^2 + 4x + 1 = 0$ (c) $4x^2 - 3 = 0$ (d) $x^2 - 1 = 0$	
Sol.	**(a) $x^2 - 4x + 1 = 0$**	**1**
6.	If $\tan\theta = \frac{5}{12}$, then the value of $\frac{\sin\theta + \cos\theta}{\sin\theta - \cos\theta}$ is : (a) $-\frac{17}{7}$ (b) $\frac{17}{7}$ (c) $\frac{17}{13}$ (d) $-\frac{7}{13}$	
Sol.	**(a) $-\frac{17}{7}$**	**1**
7.	The distance between the points $P\left(-\frac{11}{3}, 5\right)$ and $Q\left(-\frac{2}{3}, 5\right)$ is : (a) 6 units (b) 4 units (c) 2 units (d) 3 units	

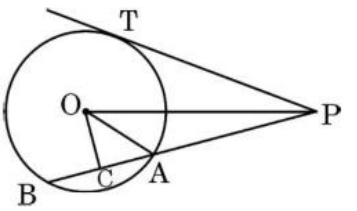
Sol.	**(d) 3 units**	**1**
8.	In the given figure, AB = BC = 10 cm. If AC = 7 cm, then the length of BP is :  (a) 3·5 cm (b) 7 cm (c) 6·5 cm (d) 5 cm	
Sol.	**(c) 6·5 cm**	**1**
9.	Water in a river which is 3 m deep and 40 m wide is flowing at the rate of 2 km/h. How much water will fall into the sea in 2 minutes ? (a) 800 m^3 (b) 4000 m^3 (c) 8000 m^3 (d) 2000 m^3	
Sol.	**(c) 8000 m^3**	**1**
10.	If the mean and the median of a data are 12 and 15 respectively, then its mode is : (a) 13·5 (b) 21 (c) 6 (d) 14	
Sol.	**(b) 21**	**1**

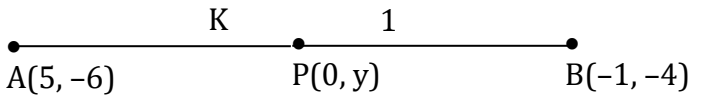
11.	In the given figure, AB is a tangent to the circle centered at O. If OA = 6 cm and $\angle$ OAB = 30°, then the radius of the circle is :  (a) 3 cm (b) $3\sqrt{3}$ cm (c) 2 cm (d) $\sqrt{3}$ cm	
Sol.	**(a) 3 cm**	**1**
12.	$\left(\frac{2\tan 30°}{1+\tan^2 30°}\right)$ is equal to : (a) sin 60° (b) cos 60° (c) tan 60° (d) sin 30°	
Sol.	**(a) sin 60°**	**1**
13.	In Δ ABC and Δ DEF, $\frac{AB}{DE}=\frac{BC}{FD}$. Which of the following makes the two triangles similar ? (a) $\angle A = \angle D$ (b) $\angle B = \angle D$ (c) $\angle B = \angle E$ (d) $\angle A = \angle F$	
Sol.	**(b) $\angle$ B = $\angle$ D**	**1**
14.	The 11^{th} term from the end of the A.P. : 10, 7, 4, ..., – 62 is : (a) 25 (b) 16 (c) – 32 (d) 0	

Sol.	**(c) – 32**	**1**
15.	Two coins are tossed together. The probability of getting at least one tail is : (a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{3}{4}$ (d) 1	
Sol.	**(c) $\frac{3}{4}$**	**1**
16.	In the given figure, AC and AB are tangents to a circle centered at O. If $\angle COD = 120°$, then $\angle BAO$ is equal to :  (a) 30° (b) 60° (c) 45° (d) 90°	
Sol.	**(a) 30°**	**1**
17.	Which of the following numbers ***cannot*** be the probability of happening of an event ? (a) 0 (b) $\frac{7}{0{\cdot}01}$ (c) 0·07 (d) $\frac{0{\cdot}07}{3}$	
Sol.	**(b) $\frac{7}{0.01}$**	**1**

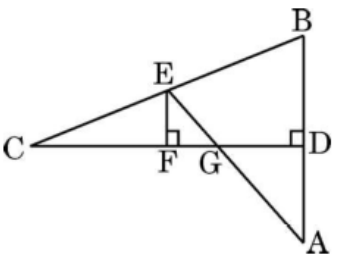
18.	If every term of the statistical data consisting of n terms is decreased by 2, then the mean of the data : (a) decreases by 2 (b) remains unchanged (c) decreases by 2n (d) decreases by 1	
Sol.	**(a) decreases by 2**	**1**
	*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.* (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* If the points A(4, 3) and B(x, 5) lie on a circle with centre O(2, 3), then the value of x is 2. *Reason (R) :* Centre of a circle is the mid-point of each chord of the circle.	
Sol.	**(c) Assertion (A) is true, but Reason (R) is false**	**1**
20.	*Assertion (A) :* The number 5^n cannot end with the digit 0, where n is a natural number. *Reason (R):* Prime factorisation of 5 has only two factors, 1 and 5.	

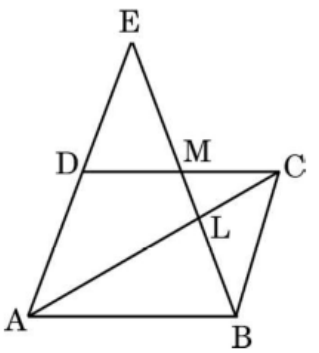
Sol.	**(c) Assertion (A) is true, but Reason (R) is false**	**1**
	SECTION B **This section comprises of very short answer (VSA) type questions of 2 marks each.**	
21(a).	The line segment joining the points A(4, – 5) and B(4, 5) is divided by the point P such that AP : AB = 2 : 5. Find the coordinates of P.	
Sol.	**AP : AB = 2 : 5 ⇒ AP : PB = 2 : 3**  $x = \frac{8+12}{5} = 4$, $y = \frac{10-15}{5} = -1$ **Point P is (4, – 1)**	$\frac{1}{2}$ **1** $\frac{1}{2}$
	OR	
21(b).	Point P(x, y) is equidistant from points A(5, 1) and B(1, 5). Prove that x = y.	
Sol.	$PA^2 = PB^2 \Rightarrow (x-5)^2 + (y-1)^2 = (x-1)^2 + (y-5)^2$ $\Rightarrow x = y$	**1** **1**

22.	In the given figure, PT is a tangent to the circle centered at O. OC is perpendicular to chord AB. Prove that $PA \cdot PB = PC^2 - AC^2$.  	
Sol.	**$PA \cdot PB = (PC - AC).(PC + BC)$** **$= (PC - AC)(PC + AC)$ [AC = BC]** **$= PC^2 - AC^2$**	**1** **$\frac{1}{2}$** **$\frac{1}{2}$**
23.	Using prime factorisation, find HCF and LCM of 96 and 120.	
ol.	**$96 = 2 \times 2 \times 2 \times 2 \times 2 \times 3$** **$= 2^5 \times 3$** **$120 = 2 \times 2 \times 2 \times 3 \times 5$** **$= 2^3 \times 3 \times 5$** **HCF = 24** **LCM = 480**	**$\frac{1}{2}$** **$\frac{1}{2}$** **$\frac{1}{2}$** **$\frac{1}{2}$**
24.	Find the ratio in which y-axis divides the line segment joining the points (5, – 6) and (– 1, – 4).	

Sol.	 **Let the point of division be P(0, y) which divides AB in the ratio K : 1** **$0 = \frac{-K+5}{K+1} \Rightarrow K = 5$** **Ratio is 5:1**	**$\frac{1}{2}$** **1** **$\frac{1}{2}$**
25(a).	If $a\cos\theta + b\sin\theta = m$ and $a\sin\theta - b\cos\theta = n$, then prove that $a^2 + b^2 = m^2 + n^2$.	
Sol.	**$m^2 + n^2 = (a\cos\theta + b\sin\theta)^2 + (a\sin\theta - b\cos\theta)^2$** **$= a^2(\cos^2\theta + \sin^2\theta) + b^2(\sin^2\theta + \cos^2\theta)$** **$= a^2 + b^2$**	**$\frac{1}{2}$** **1** **$\frac{1}{2}$**
	OR	
25(b).	Prove that : $\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2\,\text{cosec}\,A$	
Sol.	**LHS $= \frac{\sqrt{sec\ A - 1}}{\sqrt{sec\ A + 1}} + \frac{\sqrt{sec\ A + 1}}{\sqrt{sec\ A - 1}}$** **$= \frac{sec\ A - 1 + sec\ A + 1}{\sqrt{sec^2 A - 1}}$**	**1**

	$= \frac{2 \sec A}{\tan A}$ $= 2 \text{ cosec } A = RHS$	$\frac{1}{2}$ $\frac{1}{2}$
	SECTION C **This section comprises of short answer (SA) type questions of 3 marks each.**	
26(a).	Prove that $\sqrt{3}$ is an irrational number.	
Sol.	**Let $\sqrt{3}$ be a rational number.** **$\therefore \sqrt{3} = \frac{p}{q}$, let p & q be co-primes and $q \neq 0$** **$3q^2 = p^2 \Longrightarrow p^2$ is divisible by 3 $\Longrightarrow$ p is divisible by 3** **$\Longrightarrow$ p = 3a, where 'a' is some integer ----- (i)** **$9a^2 = 3q^2 \Longrightarrow q^2 = 3a^2 \Longrightarrow q^2$ is divisible by 3 $\Longrightarrow$ q is divisible by 3** **$\Longrightarrow$ q = 3b, where 'b' is some integer ----- (ii)** **(i) and (ii) leads to contradiction as 'p' and 'q' are co-primes.** **$\therefore \sqrt{3}$ is an irrational number.**	½ **1** ½ **1**
	OR	
26(b)	The traffic lights at three different road crossings change after every 48 seconds, 72 seconds and 108 seconds respectively. If they change simultaneously at 7 a.m., at what time will they change together next ?	

Sol.	LCM = 432 i.e. $\frac{432}{60}$ = 7 min 12 sec. $\Rightarrow$ traffic lights will change simultaneously again at 7 : 7 : 12 a.m.	**2** **1**
27.	If p^{th} term of an A.P. is q and q^{th} term is p, then prove that its n^{th} term is (p + q – n).	
Sol.	**a_p = a + (p – 1)d = q _____ (i)** **a_q = a + (q – 1)d = p _____ (ii)** **Solving (i) and (ii)** **d = – 1, a = q + p – 1** **a_n = (q + p – 1) + (n – 1)(– 1) = q + p - n**	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$ **1**
28(a).	In the given figure, CD is the perpendicular bisector of AB. EF is perpendicular to CD. AE intersects CD at G. Prove that $\frac{CF}{CD}=\frac{FG}{DG}$.  	

Sol.	**Δ EFG ~ Δ ADG** $\Rightarrow \frac{EF}{AD} = \frac{FG}{DG}$ _____ **(i)** **Δ EFC ~ Δ BDC** $\Rightarrow \frac{EF}{BD} = \frac{CF}{CD}$ $\Rightarrow \frac{EF}{AD} = \frac{CF}{CD}$ **{BD = AD}** _____ **(ii)** **Using (i) and (ii)** $\frac{FG}{DG} = \frac{CF}{CD}$	**1** **1** $\frac{1}{2}$ $\frac{1}{2}$
	OR	
28(b).	In the given figure, ABCD is a parallelogram. BE bisects CD at M and intersects AC at L. Prove that EL = 2BL.  	

Sol.	**Δ ALE ~ Δ CLB** **$\Rightarrow \frac{AL}{CL} = \frac{EL}{BL}$ _____ (i)** **Also Δ CLM ~ Δ ALB** **$\Rightarrow \frac{AL}{CL} = \frac{AB}{CM}$** **$\Rightarrow \frac{AL}{CL} = \frac{CD}{CM}$ {AB = CD} _____ (ii)** **Using (i) and (ii)** **$\frac{EL}{BL} = \frac{2CM}{CM}$** **$\Rightarrow$ EL = 2BL**	**1** **1** **$\frac{1}{2}$** **$\frac{1}{2}$**
29.	Two people are 16 km apart on a straight road. They start walking at the same time. If they walk towards each other with different speeds, they will meet in 2 hours. Had they walked in the same direction with same speeds as before, they would have met in 8 hours. Find their walking speeds.	
Sol.	**Let walking speeds be x km/hr. and y km/hr. (x > y)** **ATQ, 2x + 2y = 16** **and 8x – 8y = 16** **Solving to get x = 5, y = 3** **Speeds are 5 km/hr. 3 km/hr.**	**1** **1** **$\frac{1}{2} + \frac{1}{2}$**

30. Prove that :

$$\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta \operatorname{cosec}\theta$$

Sol.

$$\text{LHS} = \frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\cos\theta}{\sin\theta}} + \frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\sin\theta}{\cos\theta}}$$

$$= \frac{\sin^2\theta}{\cos\theta(\sin\theta-\cos\theta)} + \frac{\cos^2\theta}{\sin\theta(\cos\theta-\sin\theta)}$$

$$= \frac{\sin^3\theta - \cos^3\theta}{\sin\theta\cos\theta(\sin\theta-\cos\theta)}$$

$$= \frac{\sin^2\theta + \cos^2\theta + \sin\theta\cos\theta}{\sin\theta\cos\theta}$$

$$= \frac{1}{\sin\theta\cos\theta} + 1$$

$$= 1 + \operatorname{cosec}\theta \sec\theta = \text{RHS}$$

1

1

$\frac{1}{2}$

$\frac{1}{2}$

31. Find the mean of the following frequency distribution :

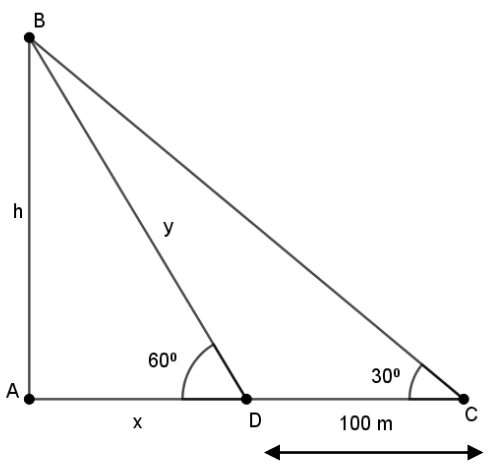
Classes	25 – 30	30 – 35	35 – 40	40 – 45	45 – 50	50 – 55	55 – 60
Frequency	14	22	16	6	5	3	4

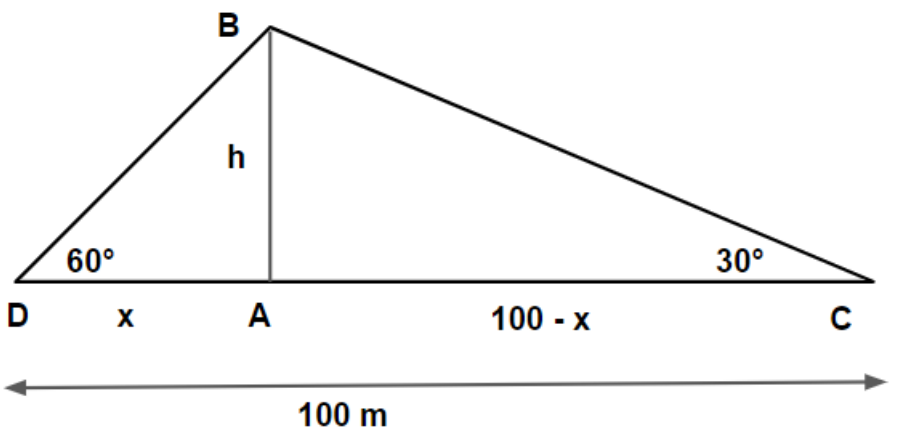
Sol.

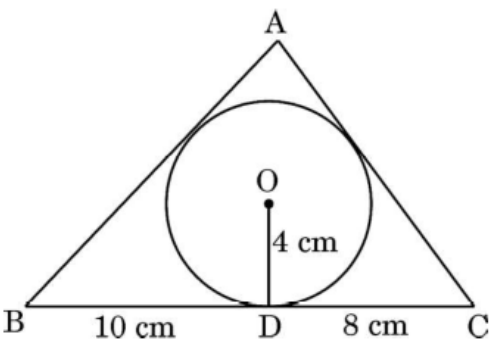
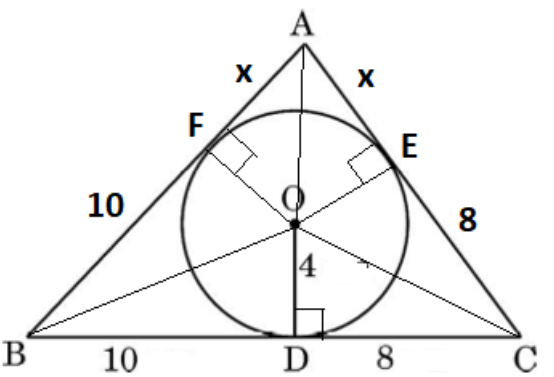
C.I.	x	f	$u = \frac{x-42{\cdot}5}{5}$	fu
25 – 30	27·5	14	– 3	– 42
30 – 35	32·5	22	– 2	– 44
35 – 40	37·5	16	– 1	– 16
40 – 45	42·5	6	0	0
45 – 50	47·5	5	1	5
50 – 55	52·5	3	2	6
55 – 60	57·5	4	3	12
		70		– 79

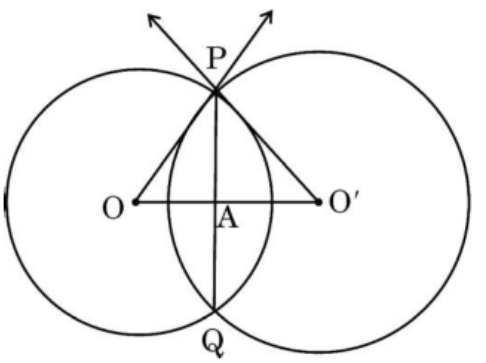
For correct table

2 Marks

	Mean = 42·5 – $\frac{79}{70}$ x 5 = 36·86	**1**
	SECTION D **This section comprises of long answer (LA) type questions of 5 marks each.**	
32.	One observer estimates the angle of elevation to the basket of a hot air balloon to be 60°, while another observer 100 m away estimates the angle of elevation to be 30°. Find : (a) The height of the basket from the ground. (b) The distance of the basket from the first observer's eye. (c) The horizontal distance of the second observer from the basket.	
Sol.	 **Let B is the basket of hot air balloon** **tan 60° = $\sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}$ _____ (i)** **tan 30° = $\frac{1}{\sqrt{3}} = \frac{h}{x+100} \Rightarrow x = h\sqrt{3} - 100$ _____ (ii)**	**Correct Figure** **1 Mark** **1** **1**

	using (i) and (ii)	
	(a) h= (h$\sqrt{3}$ –100)$\sqrt{3}$ = 3h – 100$\sqrt{3}$ ⇒ h = 50$\sqrt{3}$ m	**$\frac{1}{2}$**
	(b) sin 60° = $\frac{\sqrt{3}}{2} = \frac{h}{y} = \frac{50\sqrt{3}}{y}$ ⇒ y = 100 m	**1**
	(c) x = $\frac{h}{\sqrt{3}}$ = 50 m ⇒ x+100=150 m	**$\frac{1}{2}$**
	# ANOTHER SOLUTION AS PER BELOW FIGURE IS ALSO POSSIBLE	
		**Correct Figure** **1 Mark**
	Let B is the basket of hot air balloon. D and C be the positions of the first and second observer's respectively.	
	tan 60° = $\sqrt{3} = \frac{h}{x}$ ⇒ h = x$\sqrt{3}$ _____ (i)	**1**
	tan 30° = $\frac{1}{\sqrt{3}} = \frac{h}{100-x}$ ⇒ $\sqrt{3}h = 100 - x$ _____ (ii)	**1**
	(a) using (i) and (ii)	

	$h = \sqrt{3}\,(100 - \sqrt{3}h) \Rightarrow h = 25\sqrt{3}$ m (b) $\sin 60° = \frac{\sqrt{3}}{2} = \frac{h}{BD} \Rightarrow$ BD = 50 m (c) $x = \frac{h}{\sqrt{3}} = 25$ m $\Rightarrow$ AC = 100 – x = 75 m	$\frac{1}{2}$ 1 $\frac{1}{2}$
33(a).	A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC are of lengths 10 cm and 8 cm respectively. Find the lengths of the sides AB and AC, if it is given that area Δ ABC = 90 cm^2.  	
Sol.	 	

	Join OA, OB, OC and draw OE ⊥ AC and OF ⊥ AB. **BF = 10 cm, CE = 8 cm, Let AF = AE = x** **ar Δ ABC = ar Δ BOC + ar Δ COA + ar Δ AOB** **$90 = \frac{1}{2}$. 4 (BC + CA + AB)** **90 = 2(18 + 8 + x + 10 + x)** **90 = 4(18 + x)** **x = 4·5** **AB = 14·5 cm and AC = 12·5 cm**	**$1\frac{1}{2}$** **$1\frac{1}{2}$** **1** **1**
	OR	
33(b).	Two circles with centres O and O′ of radii 6 cm and 8 cm, respectively intersect at two points P and Q such that OP and O′P are tangents to the two circles. Find the length of the common chord PQ.  	

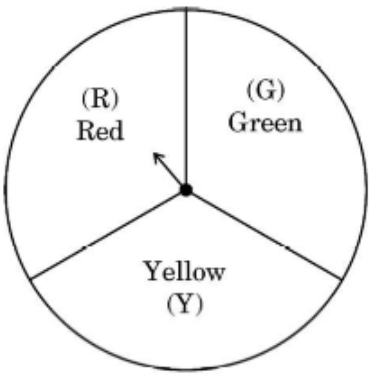
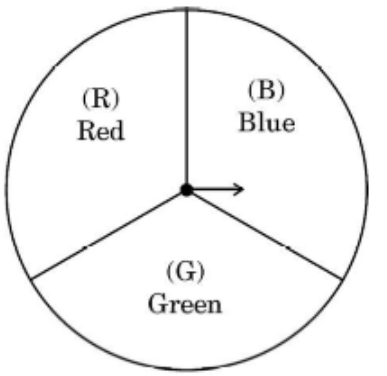
Sol.	**$OO' = \sqrt{6^2 + 8^2} = 10$ cm** **{OP ⊥ O′P}** **Let OA = x, O′A = 10 – x** **$AP^2 = 36 - x^2$** **Also $AP^2 = 64 - (10 - x)^2$** **Therefore $36 - x^2 = 64 - (10 - x)^2$** **$\Rightarrow 36 - x^2 = 64 - 100 - x^2 + 20x$** **$\Rightarrow$ x = 3·6** **In Δ PAO, $AP^2 = 36 - (3{\cdot}6)^2 = 23{\cdot}04$** **$\Rightarrow$ AP = 4·8** **Length PQ = 2 x AP = 9·6 cm**	**$\frac{1}{2}$** **$\frac{1}{2}$** **$\frac{1}{2}$** **2** **1** **$\frac{1}{2}$**
34(a).	A train travels at a certain average speed for a distance of 54 km and then travels a distance of 63 km at an average speed of 6 km/h more than the first speed. If it takes 3 hours to complete the journey, what was its first average speed ?	
Sol.	**Let first average speed of the train be x km/hr.** **$\frac{54}{x} + \frac{63}{x+6} = 3$** **$\Rightarrow 54x + 324 + 63x = 3x^2 + 18x$**	**2**

	$\Rightarrow 3x^2 - 99x - 324 = 0$ or $x^2 - 33x - 108 = 0$ $\Rightarrow (x - 36)(x + 3) = 0$ $\Rightarrow x = 36, -3$ (rejected) **Therefore, first average speed of the train was 36 km/hr.**	**2** **1**
	OR	
34(b).	Two pipes together can fill a tank in $\frac{15}{8}$ hours. The pipe with larger diameter takes 2 hours less than the pipe with smaller diameter to fill the tank separately. Find the time in which each pipe can fill the tank separately.	
Sol.	**Let the time taken by smaller diameter tap be x hrs.** **Time taken by larger diameter tap is (x – 2) hrs.** **Therefore** $\frac{1}{x-2} + \frac{1}{x} = \frac{8}{15}$ $\Rightarrow 15(2x - 2) = 8x(x - 2)$ $\Rightarrow 8x^2 - 46x + 30 = 0$ $\Rightarrow 4x^2 - 23x + 15 = 0$ $\Rightarrow (4x - 3)(x - 5) = 0$ $\Rightarrow x = \frac{3}{4}, x = 5$	**2** **1** **1**

	$x \neq \frac{3}{4}$ as $x - 2 < 0$ **Smaller diameter tap fills in 5 hrs.** **Larger diameter tap fills in 3 hrs.**	**1**
35.	A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope. Find the area of that part of the field in which the horse can graze. Also, find the increase in grazing area if length of rope is increased to 10 m. (Use $\pi = 3{\cdot}14$)	
Sol.	**Area of that part of the field in which the horse can graze by means of a 5 m long rope** $= \frac{1}{4} \times 3.14 \times (5)^2$ $= 19.625\ m^2$ **Area of that part of the field in which the horse can graze by means of a 10 m long rope** $= \frac{1}{4} \times 3.14 \times (10)^2$ $= 78.5\ m^2$ **Increase in grazing area** $= 78.5\ m^2 - 19.625\ m^2 = 58.875\ m^2$	**1** **1** **1** **1** **1**
	SECTION E **This section comprises of 3 case-study based questions of 4 marks each.**	

36.	A golf ball is spherical with about 300 – 500 dimples that help increase its velocity while in play. Golf balls are traditionally white but available in colours also. In the given figure, a golf ball has diameter 4·2 cm and the surface has 315 dimples (hemi-spherical) of radius 2 mm. Based on the above, answer the following questions : (i) Find the surface area of one such dimple. (ii) Find the volume of the material dug out to make one dimple. (iii) (a) Find the total surface area exposed to the surroundings. **OR** (iii) (b) Find the volume of the golf ball.	
Sol.	**(i) SA = $2\pi r^2 = 2 \times \frac{22}{7} \times 4 = \frac{176}{7}$ mm^2 or 25·1 mm^2** **(ii) Volume of material dug out to make one dimple = $\frac{2}{3} \times \frac{22}{7} \times 8$** **= $\frac{352}{21}$ mm^3 or 16·76 mm^3**	**1** **1**

	(iii)(a) radius of ball = 21 mm **Total surface area exposed to surroundings** **$= 4\pi(21)^2 - 315 \times \pi(2)^2 + 315 \times 2\pi(2)^2$** **$= 4 \times \frac{22}{7} \times 21 \times 21 + \frac{22}{7} \times 315 \times 4$** **$= 9504\ mm^2$** **OR** **(iii) (b) Volume of the golf ball $= \frac{4}{3}\pi(21)^3 - 315 \times \frac{2}{3}\pi(2)^3$** **$= 33528\ mm^3$**	**1** **1** **1** **1**

37.	A middle school decided to run the following spinner game as a fund-raiser on Christmas Carnival.  I  II *Making Purple :* Spin each spinner once. Blue and red make purple. So, if one spinner shows Red (R) and another Blue (B), then you 'win'. One such outcome is written as 'RB'. Based on the above, answer the following questions : (i) List all possible outcomes of the game. (ii) Find the probability of 'Making Purple'. (iii) (a) For each win, a participant gets ₹ 10, but if he/she loses, he/she has to pay ₹ 5 to the school. If 99 participants played, calculate how much fund could the school have collected. **OR** (iii) (b) If the same amount of ₹ 5 has been decided for winning or losing the game, then how much fund had been collected by school ? (Number of participants = 99)	
Sol.	**(i) All possible outcomes: RR, RG, RB, GR, GB, GG, YR, YB, YG** **(ii) Number of favourable outcome (RB) = 1**	**1**

	P (Making purple) = $\frac{1}{9}$	**1**
	(iii)(a) As P(winning) = $\frac{1}{9}$	
	Therefore, number of people must win = $\frac{1}{9}$ x 99 = 11	**$\frac{1}{2}$**
	∴ Game lost by 88 persons.	**$\frac{1}{2}$**
	Funds collected = 5 x 88 – 10 x 11 = ₹ 330	**1**
	OR	
	(iii)(b) Number of participants = 99	
	P(winning the game) = $\frac{1}{9}$	
	Number of persons won = 11	**$\frac{1}{2}$**
	Number of persons lost = 88	**$\frac{1}{2}$**
	Funds collected = 88 x 5 – 11 x 5 = ₹ 385	**1**

38.

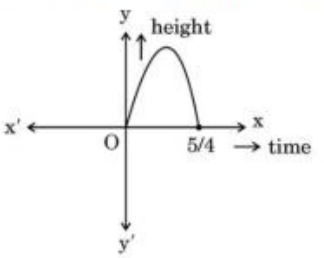
In a pool at an aquarium, a dolphin jumps out of the water travelling at 20 cm per second. Its height above water level after t seconds is given by $h = 20t - 16t^2$.

Based on the above, answer the following questions :

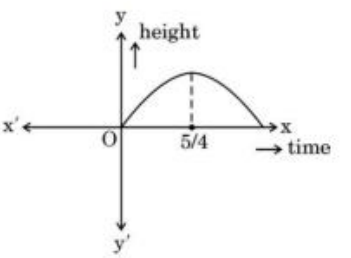
(i) Find zeroes of polynomial $p(t) = 20t - 16t^2$.

(ii) Which of the following types of graph represents p(t) ?

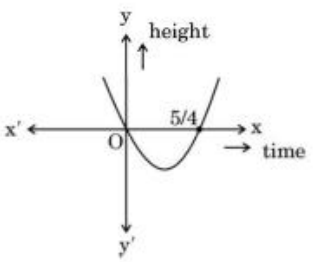
(a)



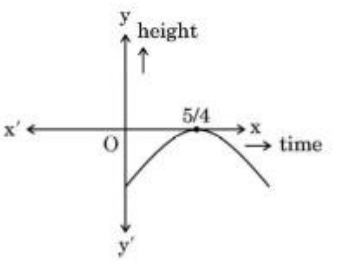
(b)



(c)



(d)



(iii) (a) What would be the value of h at $t = \frac{3}{2}$? Interpret the result.

OR

(iii) (b) How much distance has the dolphin covered before hitting the water level again ?

Sol.	**(i)** $-16t^2 + 20t = 0 \Rightarrow 4t(-4t + 5) = 0$ **t = 0,** $t = \frac{5}{4}$	**1**
	(ii) (a)	**1**
	(iii)(a) At $t = \frac{3}{2}$, $h = -16 \times \frac{9}{4} + 20 \times \frac{3}{2} = -36 + 30 = -6$	**1**
	It means after $\frac{3}{2}$ **seconds, dolphin has reached 6 cm below water level.**	**1**
	OR **(iii)(b) Speed of dolphin = 20 cm per second.** **In one second, distance covered = 20 cm** **In** $\frac{5}{4}$ **seconds, distance covered =** $20 \times \frac{5}{4} = 25$ **cm**	**2**

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are compulsory.*

(ii) *This Question Paper is divided into **FIVE** Sections – **Section A, B, C, D** and **E**.*

(iii) *In Section–**A** question number **1** to **18** are Multiple Choice Questions (MCQs) and question number **19** & **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section–**B** question number **21** to **25** are Very Short-Answer-I (SA-I) type questions of **2** marks each.*

(v) *In Section–**C** question number **26** to **31** are Short Answer-II (SA-II) type questions carrying **3** marks each.*

(vi) *In Section–**D** question number **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.*

(vii) *In Section–**E** question number **36** to **38** are Case Study / Passage based integrated units of assessment questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section–**B**, 2 questions in Section–**C**, 2 questions in Section–**D** and 3 question in Section–**E**.*

(ix) *Draw neat figures wherever required. Take $\pi = \frac{22}{7}$ wherever required if not stated.*

(x) *Use of calculator is NOT allowed.*

SECTION – A
(Multiple Choice Questions)

Section – A consists of 20 questions of 1 mark each.

1. If $p^2 = \frac{32}{50}$, then p is a/an

(A) whole number (B) integer

(C) rational number (D) irrational number

2. The distance of the point (– 6, 8) from x-axis is

(A) 6 units (B) – 6 units

(C) 8 units (D) 10 units

3. The number of quadratic polynomials having zeroes –5 and –3 is

(A) 1 (B) 2

(C) 3 (D) more than 3

4. The point of intersection of the line represented by $3x - y = 3$ and y-axis is given by

(A) (0, –3) (B) (0, 3)

(C) (2, 0) (D) (–2, 0)

5. The circumferences of two circles are in the ratio 4 : 5. What is the ratio of their radii ?

(A) 16 : 25 (B) 25 : 16

(C) $2 : \sqrt{5}$ (D) 4 : 5

6. If α and β are the zeroes of the polynomial $x^2 - 1$, then the value of $(\alpha + \beta)$ is

(A) 2 (B) 1

(C) –1 (D) 0

7. $\frac{\cos^2\theta}{\sin^2\theta} - \frac{1}{\sin^2\theta}$, in simplified form, is :

(A) $\tan^2\theta$ (B) $\sec^2\theta$

(C) 1 (D) –1

8. If $\Delta PQR \sim \Delta ABC$; PQ = 6 cm, AB = 8 cm and the perimeter of ΔABC is 36 cm, then the perimeter of ΔPQR is

(A) 20.25 cm (B) 27 cm

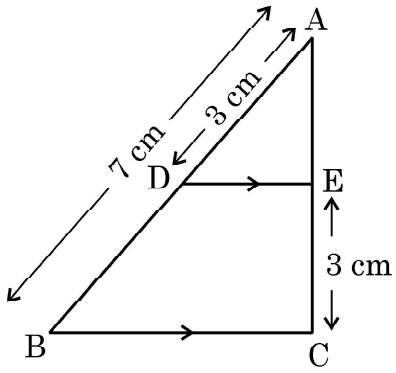
(C) 48 cm (D) 64 cm

9. If the quadratic equation $ax^2 + bx + c = 0$ has two real and equal roots, then 'c' is equal to

(A) $\frac{-b}{2a}$ (B) $\frac{b}{2a}$

(C) $\frac{-b^2}{4a}$ (D) $\frac{b^2}{4a}$

10. In the given figure, DE||BC. If AD = 3 cm, AB = 7 cm and EC = 3 cm, then the length of AE is



(A) 2 cm (B) 2.25 cm

(C) 3.5 cm (D) 4 cm

11. A bag contains 5 pink, 8 blue and 7 yellow balls. One ball is drawn at random from the bag. What is the probability of getting neither a blue nor a pink ball ?

(A) $\frac{1}{4}$ (B) $\frac{2}{5}$

(C) $\frac{7}{20}$ (D) $\frac{13}{20}$

12. The volume of a right circular cone whose area of the base is 156 cm^2 and the vertical height is 8 cm, is

(A) 2496 cm^3 (B) 1248 cm^3

(C) 1664 cm^3 (D) 416 cm^3

13. 3 chairs and 1 table cost ₹ 900; whereas 5 chairs and 3 tables cost ₹ 2,100. If the cost of 1 chair is ₹ x and the cost of 1 table is ₹ y, then the situation can be represented algebraically as

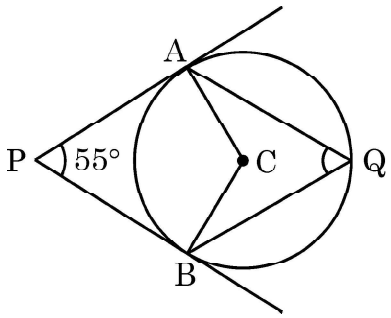
(A) $3x + y = 900,\ 3x + 5y = 2100$

(B) $x + 3y = 900,\ 3x + 5y = 2100$

(C) $3x + y = 900,\ 5x + 3y = 2100$

(D) $x + 3y = 900,\ 5x + 3y = 2100$

14. In the given figure, PA and PB are tangents from external point P to a circle with centre C and Q is any point on the circle. Then the measure of $\angle AQB$ is



(A) 62½°

(B) 125°

(C) 55°

(D) 90°

15. A card is drawn at random from a well shuffled deck of 52 playing cards. The probability of getting a face card is

(A) $\frac{1}{2}$

(B) $\frac{3}{13}$

(C) $\frac{4}{13}$

(D) $\frac{1}{13}$

16. If θ is an acute angle of a right angled triangle, then which of the following equation is **not** true ?

(A) $\sin\theta \cot\theta = \cos\theta$

(B) $\cos\theta \tan\theta = \sin\theta$

(C) $\text{cosec}^2\theta - \cot^2\theta = 1$

(D) $\tan^2\theta - \sec^2\theta = 1$

17. If the zeroes of the quadratic polynomial $x^2 + (a + 1)x + b$ are 2 and –3, then

(A) $a = -7, b = -1$

(B) $a = 5, b = -1$

(C) $a = 2, b = -6$

(D) $a = 0, b = -6$

18. If the sum of the first n terms of an A.P be $3n^2 + n$ and its common difference is 6, then its first term is

(A) 2 (B) 3

(C) 1 (D) 4

Assertion – Reason Based Questions : In question numbers **19** and **20**, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option out of the following :

(A) Both Assertion (A) and Reason (R) are true; and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true; but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true but Reason (R) is false.

(D) Assertion (A) is false but Reason (R) is true.

19. **Statement A (Assertion) :** If $5 + \sqrt{7}$ is a root of a quadratic equation with rational co-efficients, then its other root is $5 - \sqrt{7}$.

Statement R (Reason) : Surd roots of a quadratic equation with rational co-efficients occur in conjugate pairs.

20. **Statement A (Assertion) :** For $0 < \theta \leq 90°$, cosec θ – cot θ and cosec θ + cot θ are reciprocal of each other.

Statement R (Reason) : $\text{cosec}^2\theta - \cot^2\theta = 1$

SECTION – B

Section – **B** consists of Very Short Answer (VSA) type of questions of **2** marks each.

21. (A) Show that 6^n can not end with digit 0 for any natural number 'n'.

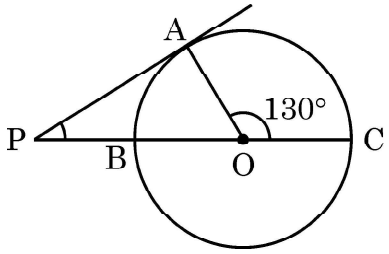
OR

(B) Find the HCF and LCM of 72 and 120.

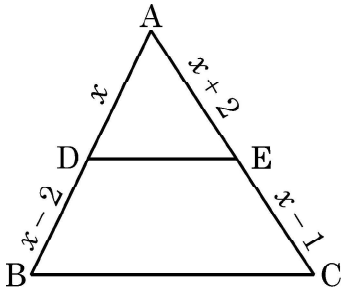
22. A line intersects y-axis and *x*-axis at point P and Q, respectively. If R(2, 5) is the mid-point of line segment PQ, then find the coordinates of P and Q.

23. Find the length of the shadow on the ground of a pole of height 18 m when angle of elevation θ of the sun is such that $\tan\theta = \frac{6}{7}$.

24. In the given figure, PA is a tangent to the circle drawn from the external point P and PBC is the secant to the circle with BC as diameter.
If $\angle AOC = 130°$, then find the measure of $\angle APB$, where O is the centre of the circle.

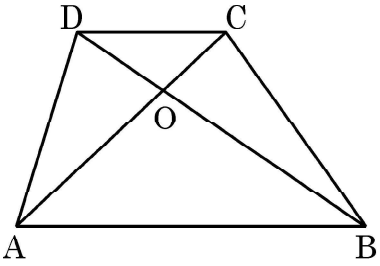


25. (A) In the given figure, ABC is a triangle in which DE||BC. If AD = x, DB = $x - 2$, AE = $x + 2$ and EC = $x - 1$, then find the value of x.



OR

(B) Diagonals AC and BD of trapezium ABCD with AB||DC intersect each other at point O. Show that $\frac{OA}{OC} = \frac{OB}{OD}$.



SECTION – C

Section – **C** consists of Short Answer (SA) type of questions of **3** marks each.

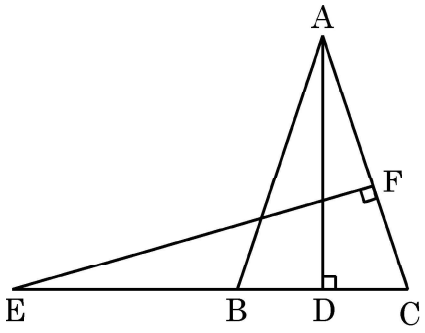
26. Find the ratio in which the line segment joining the points A(6, 3) and B(–2, –5) is divided by x-axis.

27. (A) Find the HCF and LCM of 26, 65 and 117, using prime factorisation.

OR

(B) Prove that $\sqrt{2}$ is an irrational number.

28. In the given figure, E is a point on the side CB produced of an isosceles triangle ABC with AB = AC. If AD $\perp$ BC and EF $\perp$ AC, then prove that $\Delta ABD \sim \Delta ECF$.



29. (A) The sum of two numbers is 15. If the sum of their reciprocals is $\frac{3}{10}$, find the two numbers.

OR

(B) If α and β are roots of the quadratic equation $x^2 - 7x + 10 = 0$, find the quadratic equation whose roots are α^2 and β^2.

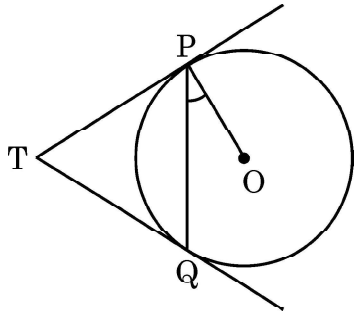
30. Prove that $\frac{1 + \sec A}{\sec A} = \frac{\sin^2 A}{1 - \cos A}$.

31. In a circle of radius 21 cm, an arc subtends an angle of 60° at the centre. Find the area of the sector formed by the arc. Also, find the length of the arc.

SECTION – D

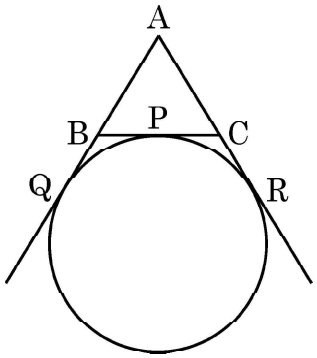
Section – D consists of Long Answer (LA) type questions of **5** marks each.

32. (A) Two tangents TP and TQ are drawn to a circle with centre O from an external point T. Prove that $\angle PTQ = 2\angle OPQ$.



OR

(B) A circle touches the side BC of a ΔABC at a point P and touches AB and AC when produced at Q and R respectively. Show that $AQ = \frac{1}{2}$ (Perimeter of ΔABC).



33. A solid is in the shape of a right-circular cone surmounted on a hemisphere, the radius of each of them being 7 cm and the height of the cone is equal to its diameter. Find the volume of the solid.

34. (A) The ratio of the 11^{th} term to the 18^{th} term of an A.P. is 2 : 3. Find the ratio of the 5^{th} term to the 21^{st} term. Also, find the ratio of the sum of first 5 terms to the sum of first 21 terms.

OR

(B) If the sum of first 6 terms of an A.P. is 36 and that of the first 16 terms is 256, find the sum of first 10 terms.

35. 250 apples of a box were weighed and the distribution of masses of the apples is given in the following table :

Mass (in grams)	80 – 100	100 – 120	120 – 140	140 – 160	160 – 180
Number of apples	20	60	70	x	60

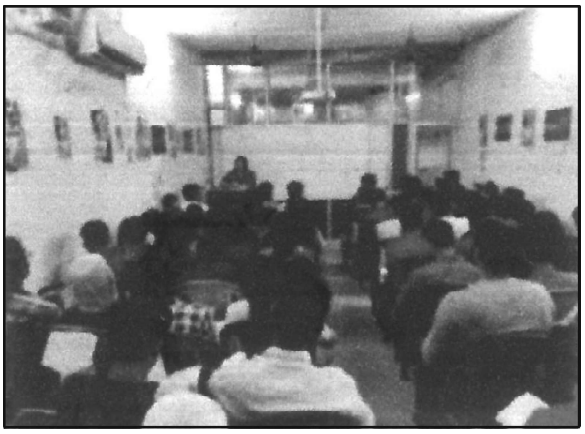
(i) Find the value of x and the mean mass of the apples. **3**

(ii) Find the modal mass of the apples. **2**

SECTION – E

3 Case Study Based Questions. Each question is of **4** marks.

36. A coaching institute of Mathematics conducts classes in two batches I and II and fees for rich and poor children are different. In batch I, there are 20 poor and 5 rich children, whereas in batch II, there are 5 poor and 25 rich children. The total monthly collection of fees from batch I is ₹ 9000 and from batch II is ₹ 26,000. Assume that each poor child pays ₹ x per month and each rich child pays ₹ y per month.



Based on the above information, answer the following questions :

(i) Represent the information given above in terms of x and y. **1**

(ii) Find the monthly fee paid by a poor child. **2**

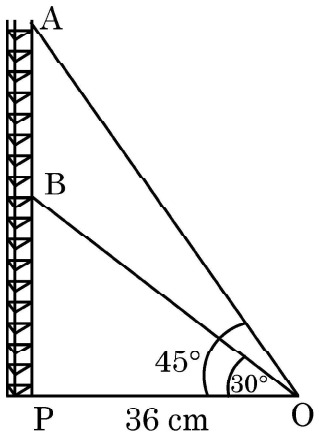
OR

Find the difference in the monthly fee paid by a poor child and a rich child.

(iii) If there are 10 poor and 20 rich children in batch II, what is the total monthly collection of fees from batch II ? **1**

37. Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two Sections A and B. Tower is supported by wires from a point O.

Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is 30° and the angle of elevation of the top of Section A is 45°.



Based on the above information, answer the following questions :

(i) Find the length of the wire from the point O to the top of Section B. **1**

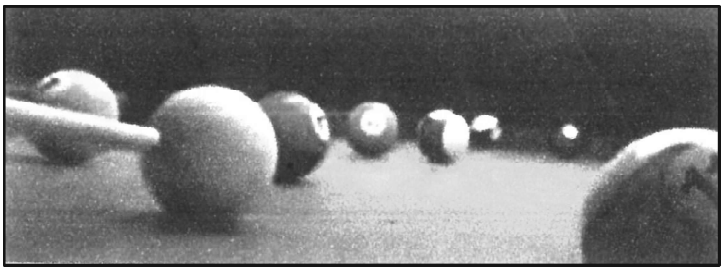
(ii) Find the distance AB. **2**

OR

Find the area of ΔOPB.

(iii) Find the height of the Section A from the base of the tower. **1**

38. "Eight Ball" is a game played on a pool table with 15 balls numbered 1 to 15 and a "cue ball" that is solid and white. Of the 15 numbered balls, eight are solid (non-white) coloured and numbered 1 to 8 and seven are striped balls numbered 9 to 15.



The 15 numbered pool balls (no cue ball) are placed in a large bowl and mixed, then one ball is drawn out at random.

Based on the above information, answer the following questions :

(i) What is the probability that the drawn ball bears number 8 ?

(ii) What is the probability that the drawn ball bears an even number ?

OR

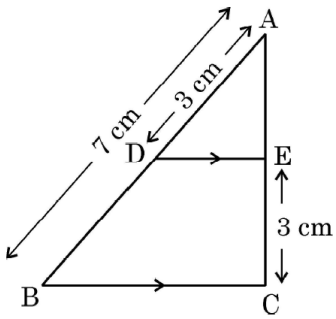
What is the probability that the drawn ball bears a number, which is a multiple of 3 ?

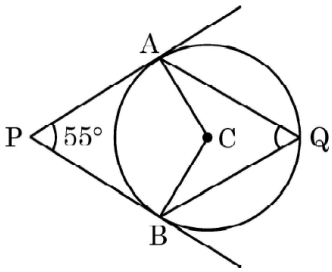
(iii) What is the probability that the drawn ball is a solid coloured and bears an even number ?

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/6/1)

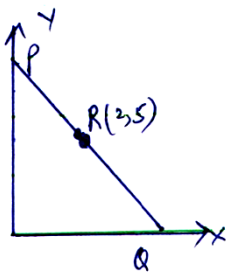
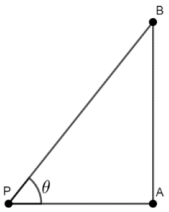
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each	
1.	If $p^2 = \frac{32}{50}$, then p is a/an (A) whole number (B) integer (C) rational number (D) irrational number	
Sol.	(C) rational	1
2.	The distance of the point $(-6, 8)$ from x-axis is (A) 6 units (B) -6 units (C) 8 units (D) 10 units	
Sol.	(C)8 units	1
3.	The number of quadratic polynomials having zeroes -5 and -3 is (A) 1 (B) 2 (C) 3 (D) more than 3	
Sol.	(D)more than 3	1
4.	The point of intersection of the line represented by $3x - y = 3$ and y-axis is given by (A) $(0, -3)$ (B) $(0, 3)$ (C) $(2, 0)$ (D) $(-2, 0)$	
Sol.	(A) $(0, -3)$	1

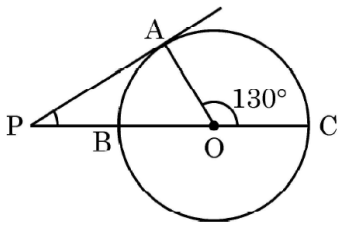
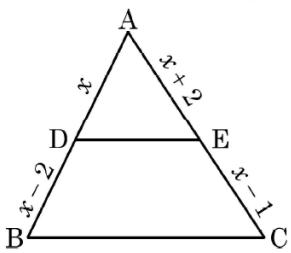
5.	The circumferences of two circles are in the ratio 4 : 5. What is the ratio of their radii ? (A) 16 : 25 (B) 25 : 16 (C) $2:\sqrt{5}$ (D) 4 : 5	
Sol.	(D) 4 : 5	1
6.	If α and β are the zeroes of the polynomial $x^2 - 1$, then the value of $(\alpha + \beta)$ is (A) 2 (B) 1 (C) –1 (D) 0	
Sol.	(D) 0	1
7.	$\frac{\cos^2\theta}{\sin^2\theta} - \frac{1}{\sin^2\theta}$, in simplified form, is : (A) $\tan^2\theta$ (B) $\sec^2\theta$ (C) 1 (D) –1	
Sol.	(D) – 1	1
8.	If $\Delta PQR \sim \Delta ABC$; PQ = 6 cm, AB = 8 cm and the perimeter of ΔABC is 36 cm, then the perimeter of ΔPQR is (A) 20.25 cm (B) 27 cm (C) 48 cm (D) 64 cm	
Sol.	(B) 27 cm	1
9.	If the quadratic equation $ax^2 + bx + c = 0$ has two real and equal roots, then 'c' is equal to (A) $\frac{-b}{2a}$ (B) $\frac{b}{2a}$ (C) $\frac{-b^2}{4a}$ (D) $\frac{b^2}{4a}$	
Sol.	(D) $\frac{b^2}{4a}$	1

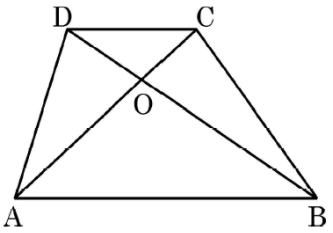
10.	In the given figure, DE‖BC. If AD = 3 cm, AB = 7 cm and EC = 3 cm, then the length of AE is  (A) 2 cm (B) 2.25 cm (C) 3.5 cm (D) 4 cm	
Sol.	(B) 2·25 cm	1
11.	A bag contains 5 pink, 8 blue and 7 yellow balls. One ball is drawn at random from the bag. What is the probability of getting neither a blue nor a pink ball ? (A) $\frac{1}{4}$ (B) $\frac{2}{5}$ (C) $\frac{7}{20}$ (D) $\frac{13}{20}$	
Sol.	(C) $\frac{7}{20}$	1
12.	The volume of a right circular cone whose area of the base is 156 cm^2 and the vertical height is 8 cm, is (A) 2496 cm^3 (B) 1248 cm^3 (C) 1664 cm^3 (D) 416 cm^3	
Sol.	(D) 416 cm^3	1
13.	3 chairs and 1 table cost ₹ 900; whereas 5 chairs and 3 tables cost ₹ 2,100. If the cost of 1 chair is ₹ x and the cost of 1 table is ₹ y, then the situation can be represented algebraically as (A) $3x + y = 900,\ 3x + 5y = 2100$ (B) $x + 3y = 900,\ 3x + 5y = 2100$ (C) $3x + y = 900,\ 5x + 3y = 2100$ (D) $x + 3y = 900,\ 5x + 3y = 2100$	
Sol.	(C) $3x + y = 900, 5x + 3y = 2100$	1

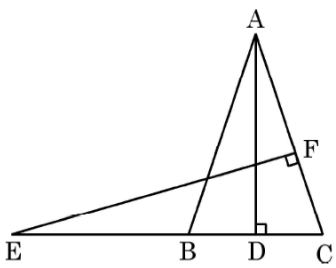
14.	In the given figure, PA and PB are tangents from external point P to a circle with centre C and Q is any point on the circle. Then the measure of ∠AQB is  (A) 62½° (B) 125° (C) 55° (D) 90°	
Sol.	(A) $62\frac{1}{2}^{\circ}$	1
15.	A card is drawn at random from a well shuffled deck of 52 playing cards. The probability of getting a face card is (A) $\frac{1}{2}$ (B) $\frac{3}{13}$ (C) $\frac{4}{13}$ (D) $\frac{1}{13}$	
Sol.	(B) $\frac{3}{13}$	1
16.	If θ is an acute angle of a right angled triangle, then which of the following equation is **not** true ? (A) $\sin\theta \cot\theta = \cos\theta$ (B) $\cos\theta \tan\theta = \sin\theta$ (C) $\text{cosec}^2\theta - \cot^2\theta = 1$ (D) $\tan^2\theta - \sec^2\theta = 1$	
Sol.	(D) $\tan^2\theta - \sec^2\theta = 1$	1
17.	If the zeroes of the quadratic polynomial $x^2 + (a + 1)x + b$ are 2 and –3, then (A) $a = -7, b = -1$ (B) $a = 5, b = -1$ (C) $a = 2, b = -6$ (D) $a = 0, b = -6$	
Sol.	(D) $a = 0, b = -6$	1
18.	If the sum of the first n terms of an A.P be $3n^2 + n$ and its common difference is 6, then its first term is (A) 2 (B) 3 (C) 1 (D) 4	
Sol.	(D) 4	1

	Assertion – Reason Based Questions : In question numbers **19** and **20**, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option out of the following : (A) Both Assertion (A) and Reason (R) are true; and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true; but Reason (R) is not the correct explanation of Assertion (A). (C) Assertion (A) is true but Reason (R) is false. (D) Assertion (A) is false but Reason (R) is true.	
19.	**Statement A (Assertion) :** If $5+\sqrt{7}$ is a root of a quadratic equation with rational co-efficients, then its other root is $5-\sqrt{7}$. **Statement R (Reason) :** Surd roots of a quadratic equation with rational co-efficients occur in conjugate pairs.	
Sol.	(A)	1
20.	**Statement A (Assertion) :** For $0 < \theta \leq 90°$, cosec θ – cot θ and cosec θ + cot θ are reciprocal of each other. **Statement R (Reason) :** $\text{cosec}^2\theta - \cot^2\theta = 1$	
Sol.	(A)	1
	SECTION – B Section – **B** consists of Very Short Answer (VSA) type of questions of **2** marks each.	
21(A).	(A) Show that 6^n can not end with digit 0 for any natural number 'n'.	
Sol.	If 6^n ends with digit 0, it would be divisible by 5. So, prime factorization of 6^n would contain 5. But $6^n = (2 \times 3)^n$, the only prime factorization of 6^n are 2 and 3 as per fundamental theorem of Arithmetic . There is no other prime in the factorization of 6^n. So, there is no natural number n for which 6^n ends with digit zero.	2
	OR	
21(B)	Find the HCF and LCM of 72 and 120.	

Sol.	$72=2^3 \times 3^2$ $120=2^3 \times 3 \times 5$ HCF = 24 LCM=360	 1 1
22.	A line intersects y-axis and x-axis at point P and Q, respectively. If R(2, 5) is the mid-point of line segment PQ, then find the coordinates of P and Q.	
Sol.	 Let the coordinates of P and Q be (0, y) and (x, 0) respectively. $\because$ R(2, 5) is the midpoint of PQ $\frac{0+x}{2} = 2$ and $\frac{y+0}{2} = 5$ $\therefore$ x = 4, y = 10 P(0, 10) and Q(4, 0)	$\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$ $\frac{1}{2}$
23.	Find the length of the shadow on the ground of a pole of height 18 m when angle of elevation θ of the sun is such that $\tan\theta = \frac{6}{7}$.	
Sol.	 Pole of height AB = 18 m AP = length of shadow In Δ APB, $\tan\theta = \frac{18}{AP}$ $\frac{6}{7} = \frac{18}{AP}$ $\Rightarrow$ AP = 21 m	 1 $\frac{1}{2}$ $\frac{1}{2}$

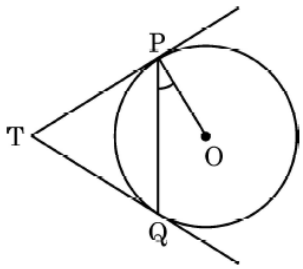
24.	In the given figure, PA is a tangent to the circle drawn from the external point P and PBC is the secant to the circle with BC as diameter. If $\angle AOC = 130°$, then find the measure of $\angle APB$, where O is the centre of the circle.  	
Sol.	$\angle AOB = 180° - 130° = 50°$ $\angle OAP = 90°$ $\therefore \angle APB = 180 - (50° + 90°) = 40°$	$\frac{1}{2}$ $\frac{1}{2}$ 1
25(A).	In the given figure, ABC is a triangle in which DE‖BC. If AD = x, DB = $x-2$, AE = $x+2$ and EC = $x-1$, then find the value of x.  	
Sol.	In ΔABC, $DE \parallel BC$ $\therefore \frac{AD}{DB} = \frac{AE}{EC} \Rightarrow \frac{x}{x-2} = \frac{x+2}{x-1}$ $x(x-1) = (x+2)(x-2)$ $x^2 - x = x^2 - 4 \Rightarrow x = 4$	1 1
	OR	

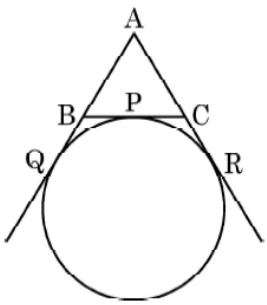
25(B).	Diagonals AC and BD of trapezium ABCD with AB‖DC intersect each other at point O. Show that $\frac{OA}{OC}=\frac{OB}{OD}$.  	
Sol.	In Δ AOB and Δ COD, $\angle$ OAB = $\angle$ OCD $\angle$ OBA = $\angle$ ODC Therefore, Δ AOB ~ Δ COD $\therefore \frac{OA}{OC}=\frac{OB}{OD}$	$1\frac{1}{2}$ $\frac{1}{2}$
	SECTION – C Section – **C** consists of Short Answer (SA) type of questions of **3** marks each.	
26.	Find the ratio in which the line segment joining the points A(6, 3) and B(–2, –5) is divided by x-axis.	
Sol.	Let P(x, 0) be the point on x axis which divides AB in the ratio k : 1 A(6, 3) — k : 1 — P — B(– 2, – 5) $\frac{-5k+3}{k+1}=0 \Rightarrow k=\frac{3}{5}$ Ratio is 3 : 5	$\frac{1}{2}$ 2 $\frac{1}{2}$
27(A).	Find the HCF and LCM of 26, 65 and 117, using prime factorisation.	
Sol.	26= 13 x 2 65= 13 x 5 117= 13 x 3 x 3	1

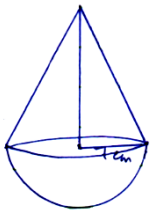
	∴ HCF = 13 LCM = 13 x 2 x 3 x 5 x 3 = 1170	1 1
	OR	
27(B)	Prove that $\sqrt{2}$ is an irrational number.	
Sol.	Let $\sqrt{2}$ be a rational number. $\therefore \sqrt{2} = \frac{p}{q}$, where q≠0 and let p & q be co-primes. $2q^2 = p^2 \Longrightarrow p^2$ is divisible by 2 $\Longrightarrow$ p is divisible by 2 $\Longrightarrow p = 2a$, where 'a' is some integer ----- (i) $4a^2 = 2q^2 \Longrightarrow q^2 = 2a^2 \Longrightarrow q^2$ is divisible by 2 $\Longrightarrow$ q is divisible by 2 $\Longrightarrow q = 2b$, where 'b' is some integer ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are co-primes. $\therefore \sqrt{2}$ is an irrational number.	½ 1 ½ 1
28.	In the given figure, E is a point on the side CB produced of an isosceles triangle ABC with AB = AC. If AD ⊥ BC and EF ⊥ AC, then prove that ΔABD ~ ΔECF.  	
Sol.	ABC is an isosceles triangle $\therefore AB = AC \Rightarrow \angle B = \angle C$ In Δ ABD and Δ ECF, ∠ ADB = ∠ EFC ∠ ABD = ∠ ECF ∴ Δ ABD ~ Δ ECF	1 1 1

29(A).	The sum of two numbers is 15. If the sum of their reciprocals is $\frac{3}{10}$, find the two numbers.	
Sol.	Let one number be x $\Rightarrow$ another number = 15 – x Therefore, $\frac{1}{x} + \frac{1}{15 - x} = \frac{3}{10}$ $\frac{15 - x + x}{x(15 - x)} = \frac{3}{10} \Rightarrow 150 = 3x(15 - x)$ $3x^2 - 45x + 150 = 0$ $x^2 - 15x + 50 = 0 \Rightarrow (x - 10)(x - 5) = 0$ $\Rightarrow x = 10, 5$ Numbers are 10, 5 or 5, 10	$\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$
	OR	
29(B).	If α and β are roots of the quadratic equation $x^2 - 7x + 10 = 0$, find the quadratic equation whose roots are α^2 and β^2.	
Sol.	$x^2 - 7x + 10 = 0$ $\alpha + \beta = 7, \alpha\beta = 10$ $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = 49 - 20 = 29$ $\alpha^2\beta^2 = (10)^2 = 100$ Quadratic Equation with roots α^2, β^2 is	$\frac{1}{2}$ 1 1

	$\therefore x^2 - (\alpha^2 + \beta^2)x + \alpha^2\beta^2 = 0$ i.e. $x^2 - 29x + 100 = 0$	$\frac{1}{2}$
30.	Prove that $\frac{1 + \sec A}{\sec A} = \frac{\sin^2 A}{1 - \cos A}$.	
Sol.	LHS $= \frac{1 + \sec A}{sec\ A} = \frac{1 + \frac{1}{\cos A}}{\frac{1}{cos\ A}}$ $= 1 + \cos A$ $= \frac{(1 - \cos A)(1 + \cos A)}{(1 - \cos A)}$ $= \frac{1 - cos^2 A}{1 - \cos A}$ $= \frac{sin^2 A}{1 - \cos A}$ = RHS	1 1 1
31.	In a circle of radius 21 cm, an arc subtends an angle of 60° at the centre. Find the area of the sector formed by the arc. Also, find the length of the arc.	
Sol.	$A = \frac{60}{360} \times \frac{22}{7} \times 21 \times 21 = 231\ cm^2$ Length of arc $= \frac{60}{360} \times 2 \times \frac{22}{7} \times 21$ $= 22$ cm	$1\frac{1}{2}$ $1\frac{1}{2}$
	SECTION – D Section – D consists of Long Answer (LA) type questions of **5** marks each.	

32(A).	Two tangents TP and TQ are drawn to a circle with centre O from an external point T. Prove that $\angle PTQ = 2\angle OPQ$.  	
Sol.	TP = TQ $\Rightarrow \angle TPQ = \angle TQP$ Let $\angle PTQ$ be θ $\Rightarrow \angle TPQ = \angle TQP = \frac{180° - \theta}{2} = 90° - \frac{\theta}{2}$ Now $\angle OPT = 90°$ $\Rightarrow \angle OPQ = 90° - (90° - \frac{\theta}{2}) = \frac{\theta}{2}$ $\angle PTQ = 2\angle OPQ$	1 $1\frac{1}{2}$ $1\frac{1}{2}$ 1
	OR	

32(B).	A circle touches the side BC of a ΔABC at a point P and touches AB and AC when produced at Q and R respectively. Show that $AQ = \frac{1}{2}$ (Perimeter of ΔABC).  	
Sol.	$AQ = AR$ $2AQ = AQ + AR$ $= AB + BQ + AC + CR$ $= AB + AC + (BP + CP)$ $= AB + AC + BC$ $AQ = \frac{1}{2}(AB + AC + BC) = \frac{1}{2}$ (Perimeter of $\triangle ABC$)	1 1 $\frac{1}{2}$ $\frac{1}{2}$ 1 1
33.	A solid is in the shape of a right-circular cone surmounted on a hemisphere, the radius of each of them being 7 cm and the height of the cone is equal to its diameter. Find the volume of the solid.	
Sol.	Radius of cone = radius of hemisphere = 7 cm $\therefore$Height of cone = 14 cm Volume of solid = Volume of hemisphere + volume of cone	1

	 $= \frac{2}{3}\pi(7)^3 + \frac{1}{3}\pi(7)^2 14$ $= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7(14 + 14)$ $= \frac{154}{3} \times 28 = \frac{4312}{3} cm^2$ or $1437.33\ cm^2$	$1\frac{1}{2} + 1\frac{1}{2}$ 1
34(A).	The ratio of the 11th term to the 18th term of an A.P. is 2 : 3. Find the ratio of the 5th term to the 21st term. Also, find the ratio of the sum of first 5 terms to the sum of first 21 terms.	
Sol.	$\frac{a + 10d}{a + 17d} = \frac{2}{3}$ $3a + 30d = 2a + 34d \Rightarrow a = 4d$ Therefore, $\frac{a + 4d}{a + 20d} = \frac{4d + 4d}{4d + 20d} = \frac{8d}{24d} = \frac{1}{3}$ $\frac{S_5}{S_{21}} = \frac{\frac{5}{2}[2a + 4d]}{\frac{21}{2}[2a + 20d]} = \frac{5[8d + 4d]}{21[8d + 20d]}$ $= \frac{5 \times 12d}{21 \times 28d} = \frac{5}{49}$ or $S_5 : S_{21} = 5 : 49$	1 1 1 1 1
	OR	
34(B).	If the sum of first 6 terms of an A.P. is 36 and that of the first 16 terms is 256, find the sum of first 10 terms.	
Sol.	$S_6 = 36 \Rightarrow \frac{6}{2}[2a + 5d] = 36$	1

	$\Rightarrow 2a + 5d = 12$ ---------- (1)	1
	$S_{16} = 256 \Rightarrow \frac{16}{2}[2a + 15d] = 256$	
	$\Rightarrow 2a + 15d = 32$ ---------- (2)	1
	Solving (1) and (2)	
	$d = 2$	1
	$a = 1$	
	$S_{10} = \frac{10}{2}[2(1) + 9(2)]$	
	$= 100$	1
35.	250 apples of a box were weighed and the distribution of masses of the apples is given in the following table :	

Mass (in grams)	80 – 100	100 – 120	120 – 140	140 – 160	160 – 180
Number of apples	20	60	70	x	60

(i) Find the value of x and the mean mass of the apples. **3**

(ii) Find the modal mass of the apples. **2**

Sol.

(i) $20 + 60 + 70 + x + 60 = 250$ — 1

$x = 250 - 210 = 40$

Mass	80 – 100	100 – 120	120 – 140	140 – 160	160 – 180	Total
No. of apples f_i	20	60	70	x = 40	60	250
x_i	90	110	130	150	170	
$x_i f_i$	1800	6600	9100	6000	10200	33700

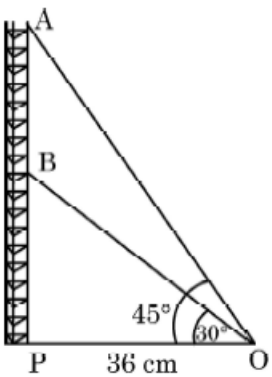
1 for correct table

Mean mass $= \frac{33700}{250} = 134{\cdot}8$ — 1

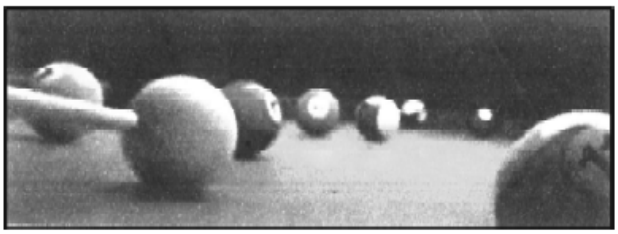
Mean mass = 134.8 g — $\frac{1}{2}$

	(ii) Modal class = 120-140 Mode = $120 + \frac{(70-60)}{(140-60-40)} \times 20$ = 125 Hence modal mass = 125 gm	1 $\frac{1}{2}$
	SECTION – E **3** Case Study Based Questions. Each question is of **4** marks.	
36.	A coaching institute of Mathematics conducts classes in two batches I and II and fees for rich and poor children are different. In batch I, there are 20 poor and 5 rich children, whereas in batch II, there are 5 poor and 25 rich children. The total monthly collection of fees from batch I is ₹ 9000 and from batch II is ₹ 26,000. Assume that each poor child pays ₹ x per month and each rich child pays ₹ y per month. Based on the above information, answer the following questions : (i) Represent the information given above in terms of x and y. (ii) Find the monthly fee paid by a poor child. **OR** Find the difference in the monthly fee paid by a poor child and a rich child. (iii) If there are 10 poor and 20 rich children in batch II, what is the total monthly collection of fees from batch II ?	

Sol.	(i) $20x + 5y = 9000$ $5x + 25y = 26000$	1
	(ii) Solving the equations $x = 200$ Monthly fee paid by poor child = ₹200	2
	OR	
	(ii) getting $x=200$ and $y= 1000$	$1+\frac{1}{2}$
	Difference in the fee = 1000 – 200 = ₹ 800	$\frac{1}{2}$
	(iii)$10x + 20y = 10(200) + 20(1000)$ = ₹ 22000	1

37.	Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two Sections A and B. Tower is supported by wires from a point O. Distance between the base of the tower and point O is 36 cm. From point O, the angle of elevation of the top of the Section B is 30° and the angle of elevation of the top of Section A is 45°.  Based on the above information, answer the following questions : (i) Find the length of the wire from the point O to the top of Section B. (ii) Find the distance AB. **OR** Find the area of ΔOPB. (iii) Find the height of the Section A from the base of the tower.	
Sol.	(i) In Δ OBP, $\cos 30° = \frac{OP}{OB}$ $\frac{\sqrt{3}}{2} = \frac{36}{OB} \Rightarrow OB = \frac{72}{\sqrt{3}}$ $= 24\sqrt{3}$ cm	$\frac{1}{2}$ $\frac{1}{2}$

	(ii)In Δ OBP, $\tan 30° = \frac{PB}{36} \Rightarrow PB = \frac{36}{\sqrt{3}}$ $PB = 12\sqrt{3}$ In Δ OAP, $\tan 45° = \frac{AP}{36} \Rightarrow AP = 36$ cm $AB = AP - PB = 36 - 12\sqrt{3} = 12(3 - \sqrt{3})$ cm **OR** (ii)Area of Δ OPB $= \frac{1}{2} \times OP \times PB$ $= \frac{1}{2} \times 36 \times 12\sqrt{3} = 216\sqrt{3}$ cm^2 (iii) AP = 36 cm	1 $\frac{1}{2}$ $\frac{1}{2}$ 1+1 1

38.	"Eight Ball" is a game played on a pool table with 15 balls numbered 1 to 15 and a "cue ball" that is solid and white. Of the 15 numbered balls, eight are solid (non-white) coloured and numbered 1 to 8 and seven are striped balls numbered 9 to 15.  The 15 numbered pool balls (no cue ball) are placed in a large bowl and mixed, then one ball is drawn out at random. Based on the above information, answer the following questions : (i) What is the probability that the drawn ball bears number 8 ? (ii) What is the probability that the drawn ball bears an even number ? **OR** What is the probability that the drawn ball bears a number, which is a multiple of 3 ? (iii) What is the probability that the drawn ball is a solid coloured and bears an even number ?	
Sol.	(i)P (drawing ball bearing number 8) = $\frac{1}{15}$ (ii)Even numbers = 2, 4, 6, 8, 10, 12, 14 No. of favourable outcomes = 7 P (even number ball) = $\frac{7}{15}$ **OR** (ii)Multiples of 3 are 3, 6, 9, 12, 15	1 $\frac{1}{2}$ $1\frac{1}{2}$ $\frac{1}{2}$

	No. of favourable outcomes = 5 $\therefore$ P(multiple of 3) = $\frac{5}{15} = \frac{1}{3}$ (iii) Solid colour and even number 2, 4, 6, 8 P(solid colour and bear an even no.) = $\frac{4}{15}$	$1\frac{1}{2}$ 1

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A**, **B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take* $\pi = \frac{22}{7}$ *wherever required, if not stated.*

(x) *Use of calculators is **not** allowed.*

SECTION A

This section comprises multiple choice questions (MCQs) of 1 mark each.

1. The values of k for which the equation $4x^2 + kx + 9 = 0$ has real and equal roots are :

(a) ± 11 (b) ± 12

(c) ± 6 (d) ± 3

2. The distance of the point (4, 7) from the x-axis is :

(a) 7 units (b) 5 units

(c) 4 units (d) 10 units

3. In a family of two children, the probability of having at least one girl is :

(a) $\frac{1}{2}$ (b) $\frac{2}{5}$

(c) $\frac{3}{4}$ (d) $\frac{1}{4}$

4. The condition for which the pair of equations $ax + 2y = 7$ and $3x + by = 16$ represent parallel lines is :

(a) $ab = \frac{7}{16}$ (b) $ab = 6$

(c) $ab = 3$ (d) $ab = 2$

5. The zeroes of the polynomial $3x^2 + 11x - 4$ are :

(a) $\frac{1}{2}, -4$ (b) $\frac{1}{4}, -3$

(c) $\frac{1}{3}, -4$ (d) $\frac{1}{3}, 4$

6. $\cot^2 \theta - \frac{1}{\sin^2 \theta}$ is equal to :

(a) 1 (b) 2

(c) -2 (d) -1

7. The coordinates of the point A, where AB is the diameter of the circle whose centre is $(3, -2)$ and B $(7, 4)$ is :

(a) $(-1, -8)$ (b) $(-1, 8)$

(c) $(1, 8)$ (d) $(1, -8)$

8. If x, $2x + 9$, $4x + 3$ are three consecutive terms of an A.P., then the value of x is :

(a) 3 (b) 10

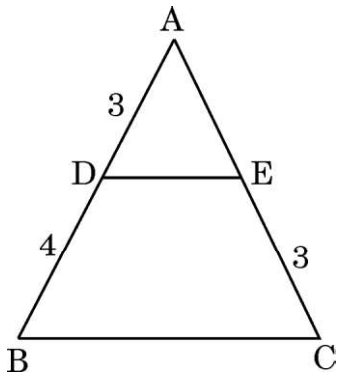
(c) 13 (d) 15

9. The height of a tower is 20 m. The length of its shadow made on the level ground when the Sun's altitude is 60°, is :

(a) $\frac{20}{\sqrt{3}}$ m (b) $\frac{20}{3}$ m

(c) $20\sqrt{3}$ m (d) 20 m

10. In the given figure, DE ∥ BC and all measurements are given in centimetres. The length of AE is :



(a) 2 cm (b) 2·25 cm

(c) 2·5 cm (d) 2·75 cm

11. A vertical pole 10 m long casts a shadow of length 5 m on the ground. At the same time, a tower casts a shadow of length 12·5 m on the ground. The height of the tower is :

(a) 20 m (b) 22 m

(c) 25 m (d) 24 m

12. Using empirical relationship, the mode of a distribution whose mean is 7·2 and the median 7·1, is :

(a) 6·2 (b) 6·3

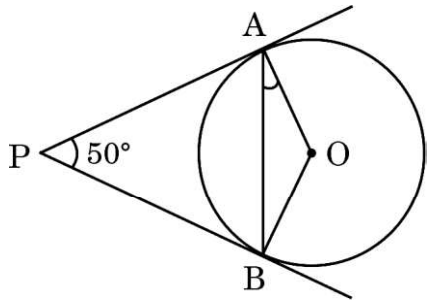
(c) 6·5 (d) 6·9

13. OACB is a quadrant of a circle with centre O and radius 7 cm where ACB is the arc. Then the perimeter of the quadrant is :

(a) 15 cm (b) 50 cm

(c) 25 cm (d) 44 cm

14. In the figure, PA and PB are two tangents to the circle with centre O such that $\angle$ APB = 50°. Then, the measure of $\angle$ OAB is :



(a) 25° (b) 50°

(c) 75° (d) 100°

15. The length of the tangent drawn from a point P, whose distance from the centre of a circle is 25 cm, and the radius of the circle is 7 cm, is :

(a) 22 cm (b) 24 cm

(c) 25 cm (d) 28 cm

16. If a bicycle wheel makes 5000 revolutions in moving 11 km, then the diameter of the wheel is :

(a) 65 cm (b) 35 cm

(c) 70 cm (d) 50 cm

17. Lali tosses two different coins simultaneously. The probability that she gets at most one head is :

(a) 1 (b) $\frac{3}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{7}$

18. A number is chosen from the numbers 1, 2, 3 and denoted as x, and a number is chosen from the numbers 1, 4, 9 and denoted as y. Then P(xy < 9) is :

(a) $\frac{1}{9}$ (b) $\frac{3}{9}$

(c) $\frac{5}{9}$ (d) $\frac{7}{9}$

*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.*

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* Two players, Sania and Ashnam play a tennis match. The probability of Sania winning the match is 0·79 and that of Ashnam winning the match is 0·21.

Reason (R) : The sum of probabilities of two complementary events is 1.

20. *Assertion (A) :* A fair die is thrown once. The probability of getting a prime number is $\frac{1}{2}$.

Reason (R) : A natural number is a prime number if it has only two factors.

SECTION B

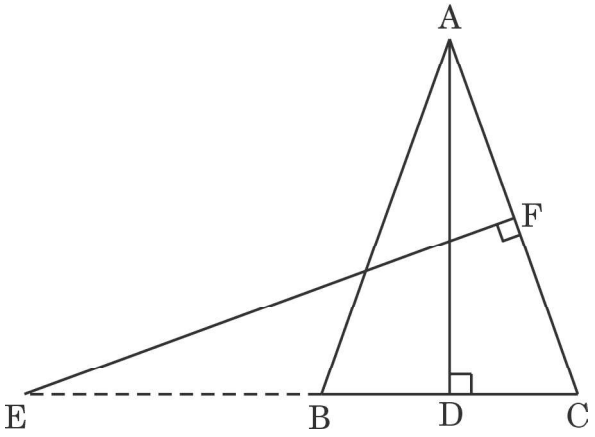
This section comprises very short answer (VSA) type questions of 2 marks each.

21. (a) If $\sqrt{2}$ is given as an irrational number, then prove that $(5 - 2\sqrt{2})$ is an irrational number.

OR

(b) Check whether 6^n can end with the digit 0 for any natural number n.

22. In the figure, E is a point on side CB produced of an isosceles triangle ABC with AB = AC. If AD ⊥ BC and EF ⊥ AC, prove that Δ ABD ~ Δ ECF.



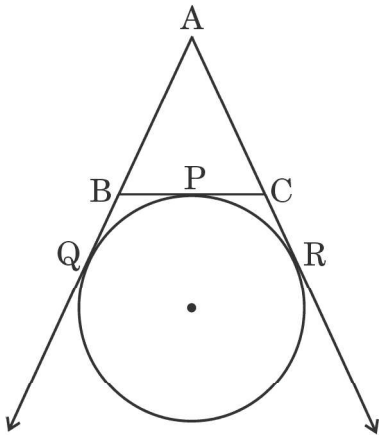
23. (a) Show that the points (– 3, – 3), (3, 3) and (– $3\sqrt{3}$, $3\sqrt{3}$) are the vertices of an equilateral triangle.

OR

(b) Prove that A(4, 3), B(6, 4), C(5, 6), D(3, 5) are the vertices of a square ABCD.

24. A circle is touching the side BC of a Δ ABC at the point P and touching AB and AC produced at points Q and R respectively.

Prove that AQ = $\frac{1}{2}$ (Perimeter of Δ ABC).



25. Find the ratio in which the point (– 1, k) divides the line segment joining the points (– 3, 10) and (6, – 8). Hence, find the value of k.

SECTION C

This section comprises of short answer (SA) type questions of 3 marks each.

26. The age of the father is twice the sum of the ages of his two children. After 20 years, his age will be equal to the sum of the ages of his children. Find the present age of the father.

27. Two water taps together can fill a tank in $3\frac{1}{3}$ hours. The tap of larger diameter takes 5 hours less than the smaller one to fill the tank separately. Find the time in which each tap can fill the tank separately.

28. State and prove Basic Proportionality theorem.

29. (a) Find the sum of all integers between 50 and 500, which are divisible by 7.

OR

(b) How many numbers lie between 10 and 300, which when divided by 4 leave a remainder 3 ? Also, find their sum.

30. Draw the graph of the following equations : $x + y = 5$, $x - y = 5$, and

(i) find the solution of the equations from the graph.

(ii) shade the triangular region formed by the lines and the y-axis.

31. (a) Find the area of the minor and the major sectors of a circle with radius 6 cm, if the angle subtended by the minor arc at the centre is 60°. (Use $\pi = 3{\cdot}14$)

OR

(b) If a chord of a circle of radius 10 cm subtends an angle of 60° at the centre of the circle, find the area of the corresponding minor segment of the circle. (Use $\pi = 3{\cdot}14$ and $\sqrt{3} = 1{\cdot}73$)

SECTION D

This section comprises long answer (LA) type questions of 5 marks each.

32. (a) A tent is in the shape of a right circular cylinder up to a height of 3 m and then a right circular cone, with a maximum height of 13·5 m above the ground. Calculate the cost of painting the inner side of the tent at the rate of ₹ 2 per square metre, if the radius of the base is 14 m.

OR

(b) A solid wooden toy is in the shape of a right circular cone mounted on a hemisphere of same radius. If the radius of the hemisphere is 4·2 cm and the total height of the toy is 10·2 cm, find the volume of the wooden toy. Also, find the total surface area of the toy.

33. As observed from the top of a lighthouse, 100 m above sea level, the angle of depression of a ship, sailing directly towards it, changes from 30° to 45°. Determine the distance travelled by the ship during the period of observation. (Use $\sqrt{3}$ = 1·732)

34. A survey regarding the heights (in cm) of 50 girls of class X of a school was conducted and the following data was obtained :

Height (in cm)	Number of girls
120 – 130	2
130 – 140	8
140 – 150	12
150 – 160	20
160 – 170	8
Total	50

Find the mean and mode of the above data.

35. (a) (i) Prove that :

$$\sqrt{\sec^2 \theta + \text{cosec}^2 \theta} = \tan \theta + \cot \theta$$

(ii) Evaluate :

$$\frac{\cos 45^\circ}{\sec 30^\circ + \text{cosec } 30^\circ}$$

OR

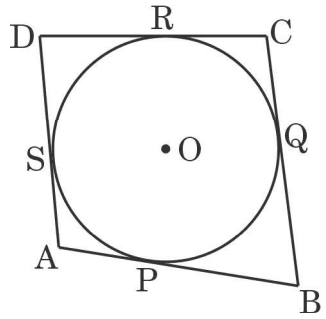
(b) If $x \sin^3 \theta + y \cos^3 \theta = \sin \theta \cos \theta$ and $x \sin \theta = y \cos \theta$, prove that $x^2 + y^2 = 1$.

SECTION E

This section comprises 3 case study based questions of 4 marks each.

Case Study – 1

36. In a park, four poles are standing at positions A, B, C and D around the circular fountain such that the cloth joining the poles AB, BC, CD and DA touches the circular fountain at P, Q, R and S respectively as shown in the figure.



Based on the above information, answer the following questions :

(i) If O is the centre of the circular fountain, then $\angle$ OSA = ... *1*

(ii) If AB = AD, then write the name of the figure ABCD. *1*

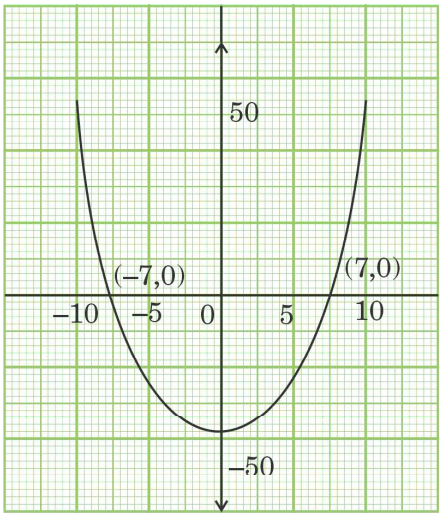
(iii) (a) If DR = 7 cm and AD = 11 cm, then find the length of AP. *2*

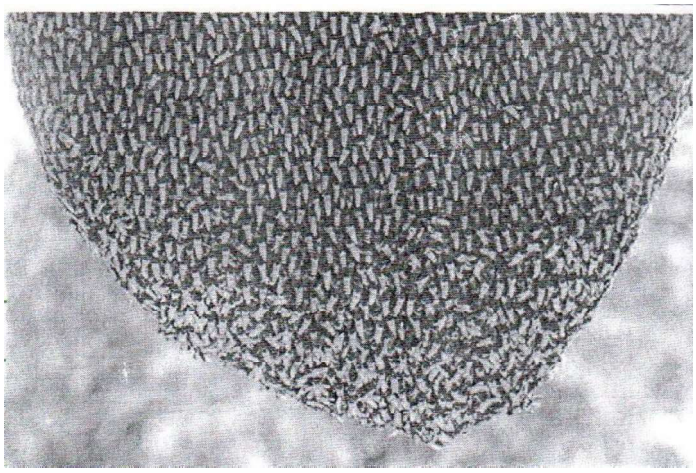
OR

(iii) (b) If O is the centre of the circular fountain with $\angle$ QCR = 60°, then find the measure of $\angle$ QOR. *2*

Case Study – 2

37. While playing in a garden, Samaira saw a honeycomb and asked her mother what is that. Her mother replied that it's a honeycomb made by honey bees to store honey. Also, she told her that the shape of the honeycomb formed is a mathematical structure. The mathematical representation of the honeycomb is shown in the graph.





Based on the above information, answer the following questions :

(i) How many zeroes are there for the polynomial represented by the graph given ? *1*

(ii) Write the zeroes of the polynomial. *1*

(iii) (a) If the zeroes of a polynomial $x^2 + (a + 1)x + b$ are 2 and – 3, then determine the values of a and b. *2*

OR

(iii) (b) If the square of difference of the zeroes of the polynomial $x^2 + px + 45$ is 144, then find the value of p. *2*

Case Study – 3

38. February 14 is celebrated as International Book Giving Day and many countries in the world celebrate this day. Some people in India also started celebrating this day and donated the following number of books of various subjects to a public library :

History = 96, Science = 240, Mathematics = 336.

These books have to be arranged in minimum number of stacks such that each stack contains books of only one subject and the number of books on each stack is the same.

Based on the above information, answer the following questions :

(i) How many books are arranged in each stack ? *1*

(ii) How many stacks are used to arrange all the Mathematics books ? *1*

(iii) (a) Determine the total number of stacks that will be used for arranging all the books. *2*

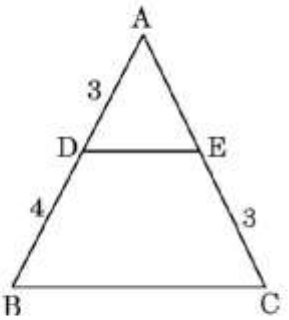
OR

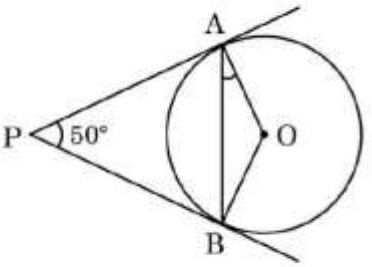
(iii) (b) If the thickness of each book of History, Science and Mathematics is 1·8 cm, 2·2 cm and 2·5 cm respectively, then find the height of each stack of History, Science and Mathematics books. *2*

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/C/1)

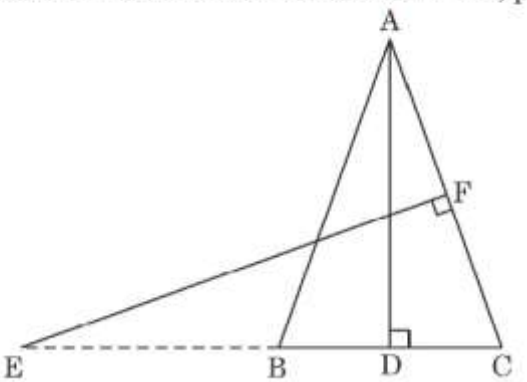
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each	
1.	The values of k for which the equation $4x^2 + kx + 9 = 0$ has real and equal roots are : (a) ± 11 (b) ± 12 (c) ± 6 (d) ± 3	
Sol.	(b) ± 12	1
2.	The distance of the point (4, 7) from the x-axis is : (a) 7 units (b) 5 units (c) 4 units (d) 10 units	
Sol.	(a) 7 units	1
3.	In a family of two children, the probability of having at least one girl is : (a) $\frac{1}{2}$ (b) $\frac{2}{5}$ (c) $\frac{3}{4}$ (d) $\frac{1}{4}$	
Sol.	(c) $\frac{3}{4}$	1
4.	The condition for which the pair of equations $ax + 2y = 7$ and $3x + by = 16$ represent parallel lines is : (a) $ab = \frac{7}{16}$ (b) $ab = 6$ (c) $ab = 3$ (d) $ab = 2$	
Sol.	(b) $ab = 6$	1

5.	The zeroes of the polynomial $3x^2 + 11x - 4$ are : (a) $\frac{1}{2}, -4$ (b) $\frac{1}{4}, -3$ (c) $\frac{1}{3}, -4$ (d) $\frac{1}{3}, 4$	
Sol.	(c) $\frac{1}{3}, -4$	1
6.	$\cot^2\theta - \frac{1}{\sin^2\theta}$ is equal to : (a) 1 (b) 2 (c) -2 (d) -1	
Sol.	(d) -1	1
7.	The coordinates of the point A, where AB is the diameter of the circle whose centre is $(3, -2)$ and B $(7, 4)$ is : (a) $(-1, -8)$ (b) $(-1, 8)$ (c) $(1, 8)$ (d) $(1, -8)$	
Sol.	(a) $(-1, -8)$	1
8.	If x, $2x + 9$, $4x + 3$ are three consecutive terms of an A.P., then the value of x is : (a) 3 (b) 10 (c) 13 (d) 15	
Sol.	(d) 15	1
9.	The height of a tower is 20 m. The length of its shadow made on the level ground when the Sun's altitude is 60°, is : (a) $\frac{20}{\sqrt{3}}$ m (b) $\frac{20}{3}$ m (c) $20\sqrt{3}$ m (d) 20 m	
Sol.	(a) $\frac{20}{\sqrt{3}}$ m	1

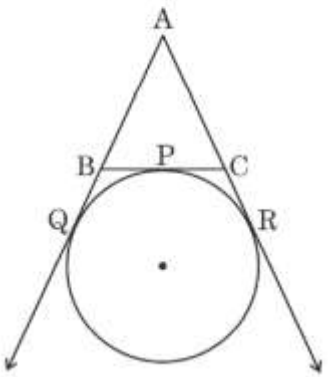
10.	In the given figure, DE ∥ BC and all measurements are given in centimetres. The length of AE is :  (a) 2 cm (b) 2·25 cm (c) 2·5 cm (d) 2·75 cm	
Sol.	(b) 2.25 cm	1
11.	A vertical pole 10 m long casts a shadow of length 5 m on the ground. At the same time, a tower casts a shadow of length 12·5 m on the ground. The height of the tower is : (a) 20 m (b) 22 m (c) 25 m (d) 24 m	
Sol.	(c) 25 m	1
12.	Using empirical relationship, the mode of a distribution whose mean is 7·2 and the median 7·1, is : (a) 6·2 (b) 6·3 (c) 6·5 (d) 6·9	
Sol.	(d) 6.9	1
13.	OACB is a quadrant of a circle with centre O and radius 7 cm where ACB is the arc. Then the perimeter of the quadrant is : (a) 15 cm (b) 50 cm (c) 25 cm (d) 44 cm	
Sol.	(c) 25 cm	1

14.	In the figure, PA and PB are two tangents to the circle with centre O such that $\angle APB = 50°$. Then, the measure of $\angle OAB$ is :  (a) 25° (b) 50° (c) 75° (d) 100°	
Sol.	(a) 25°	1
15.	The length of the tangent drawn from a point P, whose distance from the centre of a circle is 25 cm, and the radius of the circle is 7 cm, is : (a) 22 cm (b) 24 cm (c) 25 cm (d) 28 cm	
Sol.	(b) 24 cm	1
16.	If a bicycle wheel makes 5000 revolutions in moving 11 km, then the diameter of the wheel is : (a) 65 cm (b) 35 cm (c) 70 cm (d) 50 cm	
Sol.	(c) 70 cm	1
17.	Lali tosses two different coins simultaneously. The probability that she gets at most one head is : (a) 1 (b) $\frac{3}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{7}$	
Sol.	(b) $\frac{3}{4}$	1

18.	A number is chosen from the numbers 1, 2, 3 and denoted as x, and a number is chosen from the numbers 1, 4, 9 and denoted as y. Then $P(xy < 9)$ is : (a) $\frac{1}{9}$ (b) $\frac{3}{9}$ (c) $\frac{5}{9}$ (d) $\frac{7}{9}$	
Sol.	(c) $\frac{5}{9}$	1
	*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.* (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* Two players, Sania and Ashnam play a tennis match. The probability of Sania winning the match is 0·79 and that of Ashnam winning the match is 0·21. *Reason (R) :* The sum of probabilities of two complementary events is 1.	
Sol.	(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	1
20.	*Assertion (A) :* A fair die is thrown once. The probability of getting a prime number is $\frac{1}{2}$. *Reason (R) :* A natural number is a prime number if it has only two factors.	
Sol.	(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	1

	SECTION B This section comprises very short answer (VSA) type questions of 2 marks each.	
21. (a)	If $\sqrt{2}$ is given as an irrational number, then prove that $(5 - 2\sqrt{2})$ is an irrational number.	
Sol.	Let us assume that $5 - 2\sqrt{2}$ be a rational number. $\therefore 5 - 2\sqrt{2} = \frac{p}{q}$, where p and q are integers and $q \neq 0$. $\Longrightarrow \sqrt{2} = \frac{5q - p}{2q}$ RHS is a rational number. So, LHS is also a rational number which contradict the given fact that $\sqrt{2}$ is an irrational number. So, our assumption is wrong. Hence, $5 - 2\sqrt{2}$ is an irrational number.	1 ½ ½
	OR	
21. (b)	Check whether 6^n can end with the digit 0 for any natural number n.	
Sol.	If the number 6^n ends with the digit 0, then it should be divisible by 2 and 5. But prime factorisation of 6^n is $(2 \times 3)^n$. $\therefore$ Prime factorisation of 6^n does not contain prime number 5. Hence, 6^n can't end with the digit 0.	1 1
22.	In the figure, E is a point on side CB produced of an isosceles triangle ABC with AB = AC. If AD ⊥ BC and EF ⊥ AC, prove that Δ ABD ~ Δ ECF.  	

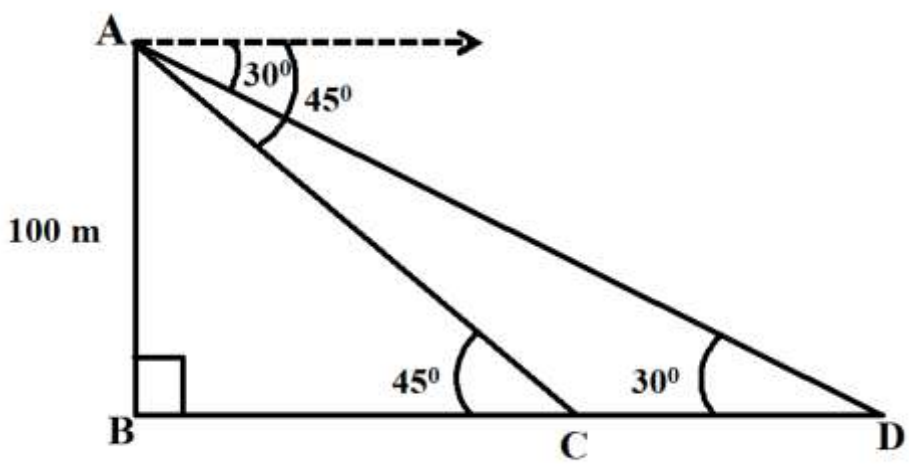
Sol.	In Δ ABC, AB = AC (Given) ∴ ∠ACB = ∠ABC ----- ① In Δ ABD and Δ ECF ∠ADB = ∠EFC (each 90°) ∠ABD = ∠ACD (from ①) ∴ Δ ABD ~ Δ ECF (AA rule)	1 ½ ½
23. (a)	Show that the points $(-3, -3)$, $(3, 3)$ and $(-3\sqrt{3}, 3\sqrt{3})$ are the vertices of an equilateral triangle.	
Sol.	Let A $(-3, -3)$, B $(3, 3)$ and C $(-3\sqrt{3}, 3\sqrt{3})$ be the given points. Using distance formula AB = $\sqrt{(3+3)^2 + (3+3)^2} = 6\sqrt{2}$ units BC = $\sqrt{(-3\sqrt{3}-3)^2 + (3\sqrt{3}-3)^2} = 6\sqrt{2}$ units CA = $\sqrt{(-3+3\sqrt{3})^2 + (-3-3\sqrt{3})^2} = 6\sqrt{2}$ units As AB = BC = CA, so the given points are the vertices of an equilateral triangle.	½ ½ ½ ½
	OR	
23(b).	Prove that A(4, 3), B(6, 4), C(5, 6), D(3, 5) are the vertices of a square ABCD.	
Sol.	AB = $\sqrt{(6-4)^2 + (4-3)^2} = \sqrt{5}$ units BC = $\sqrt{(5-6)^2 + (6-4)^2} = \sqrt{5}$ units CD = $\sqrt{(3-5)^2 + (5-6)^2} = \sqrt{5}$ units DA = $\sqrt{(4-3)^2 + (3-5)^2} = \sqrt{5}$ units AC = $\sqrt{(5-4)^2 + (6-3)^2} = \sqrt{10}$ units BD = $\sqrt{(3-6)^2 + (5-4)^2} = \sqrt{10}$ units As AB = BC = CD = DA and AC = BD, so ABCD is a square.	1 ½ ½

24.	A circle is touching the side BC of a Δ ABC at the point P and touching AB and AC produced at points Q and R respectively. Prove that AQ = $\frac{1}{2}$ (Perimeter of Δ ABC).  	
Sol.	Perimeter of Δ ABC = AB + BC + CA = AB + BP + CP + CA = AB + BQ + CR + CA [BP = BQ ; CP = CR] = AQ + AR = AQ + AQ [AQ = AR] = 2 AQ ∴ AQ = $\frac{1}{2}$ (Perimeter of Δ ABC)	½ ½ ½ ½
25.	Find the ratio in which the point (– 1, k) divides the line segment joining the points (– 3, 10) and (6, – 8). Hence, find the value of k.	
Sol.	Let C (– 1, k) be divides the line segment joining the points A (– 3, 10) and B (6, – 8) in the ratio m : 1. Using section formula $-1 = \frac{-3+6m}{m+1}$ $\Rightarrow m = \frac{2}{7}$ Hence, required ratio is 2 : 7 $k = \frac{10\times7-8\times2}{2+7} = 6$	1 1

	SECTION C This section comprises of Short Answer (SA) type questions of 3 marks each.	
26.	The age of the father is twice the sum of the ages of his two children. After 20 years, his age will be equal to the sum of the ages of his children. Find the present age of the father.	
Sol.	Let the present age of the father be 'x' years and the sum of present ages of his two children be 'y' years A.T.Q. $x = 2y$ ----- ① $x + 20 = y + 40$ ----- ② Solving ① and ②, we get $x = 40$ Hence, the present age of the father is 40 years.	 1 1 1
27.	Two water taps together can fill a tank in $3\frac{1}{3}$ hours. The tap of larger diameter takes 5 hours less than the smaller one to fill the tank separately. Find the time in which each tap can fill the tank separately.	
Sol.	Let the time taken by the tap of smaller diameter to fill the tank separately be 'x' hours and the time taken by the tap of larger diameter to fill the tank separately be $(x - 5)$ hours. A.T.Q. $\frac{1}{x} + \frac{1}{x-5} = \frac{3}{10}$ $\Rightarrow \quad 3x^2 - 35x + 50 = 0$ $\Rightarrow \quad (x - 10)(3x - 5) = 0$ $\Rightarrow \quad x = 10 \text{ or } x = \frac{5}{3}$ But $x = \frac{5}{3}$ is not possible, so $x = 10$ ∴ time taken by the tap of smaller diameter to fill the tank separately is 10 hours and time taken by the tap of larger diameter to fill the tank separately is $10 - 5 = 5$ hours	 1 1 ½ ½
28.	State and prove Basic Proportionality theorem.	
Sol.	Correct statement of Basic Proportionality Correct figure, given, to prove and construction Correct proof	½ 1 1½

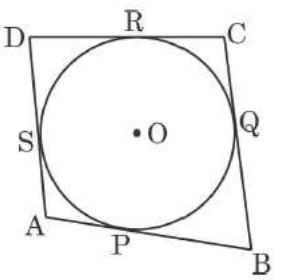
29 (a).	Find the sum of all integers between 50 and 500, which are divisible by 7.	
Sol.	56, 63, …, 497 Here a = 56 and d = 7 Let $a_n = 497$ $\Rightarrow$ 56 + (n – 1) × 7 = 497 $\Rightarrow$ n = 64 $S_{64} = \frac{64}{2} \times (56 + 497) = 17696$	1 ½ ½ 1
	OR	
29 (b).	How many numbers lie between 10 and 300, which when divided by 4 leave a remainder 3 ? Also, find their sum.	
Sol.	11, 15, …, 299 Here a = 11 and d = 4 Let $a_n = 299$ $\Rightarrow$ 11 + (n – 1) × 4 = 299 $\Rightarrow$ n = 73 $S_{73} = \frac{73}{2} \times (11 + 299) = 11315$	1 ½ ½ 1
30.	Draw the graph of the following equations : x + y = 5, x – y = 5, and (i) find the solution of the equations from the graph. (ii) shade the triangular region formed by the lines and the y-axis.	
Sol.	Correct graph of line for equation x + y = 5. Correct graph of line for equation x – y = 5. (i) (5, 0) (ii) Correct shade the required triangular region.	1 1 ½ ½
31 (a).	Find the area of the minor and the major sectors of a circle with radius 6 cm, if the angle subtended by the minor arc at the centre is 60°. (Use π = 3·14)	
Sol.	Area of minor sector = $\frac{3.14 \times (6)^2 \times 60°}{360°}$ = 18.84 Hence, area of minor sector is 18.84 cm^2	1 ½

	Area of major sector = Area of circle – Area of minor sector $= 3.14 \times (6)^2 - 18.84$ $= 94.2$ Hence, area of major sector is 94.2 cm^2	 1 ½
	OR	
31 (b).	If a chord of a circle of radius 10 cm subtends an angle of 60° at the centre of the circle, find the area of the corresponding minor segment of the circle. (Use $\pi = 3{\cdot}14$ and $\sqrt{3} = 1{\cdot}73$)	
Sol.	Area of minor segment $= \frac{3.14 \times (10)^2 \times 60°}{360°} - \frac{1}{2} \times (10)^2 \times \frac{\sqrt{3}}{2}$ $= \frac{314}{6} - \frac{173}{4}$ $= 9\frac{1}{12}$ or 9.08 Hence, area of minor segment is 9.08 cm^2.	2 ½ ½
	SECTION D This section comprises of Long Answer (LA) type questions of 5 marks each.	
32 (a).	A tent is in the shape of a right circular cylinder up to a height of 3 m and then a right circular cone, with a maximum height of 13·5 m above the ground. Calculate the cost of painting the inner side of the tent at the rate of ₹ 2 per square metre, if the radius of the base is 14 m.	
Sol.	Height of conical part = 13.5 – 3 = 10.5 m Slant height $= \sqrt{(14)^2 + (10.5)^2} = 17.5$ m SA of tent = CSA of conical part + CSA of cylindrical part $= \left(\frac{22}{7} \times 14 \times 17.5\right) + \left(2 \times \frac{22}{7} \times 14 \times 3\right)$ $= 1034$ m^2 Cost of painting @ ₹ 2 per m^2 = 1034 × 2 = ₹ 2068	½ 1 2 ½ 1
	OR	
32 (b).	A solid wooden toy is in the shape of a right circular cone mounted on a hemisphere of same radius. If the radius of the hemisphere is 4·2 cm and the total height of the toy is 10·2 cm, find the volume of the wooden toy. Also, find the total surface area of the toy.	

Sol.	Height of conical part = 10.2 – 4.2 = 6 cm	½
	Volume of toy = Volume of conical part + Volume of hemispherical part	
	$= \left(\frac{1}{3} \times \frac{22}{7} \times (4.2)^2 \times 6\right) + \left(\frac{2}{3} \times \frac{22}{7} \times (4.2)^3\right)$	1
	= 266.112	1
	Hence, Volume of toy is 266.112 cm^3	
	Slant height of conical part = $\sqrt{(4.2)^2 + (6)^2} \approx 7.32$ cm	1
	TSA of the toy = CSA of hemispherical part + CSA of conical part	
	$= \left(2 \times \frac{22}{7} \times (4.2)^2\right) + \left(\frac{22}{7} \times 4.2 \times 7.32\right)$	1
	= 207.504	½
	Hence, TSA of toy is 207.504 cm^2	
33.	As observed from the top of a lighthouse, 100 m above sea level, the angle of depression of a ship, sailing directly towards it, changes from 30° to 45°. Determine the distance travelled by the ship during the period of observation. (Use $\sqrt{3}$ = 1·732)	
Sol.	Correct figure.	2
		
	In Δ ABC	
	$\frac{100}{BC} = \tan 45° = 1$	½
	$\Rightarrow$ BC = 100 --- (1)	½
	In Δ ABD	
	$\frac{100}{BD} = \tan 30° = \frac{1}{\sqrt{3}}$	½
	$\Rightarrow$ BD = 100 $\sqrt{3}$	

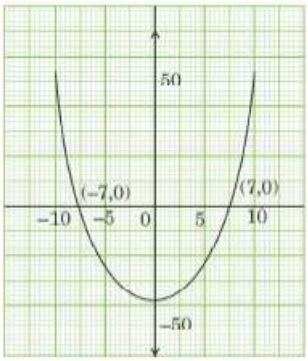
	$\Rightarrow 100 + CD = 100\sqrt{3}$ $\Rightarrow CD = 100\sqrt{3} - 100 = 100(1.732 - 1) = 73.2$ Hence, distance travelled by the ship during the period of observation is 73.2 m	½ 1
34.	A survey regarding the heights (in cm) of 50 girls of class X of a school was conducted and the following data was obtained : Height (in cm) / Number of girls 120 – 130 / 2 130 – 140 / 8 140 – 150 / 12 150 – 160 / 20 160 – 170 / 8 Total / 50 Find the mean and mode of the above data.	
Sol.	Height (in cm) / No. of girls / x_i / u_i / f_iu_i 120 – 130 / 2 / 125 / – 2 / – 4 130 – 140 / 8 / 135 / – 1 / – 8 140 – 150 / 12 / 145 = a / 0 / 0 150 – 160 / 20 / 155 / 1 / 20 160 – 170 / 8 / 165 / 2 / 16 Total / 50 / / / 24 Correct table Mean = $145 + \frac{24}{50} \times 10$ $= 149.8$ ∴ mean height is 149.8 cm Modal class is 150 – 160 Mode = $150 + \frac{(20-12)}{(2\times20-12-8)} \times 10$ $= 154$ ∴ modal height is 154 cm	1½ 1 ½ ½ 1 ½

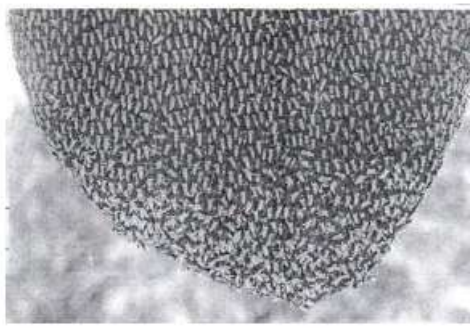
35 (a).	(i) Prove that : $\sqrt{\sec^2\theta + \text{cosec}^2\theta} = \tan\theta + \cot\theta$ (ii) Evaluate : $\frac{\cos 45^\circ}{\sec 30^\circ + \text{cosec } 30^\circ}$	
	(i) LHS = $\sqrt{1+\tan^2\theta+1+\cot^2\theta}$ $= \sqrt{\tan^2\theta+\cot^2\theta+2\times\tan\theta\times\cot\theta}$ $= \sqrt{(\tan\theta+\cot\theta)^2}$ $= \tan\theta + \cot\theta$ = RHS (ii) $\frac{\frac{1}{\sqrt{2}}}{\frac{2}{\sqrt{3}}+2}$ $= \frac{\sqrt{3}}{2\sqrt{2}(1+\sqrt{3})} \times \frac{\sqrt{2}}{\sqrt{2}}$ $= \frac{\sqrt{6}}{4(1+\sqrt{3})} \times \frac{(1-\sqrt{3})}{(1-\sqrt{3})}$ $= \frac{3\sqrt{2}-\sqrt{6}}{8}$	1 1 ½ 1 ½ ½ ½
	OR	
35 (b).	If $x\sin^3\theta + y\cos^3\theta = \sin\theta\cos\theta$ and $x\sin\theta = y\cos\theta$, prove that $x^2 + y^2 = 1$.	
Sol.	Given, $x\sin^3\theta + y\cos^3\theta = \sin\theta\cos\theta$ $\Rightarrow$ $x\sin\theta(\sin^2\theta) + y\cos\theta(\cos^2\theta) = \sin\theta\cos\theta$ $\Rightarrow$ $x\sin\theta(\sin^2\theta) + x\sin\theta(\cos^2\theta) = \sin\theta\cos\theta$ $\Rightarrow$ $x\sin\theta(\sin^2\theta+\cos^2\theta) = \sin\theta\cos\theta$ $\Rightarrow$ $x = \cos\theta$ Given, $x\sin\theta = y\cos\theta$ $\Rightarrow$ $\cos\theta\sin\theta = y\cos\theta$ $\Rightarrow$ $y = \sin\theta$ LHS = $x^2 + y^2 = (\cos\theta)^2 + (\sin\theta)^2 = 1$ = RHS	1 1 1 1 1
	SECTION E This section comprises of 3 case-study based questions of 4 marks each.	

36.	In a park, four poles are standing at positions A, B, C and D around the circular fountain such that the cloth joining the poles AB, BC, CD and DA touches the circular fountain at P, Q, R and S respectively as shown in the figure.  Based on the above information, answer the following questions : (i) If O is the centre of the circular fountain, then $\angle OSA$ = ... (ii) If AB = AD, then write the name of the figure ABCD. (iii) (a) If DR = 7 cm and AD = 11 cm, then find the length of AP. **OR** (iii) (b) If O is the centre of the circular fountain with $\angle QCR = 60°$, then find the measure of $\angle QOR$.	
Sol.	(i) 90° (ii) AB + DC = BC + DA Given, AB = AD $\Rightarrow$ BC = DC So, ABCD is a Kite (iii) (a) DS = DR = 7 cm AD = 11 cm 7 + SA = 11 $\Rightarrow$ SA = 4 cm $\therefore$ AP = SA = 4 cm OR (b) $\angle QOR = 180° - 60°$ $= 120°$	1 1 ½ ½ ½ ½ 1 1

37.

While playing in a garden, Samaira saw a honeycomb and asked her mother what is that. Her mother replied that it's a honeycomb made by honey bees to store honey. Also, she told her that the shape of the honeycomb formed is a mathematical structure. The mathematical representation of the honeycomb is shown in the graph.





Based on the above information, answer the following questions :

(i) How many zeroes are there for the polynomial represented by the graph given ?

(ii) Write the zeroes of the polynomial.

(iii) (a) If the zeroes of a polynomial $x^2 + (a + 1)x + b$ are 2 and – 3, then determine the values of a and b.

OR

(iii) (b) If the square of difference of the zeroes of the polynomial $x^2 + px + 45$ is 144, then find the value of p.

Sol.

(i) Two — 1

(ii) 7 and – 7 — 1

(iii) (a) $-(a + 1) = 2 + (-3) \Rightarrow a = 0$ — 1

$b = 2 \times (-3) \Rightarrow b = -6$ — 1

OR

(b) Let α and β be the zeroes of given polynomial

Here, $\alpha + \beta = -p$ and $\alpha\beta = 45$ — ½

$(\alpha - \beta)^2 = 144$ — ½

$\Rightarrow (\alpha + \beta)^2 - 4\alpha\beta = 144$

$\Rightarrow (-p)^2 - 4 \times 45 = 144$ — ½

$\Rightarrow p = \pm 18$ — ½

38.	February 14 is celebrated as International Book Giving Day and many countries in the world celebrate this day. Some people in India also started celebrating this day and donated the following number of books of various subjects to a public library : History = 96, Science = 240, Mathematics = 336. These books have to be arranged in minimum number of stacks such that each stack contains books of only one subject and the number of books on each stack is the same. Based on the above information, answer the following questions : (i) How many books are arranged in each stack ? (ii) How many stacks are used to arrange all the Mathematics books ? (iii) (a) Determine the total number of stacks that will be used for arranging all the books. **OR** (iii) (b) If the thickness of each book of History, Science and Mathematics is 1·8 cm, 2·2 cm and 2·5 cm respectively, then find the height of each stack of History, Science and Mathematics books.	
Sol.	(i) HCF (96, 240, 336) = 48 (ii) Number of stacks = $\frac{336}{48} = 7$ (iii) (a) Total number of stacks = $\frac{96}{48} + \frac{240}{48} + \frac{336}{48}$ $= 14$ OR (b) Height of each stack of History = $48 \times 1.8 = 86.4$ cm Height of each stack of Science = $48 \times 2.2 = 105.6$ cm Height of each stack of Mathematics = $48 \times 2.5 = 120$ cm	1 1 1 1 1 mark for 1 correct answer, 1½ mark for two correct answer and 2 marks for all correct answers.

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Question numbers **1** to **18** are multiple choice questions (MCQs) and question numbers **19** and **20** are Assertion – Reason based questions of **1** mark each.*

(iv) *In **Section B,** Question numbers **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Question numbers **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Question numbers **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Question numbers **36** to **38** are **case–study based integrated** questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section **B**, 2 questions in Section **C**, 2 questions in Section **D** and 3 questions of 2 marks in Section **E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **NOT allowed.***

SECTION - A

20×1 = 20

This section consists of 20 questions of 1 mark each.

1. If the sum of zeroes of the polynomial $p(x) = 2x^2 - k\sqrt{2}x + 1$ is $\sqrt{2}$, then value of k is : **1**

(a) $\sqrt{2}$ (b) 2 (c) $2\sqrt{2}$ (d) $\frac{1}{2}$

2. If the probability of a player winning a game is 0.79, then the probability of his losing the same game is : **1**

(a) 1.79 (b) 0.31 (c) 0.21% (d) 0.21

3. If the roots of equation $ax^2 + bx + c = 0$, $a \neq 0$ are real and equal, then which of the following relation is true ? **1**

(a) $a = \frac{b^2}{c}$ (b) $b^2 = ac$ (c) $ac = \frac{b^2}{4}$ (d) $c = \frac{b^2}{a}$

4. In an A.P., if the first term $a = 7$, nth term $a_n = 84$ and the sum of first n terms $s_n = \frac{2093}{2}$, then n is equal to : **1**

(a) 22 (b) 24 (c) 23 (d) 26

5. If two positive integers p and q can be expressed as $p = 18\ a^2b^4$ and $q = 20\ a^3b^2$, where a and b are prime numbers, then LCM (p, q) is : **1**

(a) $2\ a^2b^2$ (b) $180\ a^2b^2$ (c) $12\ a^2b^2$ (d) $180\ a^3b^4$

6. AD is a median of ΔABC with vertices A(5, – 6), B(6, 4) and C(0, 0). Length AD is equal to : **1**

(a) $\sqrt{68}$ units (b) $2\sqrt{15}$ units (c) $\sqrt{101}$ units (d) 10 units

7. If $\sec\theta - \tan\theta = m$, then the value of $\sec\theta + \tan\theta$ is : **1**

(a) $1-\frac{1}{m}$ (b) $m^2 - 1$ (c) $\frac{1}{m}$ (d) $-m$

8. From the data 1, 4, 7, 9, 16, 21, 25, if all the even numbers are removed, then the probability of getting at random a prime number from the remaining is : **1**

(a) $\frac{2}{5}$ (b) $\frac{1}{5}$ (c) $\frac{1}{7}$ (d) $\frac{2}{7}$

9. For some data $x_1, x_2, \ldots\ldots x_n$ with respective frequencies $f_1, f_2, \ldots\ldots f_n$, the value of $\sum_1^n f_i\left(x_i - \bar{x}\right)$ is equal to : **1**

(a) $n\bar{x}$ (b) 1 (c) $\sum f_i$ (d) 0

10. The zeroes of a polynomial $x^2 + px + q$ are twice the zeroes of the polynomial $4x^2 - 5x - 6$. The value of p is : **1**

(a) $-\frac{5}{2}$ (b) $\frac{5}{2}$ (c) – 5 (d) 10

11. If the distance between the points (3, – 5) and (x, – 5) is 15 units, then the values of x are : **1**

(a) 12, – 18 (b) – 12, 18 (c) 18, 5 (d) – 9, – 12

12. If $\cos(\alpha + \beta) = 0$, then value of $\cos\left(\frac{\alpha + \beta}{2}\right)$ is equal to : **1**

(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2}$ (c) 0 (d) $\sqrt{2}$

13. A solid sphere is cut into two hemispheres. The ratio of the surface areas of sphere to that of two hemispheres taken together, is : **1**

(a) 1 : 1 (b) 1 : 4 (c) 2 : 3 (d) 3 : 2

14. The middle most observation of every data arranged in order is called : **1**

(a) mode (b) median (c) mean (d) deviation

15. The volume of the largest right circular cone that can be carved out from a solid cube of edge 2 cm is : **1**

(a) $\frac{4\pi}{3}$ cu cm (b) $\frac{5\pi}{3}$ cu cm (c) $\frac{8\pi}{3}$ cu cm (d) $\frac{2\pi}{3}$ cu cm

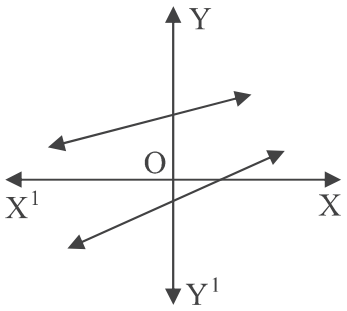
16. Two dice are rolled together. The probability of getting sum of numbers on the two dice as 2, 3 or 5, is : **1**

(a) $\frac{7}{36}$ (b) $\frac{11}{36}$ (c) $\frac{5}{36}$ (d) $\frac{4}{9}$

17. The centre of a circle is at (2, 0). If one end of a diameter is at (6, 0), then the other end is at : **1**

(a) (0, 0) (b) (4, 0) (c) (– 2, 0) (d) (– 6, 0)

18. In the given figure, graphs of two linear equations are shown. The pair of these linear equations is : **1**



(a) consistent with unique solution.

(b) consistent with infinitely many solutions.

(c) inconsistent.

(d) inconsistent but can be made consistent by extending these lines.

Directions :
In Q. No. 19 and 20 a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.

(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not correct explanation for Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A) :** The tangents drawn at the end points of a diameter of a circle, are parallel.

Reason (R) : Diameter of a circle is the longest chord. **1**

20. **Assertion (A) :** If the graph of a polynomial touches x-axis at only one point, then the polynomial cannot be a quadratic polynomial.

Reason (R) : A polynomial of degree $n(n > 1)$ can have at most n zeroes. **1**

SECTION - B

This section consists of 5 questions of 2 marks each.

21. Solve the following system of linear equations
$7x - 2y = 5$ and $8x + 7y = 15$ and verify your answer. **2**

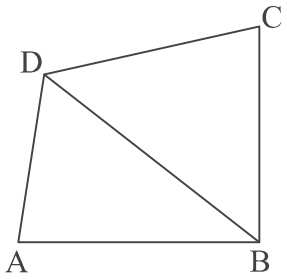
22. In a pack of 52 playing cards one card is lost. From the remaining cards, a card is drawn at random. Find the probability that the drawn card is queen of heart, if the lost card is a black card. **2**

23. **(A)** Evaluate : $2\sqrt{2}\ \cos 45^{o} \sin 30^{o} + 2\sqrt{3}\ \cos 30^{o}$ **2**

OR

(B) If $A = 60^{o}$ and $B = 30^{o}$, verify that :
$\sin (A + B) = \sin A \cos B + \cos A \sin B$ **2**

24. In the given figure, ABCD is a quadrilateral. Diagonal BD bisects $\angle B$ and $\angle D$ both.
Prove that : **2**



(i) $\Delta ABD \sim \Delta CBD$

(ii) $AB = BC$

25. **(A)** Prove that $5 - 2\sqrt{3}$ is an irrational number. It is given that $\sqrt{3}$ is an irrational number. **2**

OR

(B) Show that the number $5 \times 11 \times 17 + 3 \times 11$ is a composite number. **2**

SECTION - C

This section consists of 6 questions of 3 marks each.

26. **(A)** Find the ratio in which the point $\left(\frac{8}{5}, y\right)$ divides the line segment joining the points (1, 2) and (2, 3). Also, find the value of y. **3**

OR

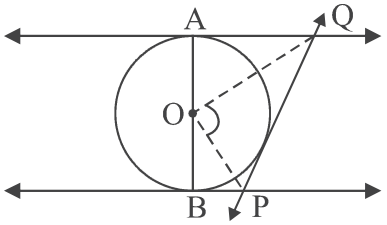
(B) ABCD is a rectangle formed by the points A (–1, –1), B (–1, 6), C (3, 6) and D (3, –1). P, Q, R and S are mid–points of sides AB, BC, CD and DA respectively. Show that diagonals of the quadrilateral PQRS bisect each other. **3**

27. In a teachers' workshop, the number of teachers teaching French, Hindi and English are 48, 80 and 144 respectively. Find the minimum number of rooms required if in each room the same number of teachers are seated and all of them are of the same subject. **3**

28. Prove that : $\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta \operatorname{cosec}\theta$ **3**

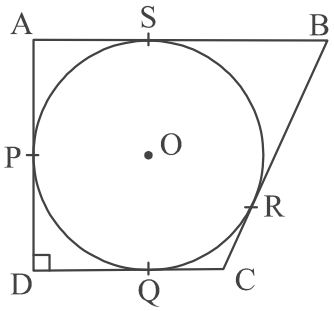
29. Three years ago, Rashmi was thrice as old as Nazma. Ten years later, Rashmi will be twice as old as Nazma. How old are Rashmi and Nazma now ? **3**

30. **(A)** In the given figure, AB is a diameter of the circle with centre O. AQ, BP and PQ are tangents to the circle. Prove that $\angle POQ = 90^o$. **3**



OR

(B) A circle with centre O and radius 8 cm is inscribed in a quadrilateral ABCD in which P, Q, R, S are the points of contact as shown. If AD is perpendicular to DC, BC = 30 cm and BS = 24 cm, then find the length DC. **3**



31. The difference between the outer and inner radii of a hollow right circular cylinder of length 14 cm is 1 cm. If the volume of the metal used in making the cylinder is 176 cm^3, find the outer and inner radii of the cylinder. **3**

SECTION - D

This section consists of 4 questions of 5 marks each.

32. An arc of a circle of radius 21 cm subtends an angle of 60^o at the centre. Find : **5**

(i) the length of the arc.

(ii) the area of the minor segment of the circle made by the corresponding chord.

33. **(A)** The sum of first and eighth terms of an A.P. is 32 and their product is 60. Find the first term and common difference of the A.P. Hence, also find the sum of its first 20 terms. **5**

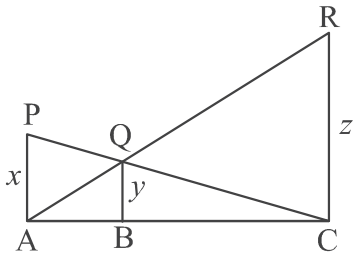
OR

(B) In an A.P. of 40 terms, the sum of first 9 terms is 153 and the sum of last 6 terms is 687. Determine the first term and common difference of A.P. Also, find the sum of all the terms of the A.P. **5**

34. **(A)** If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then prove that the other two sides are divided in the same ratio. **5**

OR

(B) In the given figure PA, QB and RC are each perpendicular to AC. If AP = x, BQ = y and CR = z, then prove that $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$ **5**



35. A pole 6m high is fixed on the top of a tower. The angle of elevation of the top of the pole observed from a point P on the ground is 60^o and the angle of depression of the point P from the top of the tower is 45^o. Find the height of the tower and the distance of point P from the foot of the tower. (Use $\sqrt{3} = 1.73$) **5**

SECTION - E

This section consists of 3 Case-Study Based Questions of 4 marks each.

36. A rectangular floor area can be completely tiled with 200 square tiles. If the side length of each tile is increased by 1 unit, it would take only 128 tiles to cover the floor.

(i) Assuming the original length of each side of a tile be x units, make a quadratic equation from the above information. **1**

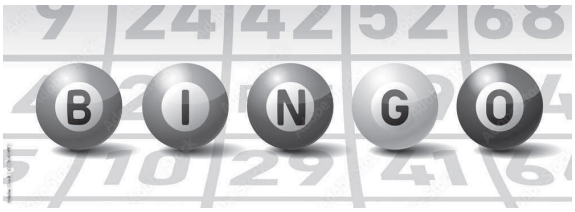
(ii) Write the corresponding quadratic equation in standard form. **1**

(iii) (a) Find the value of x, the length of side of a tile by factorisation. **2**

OR

(b) Solve the quadratic equation for x, using quadratic formula. **2**

37. BINGO is game of chance. The host has 75 balls numbered 1 through 75. Each player has a BINGO card with some numbers written on it. The participant cancels the number on the card when called out a number written on the ball selected at random. Whosoever cancels all the numbers on his/her card, says BINGO and wins the game.



The table given below, shows the data of one such game where 48 balls were used before Tara said 'BINGO'.

Numbers announced	Number of times
0-15	8
15-30	9
30-45	10
45-60	12
60-75	9

Based on the above information, answer the following :

(i) Write the median class. **1**

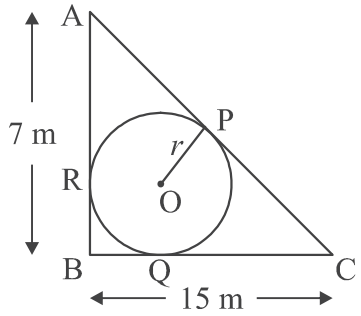
(ii) When first ball was picked up, what was the probability of calling out an even number ? **1**

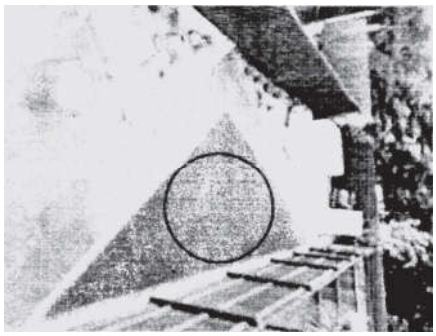
(iii) (a) Find median of the given data. **2**

OR

(b) Find mode of the given data. **2**

38. A backyard is in the shape of a triangle ABC with right angle at B. AB = 7 m and BC = 15 m. A circular pit was dug inside it such that it touches the walls AC, BC and AB at P, Q and R respectively such that AP = x m.





Based on the above information, answer the following questions :

(i) Find the length of AR in terms of x. **1**

(ii) Write the type of quadrilateral BQOR. **1**

(iii) (a) Find the length PC in terms of x and hence find the value of x. **2**

OR

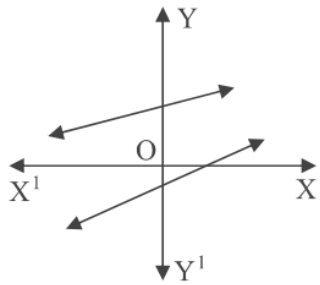
(b) Find x and hence find the radius r of circle. **2**

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/1/1)

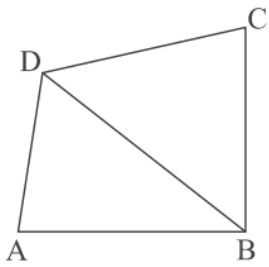
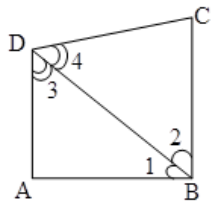
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section consists of 20 questions of 1 mark each.	
1.	If the sum of zeroes of the polynomial $p(x) = 2x^2 - k\sqrt{2}x + 1$ is $\sqrt{2}$, then value of k is : (a) $\sqrt{2}$ (b) 2 (c) $2\sqrt{2}$ (d) $\frac{1}{2}$	
Sol.	(b) 2	1
2.	If the probability of a player winning a game is 0.79, then the probability of his losing the same game is : (a) 1.79 (b) 0.31 (c) 0.21% (d) 0.21	
Sol.	(d) 0.21	1
3.	If the roots of equation $ax^2 + bx + c = 0$, $a \neq 0$ are real and equal, then which of the following relation is true ? (a) $a = \frac{b^2}{c}$ (b) $b^2 = ac$ (c) $ac = \frac{b^2}{4}$ (d) $c = \frac{b^2}{a}$	
Sol.	(c) ac = $\frac{b^2}{4}$	1
4.	In an A.P., if the first term $a = 7$, nth term $a_n = 84$ and the sum of first n terms $s_n = \frac{2093}{2}$, then n is equal to : (a) 22 (b) 24 (c) 23 (d) 26	
Sol.	(c) 23	1
5.	If two positive integers p and q can be expressed as $p = 18\ a^2b^4$ and $q = 20\ a^3b^2$, where a and b are prime numbers, then LCM (p, q) is : (a) $2\ a^2b^2$ (b) $180\ a^2b^2$ (c) $12\ a^2b^2$ (d) $180\ a^3b^4$	
Sol.	(d) 180 a^3b^4	1

6.	AD is a median of ΔABC with vertices A(5, – 6), B(6, 4) and C(0, 0). Length AD is equal to : (a) $\sqrt{68}$ units (b) $2\sqrt{15}$ units (c) $\sqrt{101}$ units (d) 10 units	
Sol.	(a) $\sqrt{68}$ units	1
7.	If $\sec\theta - \tan\theta = m$, then the value of $\sec\theta + \tan\theta$ is : (a) $1-\frac{1}{m}$ (b) $m^2 - 1$ (c) $\frac{1}{m}$ (d) $-m$	
Sol.	(c) $\frac{1}{m}$	1
8.	From the data 1, 4, 7, 9, 16, 21, 25, if all the even numbers are removed, then the probability of getting at random a prime number from the remaining is : (a) $\frac{2}{5}$ (b) $\frac{1}{5}$ (c) $\frac{1}{7}$ (d) $\frac{2}{7}$	
Sol.	(b) $\frac{1}{5}$	1
9.	For some data $x_1, x_2, \ldots\ldots x_n$ with respective frequencies $f_1, f_2, \ldots\ldots f_n$, the value of $\sum_1^n f_i\left(x_i - \bar{x}\right)$ is equal to : (a) $n\bar{x}$ (b) 1 (c) $\sum f_i$ (d) 0	
Sol.	(d) 0	1
10.	The zeroes of a polynomial $x^2 + px + q$ are twice the zeroes of the polynomial $4x^2 - 5x - 6$. The value of p is : (a) $-\frac{5}{2}$ (b) $\frac{5}{2}$ (c) -5 (d) 10	
Sol.	(a) $-\frac{5}{2}$	1
11.	If the distance between the points (3, – 5) and (x, – 5) is 15 units, then the values of x are : (a) 12, – 18 (b) – 12, 18 (c) 18, 5 (d) – 9, – 12	
Sol.	(b) – 12, 18	1

12.	If $\cos(\alpha + \beta) = 0$, then value of $\cos\left(\frac{\alpha + \beta}{2}\right)$ is equal to : (a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2}$ (c) 0 (d) $\sqrt{2}$	
Sol.	(a) $\frac{1}{\sqrt{2}}$	1
13.	A solid sphere is cut into two hemispheres. The ratio of the surface areas of sphere to that of two hemispheres taken together, is : (a) 1 : 1 (b) 1 : 4 (c) 2 : 3 (d) 3 : 2	
Sol.	(c) 2 : 3	1
14.	The middle most observation of every data arranged in order is called : (a) mode (b) median (c) mean (d) deviation	
Sol.	(b) median	1
15.	The volume of the largest right circular cone that can be carved out from a solid cube of edge 2 cm is : (a) $\frac{4\pi}{3}$ cu cm (b) $\frac{5\pi}{3}$ cu cm (c) $\frac{8\pi}{3}$ cu cm (d) $\frac{2\pi}{3}$ cu cm	
Sol.	(d) $\frac{2\pi}{3}$ cu cm	1
16.	Two dice are rolled together. The probability of getting sum of numbers on the two dice as 2, 3 or 5, is : (a) $\frac{7}{36}$ (b) $\frac{11}{36}$ (c) $\frac{5}{36}$ (d) $\frac{4}{9}$	
Sol.	(a) $\frac{7}{36}$	1
17.	The centre of a circle is at (2, 0). If one end of a diameter is at (6, 0), then the other end is at : (a) (0, 0) (b) (4, 0) (c) (– 2, 0) (d) (– 6, 0)	
Sol.	(c) (– 2, 0)	1

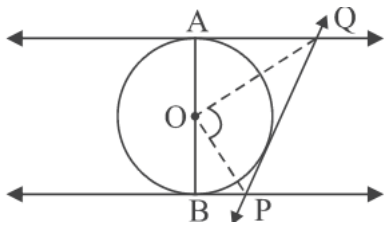
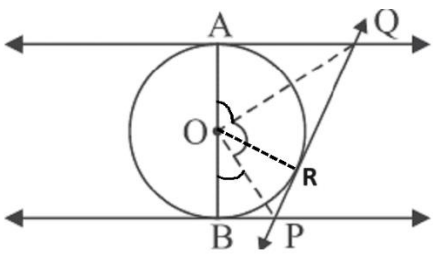
18.	In the given figure, graphs of two linear equations are shown. The pair of these linear equations is : (a) consistent with unique solution. (b) consistent with infinitely many solutions. (c) inconsistent. (d) inconsistent but can be made consistent by extending these lines. 	
Sol.	(a) consistent with unique solution	1
	Directions : **In Q. No. 19 and 20 a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.** (a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A). (b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not correct explanation for Assertion (A). (c) Assertion (A) is true but Reason (R) is false. (d) Assertion (A) is false but Reason (R) is true.	
19.	**Assertion (A) :** The tangents drawn at the end points of a diameter of a circle, are parallel. **Reason (R) :** Diameter of a circle is the longest chord.	
Sol.	(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation for Assertion (A).	1
20.	**Assertion (A) :** If the graph of a polynomial touches x-axis at only one point, then the polynomial cannot be a quadratic polynomial. **Reason (R) :** A polynomial of degree $n(n>1)$ can have at most n zeroes.	
Sol.	(d) Assertion (A) is false but Reason (R) is true.	1

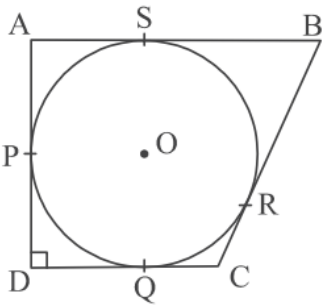
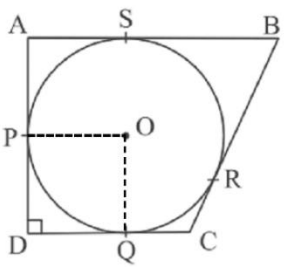
	SECTION B This section consists of 5 questions of 2 marks each.	
21.	Solve the following system of linear equations $7x - 2y = 5$ and $8x + 7y = 15$ and verify your answer.	
Sol.	$7x - 2y = 5$ ----- (i) $8x + 7y = 15$ ----- (ii) Solving equation (i) and (ii), we get $x = 1$, $y = 1$ Verification of answer	 1 + ½ ½
22.	In a pack of 52 playing cards one card is lost. From the remaining cards, a card is drawn at random. Find the probability that the drawn card is queen of heart, if the lost card is a black card.	
Sol.	Total number of remaining cards = 51 P (getting queen of heart) = $\frac{1}{51}$	1 1
23. (A)	Evaluate : $2\sqrt{2}\ \cos 45^\circ \sin 30^\circ + 2\sqrt{3}\ \cos 30^\circ$	
Sol.	$2\sqrt{2} \times \frac{1}{\sqrt{2}} \times \frac{1}{2} + 2\sqrt{3} \times \frac{\sqrt{3}}{2}$ $= 4$	½+½ + ½ ½
	OR	
23. (B)	If $A = 60^\circ$ and $B = 30^\circ$, verify that : $\sin (A + B) = \sin A \cos B + \cos A \sin B$	
Sol.	LHS = $\sin (60° + 30°) = \sin 90° = 1$ RHS = $\sin 60° \cos 30° + \cos 60° \sin 30°$ $= \frac{\sqrt{3}}{2} \times \frac{\sqrt{3}}{2} + \frac{1}{2} \times \frac{1}{2} = 1$ ∴ LHS = RHS	1 1

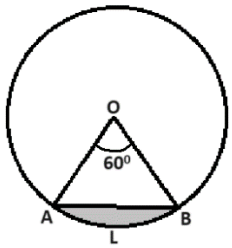
24.	In the given figure, ABCD is a quadrilateral. Diagonal BD bisects ∠B and ∠D both. Prove that : (i) ΔABD ~ ΔCBD (ii) AB = BC 	
Sol.	(i) In ΔABD & ΔCBD ∠ 3 = ∠ 4 ∠1 = ∠ 2 ∴ ΔABD ~ ΔCBD (ii) ΔABD ≅ ΔCBD ∴ AB = BC 	1 1
25. (A)	Prove that $5-2\sqrt{3}$ is an irrational number. It is given that $\sqrt{3}$ is an irrational number.	
Sol.	Assuming $5 - 2\sqrt{3}$ to be a rational number. Let $5 - 2\sqrt{3} = \frac{a}{b}$ where a and b are integers & $b \neq 0$ $\Longrightarrow \sqrt{3} = \frac{5b-a}{2b}$ Here RHS is rational but LHS is irrational. Therefore our assumption is wrong. Hence, $5 - 2\sqrt{3}$ is an irrational number.	½ ½ ½ ½
	OR	
25. (B)	Show that the number $5\times11\times17+3\times11$ is a composite number.	
Sol.	$5 \times 11 \times 17 + 3 \times 11 = 11 \times (5 \times 17 + 3)$ $= 11\times 88$ or $11 \times 11 \times 2^3$ It means the number can be expressed as a product of two factors other than 1, therefore the given number is a composite number.	1 ½ ½

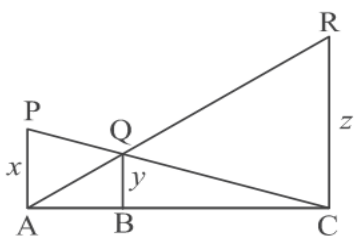
	SECTION C This section consists of 6 questions of 3 marks each.	
26. (A)	Find the ratio in which the point $\left(\frac{8}{5}, y\right)$ divides the line segment joining the points (1, 2) and (2, 3). Also, find the value of y.	
Sol.	Let AP: PB = k : 1 $\therefore \frac{2k+1}{k+1} = \frac{8}{5}$ $\Rightarrow k = \frac{3}{2}$ $\therefore$ required ratio is 3: 2. $y = \frac{3\times3+2\times2}{3+2} = \frac{13}{5}$	1 ½ ½ 1
	OR	
26. (B)	ABCD is a rectangle formed by the points A (–1, –1), B (–1, 6), C (3, 6) and D (3, –1). P, Q, R and S are mid–points of sides AB, BC, CD and DA respectively. Show that diagonals of the quadrilateral PQRS bisect each other.	
Sol.	Co-ordinates of point P are $\left(\frac{-1-1}{2}, \frac{-1+6}{2}\right)$ i.e. $\left(-1, \frac{5}{2}\right)$ Co-ordinates of point Q are $\left(\frac{-1+3}{2}, \frac{6+6}{2}\right)$ i.e. $(1, 6)$ Co-ordinates of point R are $\left(\frac{3+3}{2}, \frac{6-1}{2}\right)$ i.e. $\left(3, \frac{5}{2}\right)$ Co-ordinates of point S are $\left(\frac{-1+3}{2}, \frac{-1-1}{2}\right)$ i.e. $(1, -1)$ Co-ordinates of mid point of diagonal QS are $\left(\frac{1+1}{2}, \frac{6-1}{2}\right)$ i.e. $\left(1, \frac{5}{2}\right)$ Co-ordinates of mid point of diagonal PR are $\left(\frac{-1+3}{2}, \frac{\frac{5}{2}+\frac{5}{2}}{2}\right)$ i.e. $\left(1, \frac{5}{2}\right)$ Since coordinates of mid point of QS = coordinates of mid point of PR Therefore, diagonals PR and QS bisect each other.	½ ½ ½ ½ ½ ½

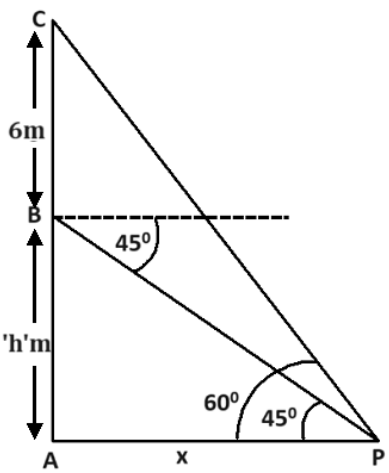
27.	In a teachers' workshop, the number of teachers teaching French, Hindi and English are 48, 80 and 144 respectively. Find the minimum number of rooms required if in each room the same number of teachers are seated and all of them are of the same subject.	
Sol.	Minimum number of rooms required means there should be maximum number of teachers in a room. We have to find HCF of 48, 80 and 144. $48 = 2^4 \times 3$ $80 = 2^4 \times 5$ $144 = 2^4 \times 3^2$ HCF (48, 80, 144) = $2^4 = 16$ Therefore, total number of rooms required = $\frac{48}{16} + \frac{80}{16} + \frac{144}{16} = 17$	 ½ ½ ½ ½ 1
28.	Prove that : $\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta \operatorname{cosec}\theta$	
Sol.	LHS = $\frac{\frac{sin\theta}{cos\theta}}{\frac{(\sin\theta - cos\theta)}{sin\theta}} + \frac{\frac{cos\theta}{sin\theta}}{\frac{(\cos\theta - sin\theta)}{cos\theta}}$ $= \frac{1}{(sin\theta - cos\theta)}\left[\frac{sin^2\theta}{cos\theta} - \frac{cos^2\theta}{sin\theta}\right]$ $= \frac{1}{(sin\theta - cos\theta)} \times \frac{(sin\theta - cos\theta)(sin^2\theta + cos^2\theta + sin\theta cos\theta)}{sin\theta cos\theta}$ $= \frac{1}{sin\theta cos\theta} + 1$ $= 1 + sec\theta\ cosec\theta$ = RHS	½ 1 1 ½

29.	Three years ago, Rashmi was thrice as old as Nazma. Ten years later, Rashmi will be twice as old as Nazma. How old are Rashmi and Nazma now ?	
Sol.	Let present age of Rashmi and Nazma be x years and y years respectively. Therefore, $x - 3 = 3(y - 3)$ or $x - 3y + 6 = 0$ and $x + 10 = 2(y + 10)$ or $x - 2y - 10 = 0$ Solving equations to get $x = 42$, $y = 16$ $\therefore$ Present age of Rashmi is 42 years and that of Nazma is 16 years.	1 1 1
30. (A)	In the given figure, AB is a diameter of the circle with centre O. AQ, BP and PQ are tangents to the circle. Prove that $\angle POQ = 90^o$. 	
Sol.	 Join OR. $\Delta AOQ \cong \Delta ROQ \Longrightarrow \angle AOQ = \angle ROQ$ ----- (i) $\Delta BOP \cong \Delta ROP \Longrightarrow \angle BOP = \angle ROP$ ----- (ii) Since $\angle AOR + \angle ROB = 180°$ $\Longrightarrow 2\angle QOR + 2\angle ROP = 180°$ $\Longrightarrow \angle QOR + \angle ROP = \angle POQ = 90°$	½ 1 ½ ½ ½
	OR	

30. (B)	A circle with centre O and radius 8 cm is inscribed in a quadrilateral ABCD in which P, Q, R, S are the points of contact as shown. If AD is perpendicular to DC, BC = 30 cm and BS = 24 cm, then find the length DC. 	
Sol.	Join OP and OQ. BR = BS = 24 cm $\therefore$ CR = 6 cm $\Longrightarrow$ CQ = 6 cm Also, DQ = OP = 8 cm Hence, DC = 8 + 6 = 14 cm 	½ ½ ½ ½ 1
31.	The difference between the outer and inner radii of a hollow right circular cylinder of length 14 cm is 1 cm. If the volume of the metal used in making the cylinder is 176 cm^3, find the outer and inner radii of the cylinder.	
Sol.	Let outer radius be r_2 cm and inner radius be r_1 cm. $\therefore r_2 - r_1 = 1$ ---- (i) Volume of metal used = 176 cm^3 $\Longrightarrow \frac{22}{7} \times 14 \times (r_2^2 - r_1^2) = 176$ $\Longrightarrow r_2 + r_1 = 4$ ---- (ii) Solving (i) and (ii), we get $r_2 = \frac{5}{2}$ or 2.5 , $r_1 = \frac{3}{2}$ or 1.5 Therefore, outer radius = 2.5 cm and inner radius = 1.5 cm	½ 1 ½ 1

	SECTION D This section consists of 4 questions of 5 marks each.	
32.	An arc of a circle of radius 21 cm subtends an angle of 60^o at the centre. Find : (i) the length of the arc. (ii) the area of the minor segment of the circle made by the corresponding chord.	
Sol.	 (i) Length of the arc AB = $2 \times \frac{22}{7} \times 21 \times \frac{60}{360}$ = 22 cm (ii) Area of sector OALB = $\frac{22}{7} \times 21 \times 21 \times \frac{60}{360}$ = 231 cm^2 Area of $\Delta OAB = \frac{\sqrt{3}}{4} \times 21 \times 21 = \frac{441\sqrt{3}}{4}$ cm^2 Area of minor segment = $\left(231 - \frac{441\sqrt{3}}{4}\right)$ cm^2 or (231 – 190.95) = 40.05 cm^2	1½ ½ 1 1½ ½
33. (A)	The sum of first and eighth terms of an A.P. is 32 and their product is 60. Find the first term and common difference of the A.P. Hence, also find the sum of its first 20 terms.	
Sol.	$a + a_8 = 32 \Longrightarrow 2a + 7d = 32$ ----- (i) $a \times a_8 = 60 \Longrightarrow a(a + 7d) = 60$ ----- (ii) Solving (i) & (ii), we get a = 2 or a = 30 and d = 4 or d = – 4 First term and common difference of A.P. are 2 and 4 or 30 and – 4 respectively.	1 1 2

	Now, for a = 2 & d = 4 S_{20} = 10 (4 + 76) = 800 and for a = 30 & d = – 4 S_{20} = 10 (60 – 76) = – 160	½ ½
	OR	
33. (B)	In an A.P. of 40 terms, the sum of first 9 terms is 153 and the sum of last 6 terms is 687. Determine the first term and common difference of A.P. Also, find the sum of all the terms of the A.P.	
Sol.	Here n = 40, $S_9 = \frac{9}{2}[2a + 8d] = 153 \Rightarrow a + 4d = 17$ ---- (i) and $S_{40} - S_{34} = 687$ or $a_{35} + a_{36} + a_{37} + a_{38} + a_{39} + a_{40} = 687$ $\Rightarrow 6a + 219d = 687$ or $2a + 73d = 229$ ---- (ii) solving (i) and (ii) to get a = 5, d = 3 Also, $S_{40} = \frac{40}{2}(10 + 39 \times 3) = 2540$	1 2 1 1
34.(A)	If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then prove that the other two sides are divided in the same ratio.	
Sol.	Correct figure, given, to prove and construction Correct proof	4×½ = 2 3
	OR	
34. (B)	In the given figure PA, QB and RC are each perpendicular to AC. If AP = x, BQ = y and CR = z, then prove that $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$  	
Sol.	$\Delta PAC \sim \Delta QBC$ $\therefore \frac{x}{y} = \frac{AC}{BC}$ or $\frac{y}{x} = \frac{BC}{AC}$ ---- (i)	1 1

	$\Delta RCA \sim \Delta QBA$	1
	$\therefore \frac{z}{y} = \frac{AC}{AB}$ or $\frac{y}{z} = \frac{AB}{AC}$ ---- (ii)	1
	Adding (i) and (ii)	
	$\frac{y}{x} + \frac{y}{z} = \frac{BC+AB}{AC}$	½
	$\Longrightarrow \frac{1}{x} + \frac{1}{z} = \frac{1}{y}$	½
35.	A pole 6m high is fixed on the top of a tower. The angle of elevation of the top of the pole observed from a point P on the ground is 60^o and the angle of depression of the point P from the top of the tower is 45^o. Find the height of the tower and the distance of point P from the foot of the tower. (Use $\sqrt{3} = 1.73$)	
Sol.	Correct figure	1
		
	Let BC be the pole and AB be the tower of height 'h' m.	
	$\tan 45° = 1 = \frac{h}{x}$	1
	$\Longrightarrow h = x$ ---- (i)	½
	$\tan 60° = \sqrt{3} = \frac{h + 6}{x}$	1
	$\Longrightarrow h + 6 = x\sqrt{3}$ ---- (ii)	½

	Solving (i) & (ii) to get $h = 3(\sqrt{3} + 1) = 8.19$ and $x = 8.19$ Therefore, the height of tower is 8.19 m and the distance of point P from the foot of the tower is 8.19 m	½ ½
	SECTION E This section consists of 3 Case-Study Based Questions of 4 marks each.	
36.	A rectangular floor area can be completely tiled with 200 square tiles. If the side length of each tile is increased by 1 unit, it would take only 128 tiles to cover the floor. (i) Assuming the original length of each side of a tile be x units, make a quadratic equation from the above information. (ii) Write the corresponding quadratic equation in standard form. (iii) (a) Find the value of x, the length of side of a tile by factorisation. **OR** (b) Solve the quadratic equation for x, using quadratic formula.	
Sol.	(i) $200x^2 = 128(x + 1)^2$ (ii) $25x^2 = 16x^2 + 32x + 16$ $\Rightarrow 9x^2 - 32x - 16 = 0$ (iii) (a) $9x^2 - 32x - 16 = 0$ $\Rightarrow (9x + 4)(x - 4) = 0$ $x \neq \frac{-4}{9}$ so, $x = 4$ OR (iii) (b) $x = \frac{32 \pm \sqrt{1024+576}}{18} = \frac{32 \pm 40}{18}$ $x \neq \frac{-4}{9}$ so, $x = 4$	1 1 1 1 1 1 1

37.

BINGO is game of chance. The host has 75 balls numbered 1 through 75. Each player has a BINGO card with some numbers written on it.

The participant cancels the number on the card when called out a number written on the ball selected at random. Whosoever cancels all the numbers on his/her card, says BINGO and wins the game.

The table given below, shows the data of one such game where 48 balls were used before Tara said 'BINGO'.

Numbers announced	Number of times
0-15	8
15-30	9
30-45	10
45-60	12
60-75	9

Based on the above information, answer the following :

(i) Write the median class.

(ii) When first ball was picked up, what was the probability of calling out an even number ?

(iii) (a) Find median of the given data.

OR

(b) Find mode of the given data.

Sol.

Number announced	0 – 15	15 – 30	30 – 45	45 – 60	60 – 75
Number of times (*f*)	8	9	10	12	9
cf	8	17	27	39	48=N

(i) $\frac{N}{2} = 24$

$\therefore$ median class is 30 – 45 — 1

(ii) P (picking up an even number) = $\frac{37}{75}$ — 1

(iii) (a) Median = $30 + \frac{\left(\frac{48}{2} - 17\right)}{10} \times 15$ — 1

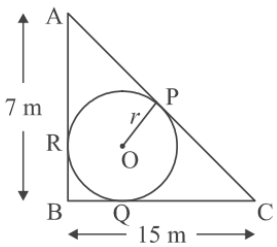
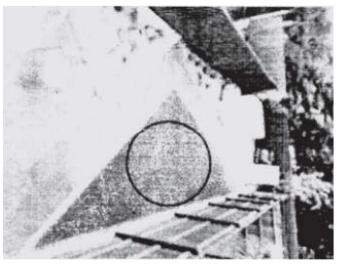
= 40.5 — 1

OR

(iii) (b) Modal class is 45 – 60 — ½

Mode = $45 + \frac{12 - 10}{2 \times 12 - 10 - 9} \times 15$ — 1

= 51 — ½

38.	A backyard is in the shape of a triangle ABC with right angle at B. AB = 7 m and BC = 15 m. A circular pit was dug inside it such that it touches the walls AC, BC and AB at P, Q and R respectively such that AP = x m.   Based on the above information, answer the following questions : (i) Find the length of AR in terms of x. (ii) Write the type of quadrilateral BQOR. (iii) (a) Find the length PC in terms of x and hence find the value of x. **OR** (b) Find x and hence find the radius r of circle.	
Sol.	(i) AR = x m	1
	(ii) Quad. ORBQ is a square.	1
	(iii) (a) PC = 8 + x	½
	$AC^2 = (8 + 2x)^2 = 49 + 225 = 274$ $\Rightarrow 8 + 2x = \sqrt{274}$	1
	$\Rightarrow x = \frac{-8+\sqrt{274}}{2}$ or 4.28 approx.	½
	OR	
	(iii) (b) $AC^2 = (8 + 2x)^2 = 49 + 225 = 274$ $\Rightarrow 8 + 2x = \sqrt{274}$	1
	$\Rightarrow x = \frac{-8+\sqrt{274}}{2}$ or 4.28 approx.	½
	Hence, radius $r = 7 - x = 7 - \left(-4 + \frac{\sqrt{274}}{2}\right)$ $= \left(11 - \frac{\sqrt{274}}{2}\right)$ or 2.72 approx.	½
	Therefore, radius of the circle is $\left(11 - \frac{\sqrt{274}}{2}\right)$ m or 2.72 m approx.	

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **FIVE** Sections – **A, B, C, D** and **E**.*

(iii) *In Section–**A** questions number **1** to **18** are Multiple Choice Questions (MCQs) and question number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section–**B** questions number **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In Section–**C** questions number **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In Section–**D** questions number **32** to **35** are Long Answer (LA) type questions, carrying **5** marks each.*

(vii) *In Section–**E** question number **36** to **38** are Case Study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section–**B**, 2 questions in Section–**C**, 2 questions in Section–**D** and 3 question in Section–**E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **NOT** allowed.*

SECTION – A

20 × 1 = 20

This section consists of 20 questions of 1 mark each.

1. The value of k for which the system of equations $3x - y + 8 = 0$ and $6x - ky + 16 = 0$ has infinitely many solutions, is **1**

(A) -2 (B) 2

(C) $\frac{1}{2}$ (D) $-\frac{1}{2}$

2. Point P divides the line segment joining the points A(4, –5) and B(1, 2) in the ratio 5:2. Co-ordinates of point P are **1**

(A) $\left(\frac{5}{2}, \frac{-3}{2}\right)$ (B) $\left(\frac{11}{7}, 0\right)$

(C) $\left(\frac{13}{7}, 0\right)$ (D) $\left(0, \frac{13}{7}\right)$

3. The common difference of an A.P. in which $a_{15} - a_{11} = 48$, is **1**

(A) 12 (B) 16

(C) –12 (D) –16

4. The quadratic equation $x^2 + x + 1 = 0$ has _____ roots. **1**

(A) real and equal (B) irrational

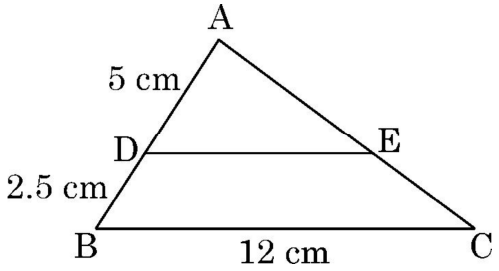
(C) real and distinct (D) not-real

5. If the HCF (2520, 6600) = 40 and LCM (2520, 6600) = 252 × k, then the value of k is **1**

(A) 1650 (B) 1600

(C) 165 (D) 1625

6. In the given figure ΔABC is shown. DE is parallel to BC. If AD = 5 cm, DB = 2.5 cm and BC = 12 cm, then DE is equal to **1**



(A) 10 cm (B) 6 cm

(C) 8 cm (D) 7.5 cm

7. If $\sin\theta = \cos\theta$, $(0° < \theta < 90°)$, then value of $(\sec\theta \cdot \sin\theta)$ is : **1**

(A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$

(C) 1 (D) 0

8. Two dice are rolled together. The probability of getting the sum of the two numbers to be more than 10, is **1**

(A) $\frac{1}{9}$ (B) $\frac{1}{6}$

(C) $\frac{7}{12}$ (D) $\frac{1}{12}$

9. If α and β are zeroes of the polynomial $5x^2 + 3x - 7$, the value of $\frac{1}{\alpha} + \frac{1}{\beta}$ is **1**

(A) $-\frac{3}{7}$ (B) $\frac{3}{5}$

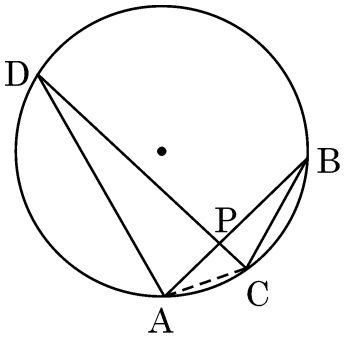
(C) $\frac{3}{7}$ (D) $-\frac{5}{7}$

10. The perimeters of two similar triangles ABC and PQR are 56 cm and 48 cm respectively. PQ/AB is equal to **1**

(A) $\frac{7}{8}$ (B) $\frac{6}{7}$

(C) $\frac{7}{6}$ (D) $\frac{8}{7}$

11. AB and CD are two chords of a circle intersecting at P. Choose the correct statement from the following : **1**



(A) $\Delta ADP \sim \Delta CBA$ (B) $\Delta ADP \sim \Delta BPC$

(C) $\Delta ADP \sim \Delta BCP$ (D) $\Delta ADP \sim \Delta CBP$

12. If value of each observation in a data is increased by 2, then median of the new data **1**

(A) increases by 2 (B) increases by 2n

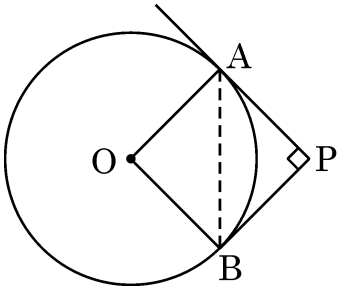
(C) remains same (D) decreases by 2

13. A box contains cards numbered 6 to 55. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square, is **1**

(A) $\frac{7}{50}$ (B) $\frac{7}{55}$

(C) $\frac{1}{10}$ (D) $\frac{5}{49}$

14. In the given figure, tangents PA and PB to the circle centred at O, from point P are perpendicular to each other. If PA = 5 cm, then length of AB is equal to **1**



(A) 5 cm (B) $5\sqrt{2}$ cm

(C) $2\sqrt{5}$ cm (D) 10 cm

15. XOYZ is a rectangle with vertices X(–3, 0), O(0, 0), Y(0, 4) and Z(x, y). The length of its each diagonal is **1**

(A) 5 units (B) $\sqrt{5}$ units

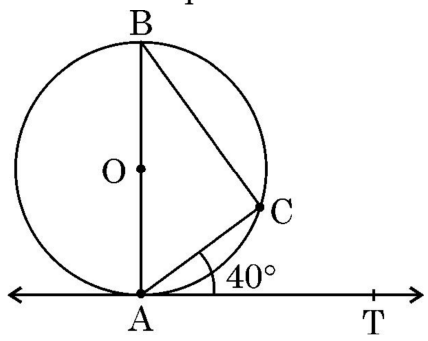
(C) $x^2 + y^2$ units (D) 4 units

16. Which term of the A.P. –29, –26, –23, ..., 61 is 16 ? **1**

(A) 11^{th} (B) 16^{th}

(C) 10^{th} (D) 31^{st}

17. In the given figure, AT is tangent to a circle centred at O. If $\angle CAT = 40°$, then $\angle CBA$ is equal to **1**



(A) 70° (B) 50°

(C) 65° (D) 40°

18. After an examination, a teacher wants to know the marks obtained by maximum number of the students in her class. She requires to calculate _____ of marks. **1**

(A) median (B) mode

(C) mean (D) range

Directions : In Question **19** and **20**, **Assertion (A)** and **Reason (R)** are given. Select the correct option from the following :

(A) Both Assertion (A) and Reason (R) are true. Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true. Reason (R) does not give correct explanation of (A).

(C) Assertion (A) is true but Reason (R) is not true.

(D) Assertion (A) is not true but Reason (R) is true.

19. **Assertion (A) :** If $\sin A = \frac{1}{3}$ $(0° < A < 90°)$, then the value of $\cos A$ is $\frac{2\sqrt{2}}{3}$

Reason (R) : For every angle θ, $\sin^2\theta + \cos^2\theta = 1$. **1**

20. **Assertion (A) :** Two cubes each of edge length 10 cm are joined together. The total surface area of newly formed cuboid is 1200 cm^2.

Reason (R) : Area of each surface of a cube of side 10 cm is 100 cm^2. **1**

SECTION – B

In this section, there are 5 questions of 2 marks each.

21. Can the number $(15)^n$, n being a natural number, end with the digit 0 ? Give reasons. **2**

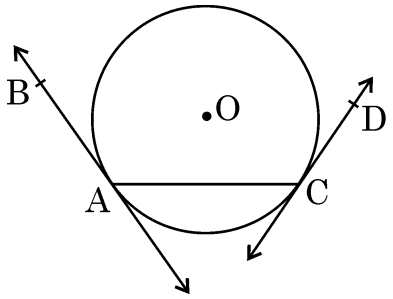
22. Find the type of triangle ABC formed whose vertices are A(1, 0), B(–5, 0) and C(–2, 5). **2**

23. (a) Evaluate : $2 \sin^2 30° \sec 60° + \tan^2 60°$. **2**

OR

(b) If $2 \sin (A + B) = \sqrt{3}$ and $\cos (A - B) = 1$, then find the measures of angles A and B. $0 \leq A, B, (A + B) \leq 90°$. **2**

24. In the given figure, AB and CD are tangents to a circle centred at O. Is $\angle BAC = \angle DCA$? Justify your answer. **2**



25. (a) In what ratio is the line segment joining the points (3, –5) and (–1, 6) divided by the line $y = x$? **2**

OR

(b) A(3, 0), B(6, 4) and C(–1, 3) are vertices of a triangle ABC. Find length of its median BE. **2**

SECTION – C

This section consists of 6 questions of 3 marks each.

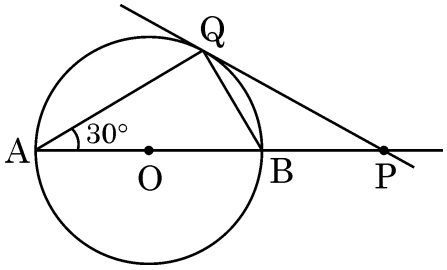
26. (a) If the sum of first m terms of an A.P. is same as sum of its first n terms ($m \neq n$), then show that the sum of its first (m + n) terms is zero. **3**

OR

(b) In an A.P., the sum of three consecutive terms is 24 and the sum of their squares is 194. Find the numbers. **3**

27. Prove that $\sqrt{5}$ is an irrational number. **3**

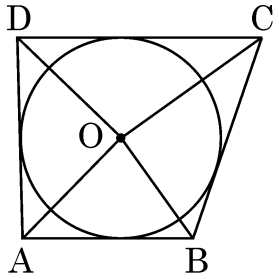
28. (a) In the given figure, PQ is tangent to a circle centred at O and $\angle BAQ = 30°$; show that BP = BQ. **3**



OR

(b) In the given figure, AB, BC, CD and DA are tangents to the circle with centre O forming a quadrilateral ABCD. **3**

Show that $\angle AOB + \angle COD = 180°$



29. Prove that $\frac{1 + \sec\theta - \tan\theta}{1 + \sec\theta + \tan\theta} = \frac{1 - \sin\theta}{\cos\theta}$. **3**

30. In a test, the marks obtained by 100 students (out of 50) are given below : **3**

Marks obtained :	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
Number of students :	12	23	34	25	6

Find the mean marks of the students.

31. In a 2-digit number, the digit at the unit's place is 5 less than the digit at the ten's place. The product of the digits is 36. Find the number. **3**

SECTION – D

This section consists of 4 questions of 5 marks each.

32. (a) Using graphical method, solve the following system of equations : **5**

$3x + y + 4 = 0$ and $3x - y + 2 = 0$

OR

(b) Tara scored 40 marks in a test, getting 3 marks for each right answer and losing 1 mark for each wrong answer. Had 4 marks been awarded for each correct answer and 2 marks been deducted for each wrong answer, then Tara would have scored 50 marks. Assuming that Tara attempted all questions, find the total number of questions in the test. **5**

33. (a) If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then prove that the other two sides are divided in the same ratio. **5**

OR

(b) Sides AB and AC and median AD to ΔABC are respectively proportional to sides PQ and PR and median PM of another triangle PQR. Show that $\Delta ABC \sim \Delta PQR$. **5**

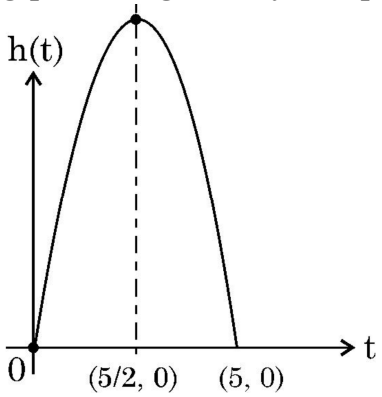
34. From the top of a 45 m high light house, the angles of depression of two ships, on the opposite side of it, are observed to be 30° and 60°. If the line joining the ships passes through the foot of the light house, find the distance between the ships. (Use $\sqrt{3} = 1.73$) **5**

35. The perimeter of a certain sector of a circle of radius 5.6 m is 20.0 m. Find the area of the sector. **5**

SECTION – E

This section consists of 3 case based questions of 4 marks each.

36. A ball is thrown in the air so that t seconds after it is thrown, its height h metre above its starting point is given by the polynomial $h = 25t - 5t^2$.



Observe the graph of the polynomial and answer the following questions :

(i) Write zeroes of the given polynomial. **1**

(ii) Find the maximum height achieved by ball. **1**

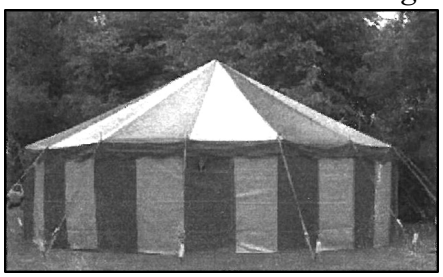
(iii) (a) After throwing upward, how much time did the ball take to reach to the height of 30 m ? **2**

OR

(iii) (b) Find the two different values of t when the height of the ball was 20 m. **2**

37. The word 'circus' has the same root as 'circle'. In a closed circular area, various entertainment acts including human skill and animal training are presented before the crowd.

A circus tent is cylindrical upto a height of 8 m and conical above it. The diameter of the base is 28 m and total height of tent is 18.5 m.



Based on the above, answer the following questions :

(i) Find slant height of the conical part. **1**

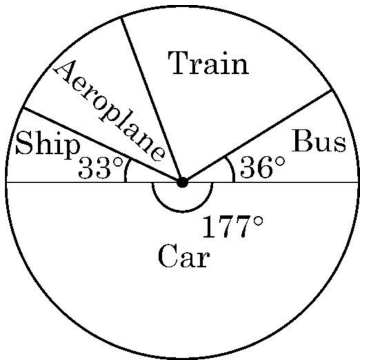
(ii) Determine the floor area of the tent. **1**

(iii) (a) Find area of the cloth used for making tent. **2**

OR

(iii) (b) Find total volume of air inside an empty tent. **2**

38. In a survey on holidays, 120 people were asked to state which type of transport they used on their last holiday. The following pie chart shows the results of the survey.



Observe the pie chart and answer the following questions :

(i) If one person is selected at random, find the probability that he/she travelled by bus or ship. **1**

(ii) Which is most favourite mode of transport and how many people used it ? **1**

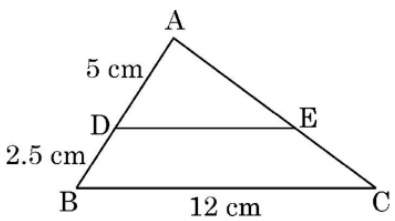
(iii) (a) A person is selected at random. If the probability that he did not use train is 4/5, find the number of people who used train. **2**

OR

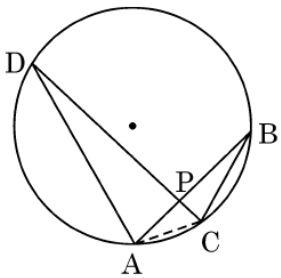
(iii) (b) The probability that randomly selected person used aeroplane is 7/60. Find the revenue collected by air company at the rate of ₹ 5,000 per person. **2**

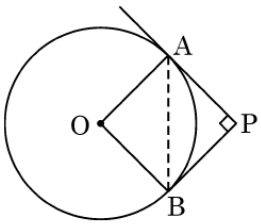
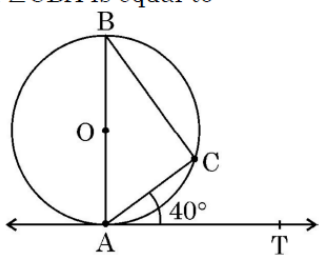
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/2/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **This section consists of 20 questions of 1 mark each.**	
1.	The value of k for which the system of equations $3x - y + 8 = 0$ and $6x - ky + 16 = 0$ has infinitely many solutions, is (A) -2 (B) 2 (C) $\frac{1}{2}$ (D) $-\frac{1}{2}$	
Sol.	(B) 2	**1**
2.	Point P divides the line segment joining the points A(4, –5) and B(1, 2) in the ratio 5:2. Co-ordinates of point P are (A) $\left(\frac{5}{2}, \frac{-3}{2}\right)$ (B) $\left(\frac{11}{7}, 0\right)$ (C) $\left(\frac{13}{7}, 0\right)$ (D) $\left(0, \frac{13}{7}\right)$	
Sol.	(C) $\left(\frac{13}{7}, 0\right)$	**1**

3.	The common difference of an A.P. in which $a_{15} - a_{11} = 48$, is (A) 12 (B) 16 (C) –12 (D) –16	
Sol.	(A) 12	**1**
4.	The quadratic equation $x^2 + x + 1 = 0$ has _____ roots. (A) real and equal (B) irrational (C) real and distinct (D) not-real	
Sol.	(D) not-real	**1**
5.	If the HCF (2520, 6600) = 40 and LCM (2520, 6600) = 252 × k, then the value of k is (A) 1650 (B) 1600 (C) 165 (D) 1625	
Sol.	(A) 1650	**1**
6.	In the given figure ΔABC is shown. DE is parallel to BC. If AD = 5 cm, DB = 2.5 cm and BC = 12 cm, then DE is equal to  (A) 10 cm (B) 6 cm (C) 8 cm (D) 7.5 cm	
Sol.	(C) 8 cm	**1**

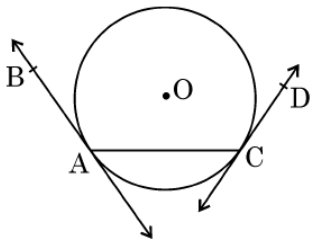
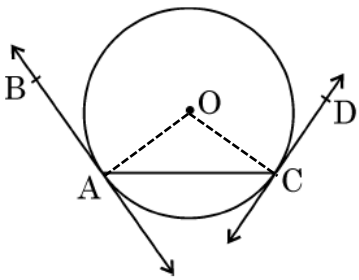
7.	If $\sin\theta = \cos\theta$, $(0° < \theta < 90°)$, then value of $(\sec\theta \cdot \sin\theta)$ is : (A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$ (C) 1 (D) 0	
Sol.	(C) 1	**1**
8.	Two dice are rolled together. The probability of getting the sum of the two numbers to be more than 10, is (A) $\frac{1}{9}$ (B) $\frac{1}{6}$ (C) $\frac{7}{12}$ (D) $\frac{1}{12}$	
Sol.	(D) $\mathbf{\frac{1}{12}}$	**1**
9.	If α and β are zeroes of the polynomial $5x^2 + 3x - 7$, the value of $\frac{1}{\alpha} + \frac{1}{\beta}$ is (A) $-\frac{3}{7}$ (B) $\frac{3}{5}$ (C) $\frac{3}{7}$ (D) $-\frac{5}{7}$	
Sol.	(C) $\mathbf{\frac{3}{7}}$	**1**
10.	The perimeters of two similar triangles ABC and PQR are 56 cm and 48 cm respectively. PQ/AB is equal to (A) $\frac{7}{8}$ (B) $\frac{6}{7}$ (C) $\frac{7}{6}$ (D) $\frac{8}{7}$	
Sol.	(B) $\mathbf{\frac{6}{7}}$	**1**

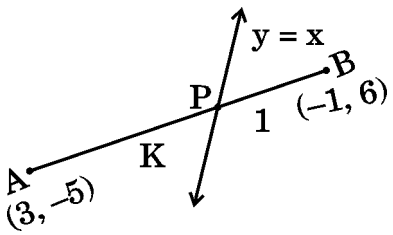
11.	AB and CD are two chords of a circle intersecting at P. Choose the correct statement from the following :  (A) $\Delta ADP \sim \Delta CBA$ (B) $\Delta ADP \sim \Delta BPC$ (C) $\Delta ADP \sim \Delta BCP$ (D) $\Delta ADP \sim \Delta CBP$	
Sol.	(D) $\Delta ADP \sim \Delta CBP$	**1**
12.	If value of each observation in a data is increased by 2, then median of the new data (A) increases by 2 (B) increases by 2n (C) remains same (D) decreases by 2	
Sol.	(A) increases by 2	**1**
13.	A box contains cards numbered 6 to 55. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square, is (A) $\frac{7}{50}$ (B) $\frac{7}{55}$ (C) $\frac{1}{10}$ (D) $\frac{5}{49}$	
Sol.	(C) $\frac{1}{10}$	**1**

14.	In the given figure, tangents PA and PB to the circle centred at O, from point P are perpendicular to each other. If PA = 5 cm, then length of AB is equal to  (A) 5 cm (B) $5\sqrt{2}$ cm (C) $2\sqrt{5}$ cm (D) 10 cm	
Sol.	(B) $5\sqrt{2}$ cm	**1**
15.	XOYZ is a rectangle with vertices X(–3, 0), O(0, 0), Y(0, 4) and Z(x, y). The length of its each diagonal is (A) 5 units (B) $\sqrt{5}$ units (C) $x^2 + y^2$ units (D) 4 units	
Sol.	(A) 5 units	**1**
16.	Which term of the A.P. –29, –26, –23, ..., 61 is 16 ? (A) 11^{th} (B) 16^{th} (C) 10^{th} (D) 31^{st}	
Sol.	(B) 16^{th}	**1**
17.	In the given figure, AT is tangent to a circle centred at O. If ∠CAT = 40°, then ∠CBA is equal to  (A) 70° (B) 50° (C) 65° (D) 40°	
Sol.	(D) 40°	**1**

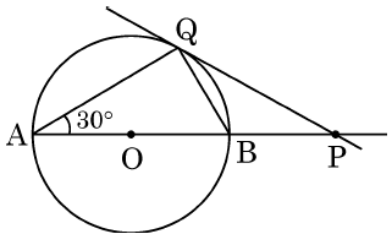
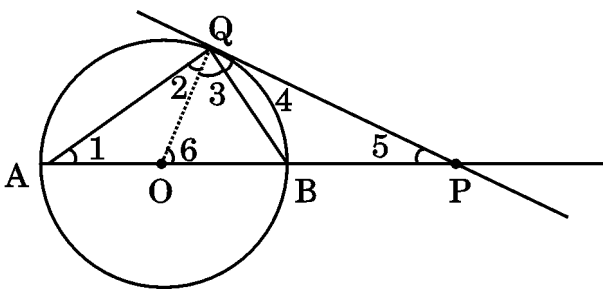
18.	After an examination, a teacher wants to know the marks obtained by maximum number of the students in her class. She requires to calculate _____ of marks. (A) median (B) mode (C) mean (D) range	
Sol.	(B) mode	**1**
	Directions : In Question **19** and **20**, **Assertion (A)** and **Reason (R)** are given. Select the correct option from the following : (A) Both Assertion (A) and Reason (R) are true. Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true. Reason (R) does not give correct explanation of (A). (C) Assertion (A) is true but Reason (R) is not true. (D) Assertion (A) is not true but Reason (R) is true.	
19.	**Assertion (A) :** If $\sin A = \frac{1}{3}$ $(0° < A < 90°)$, then the value of $\cos A$ is $\frac{2\sqrt{2}}{3}$ **Reason (R) :** For every angle θ, $\sin^2\theta + \cos^2\theta = 1$.	
Sol.	(A) Both Assertion (A) and (R) are true. Reason (R) is the correct explanation of Assertion (A)	**1**
20.	**Assertion (A) :** Two cubes each of edge length 10 cm are joined together. The total surface area of newly formed cuboid is 1200 cm^2. **Reason (R) :** Area of each surface of a cube of side 10 cm is 100 cm^2.	
Sol.	(D) Assertion (A) is not true but Reason (R) is true.	**1**

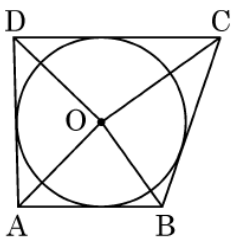
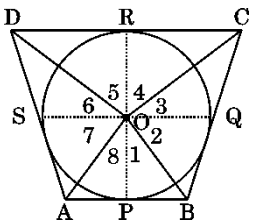
	SECTION B **In this section, there are 5 questions of 2 marks each.**	
21.	Can the number $(15)^n$, n being a natural number, end with the digit 0 ? Give reasons.	
Sol.	$\mathbf{15^n = 5^n \times 3^n}$ A number ends with zero if it has two prime factors 2 and 5 both. Since $\mathbf{15^n}$ does not have 2 as a prime factor, so it can't end with zero	**1** **1**
22.	Find the type of triangle ABC formed whose vertices are A(1, 0), B(–5, 0) and C(–2, 5).	
Sol.	$A(1,0)\quad B(-5,0)\quad C(-2,5)$ $AB = \sqrt{(-5-1)^2 + (0-0)^2} = 6$ $BC = \sqrt{(-5+2)^2 + (0-5)^2} = \sqrt{34}$ $CA = \sqrt{(1+2)^2 + (0-5)^2} = \sqrt{34}$ $\therefore BC = CA$ So, ΔABC is isosceles.	½ ½ ½ ½
23(a).	Evaluate : $2\sin^2 30° \sec 60° + \tan^2 60°$.	
Sol.	$2sin^2 30° \sec 60° + tan^2 60°$ $= 2 \times \left(\frac{1}{2}\right)^2 \times 2 + \left(\sqrt{3}\right)^2$ $= 4$	**1½** ½
	OR	
23(b).	If $2\sin(A + B) = \sqrt{3}$ and $\cos(A - B) = 1$, then find the measures of angles A and B. $0 \le A, B, (A + B) \le 90°$.	
Sol.	$\sin(A + B) = \frac{\sqrt{3}}{2} \Rightarrow A + B = 60° \ldots (1)$	½

	$\cos(A - B) = 1 \Rightarrow A - B = 0° \ldots (2)$ Solving (1) and (2), we get $A = B = 30°$	½ **1**
24.	In the given figure, AB and CD are tangents to a circle centred at O. Is $\angle BAC = \angle DCA$? Justify your answer.  	
Sol.	 Join OA and OC $OA = OC$ $\angle OAC = \angle OCA$ Also, $\angle OAB = \angle OCD$ $\Rightarrow \angle OAC + \angle OAB = \angle OCA + \angle OCD$ $\Rightarrow \angle BAC = \angle DCA$	 ½ ½ ½ ½

25(a).	In what ratio is the line segment joining the points (3, –5) and (–1, 6) divided by the line y = x ?	
Sol.	 Let the required ratio be K:1 Coordinates of point P are $\left(\frac{-K+3}{K+1}, \frac{6K-5}{K+1}\right)$ Point P lies on line y = x $\Rightarrow \frac{-K+3}{K+1} = \frac{6K-5}{K+1}$ Solving, we get K = $\frac{8}{7}$ ∴ Required ratio is 8: 7	**1** ½ ½
	OR	
25(b).	A(3, 0), B(6, 4) and C(–1, 3) are vertices of a triangle ABC. Find length of its median BE.	
Sol.	Mid-point of AC is $E\left(1, \frac{3}{2}\right)$ Length of median BE $= \sqrt{(6-1)^2 + (4-\frac{3}{2})^2} = \sqrt{\frac{125}{4}}$ or $\frac{5\sqrt{5}}{2}$	**1** **1**
	SECTION C **This section consists of 6 questions of 3 marks each.**	

26(a).	If the sum of first m terms of an A.P. is same as sum of its first n terms (m ≠ n), then show that the sum of its first (m + n) terms is zero.	
Sol.	$\mathbf{S_m = S_n}$ $\mathbf{\Rightarrow \frac{m}{2}[2a + (m-1)d = \frac{n}{2}[2a + (n-1)d]}$ $\mathbf{\Rightarrow 2a(m-n) = d(n^2 - m^2) - d(n-m)}$ $\mathbf{\Rightarrow 2a = -d(m+n-1)}$ $\mathbf{or\ 2a + (m+n-1)d = 0}$ $\mathbf{i.e., S_{m+n} = \frac{m+n}{2}[2a + (m+n-1)d] = 0}$	**1** **1** ½ ½
	OR	
26(b).	In an A.P., the sum of three consecutive terms is 24 and the sum of their squares is 194. Find the numbers.	
Sol.	Let the numbers be $a - d, a, a + d$ $\therefore a - d + a + a + d = 24$ $\Rightarrow a = 8$ Also, $(a-d)^2 + a^2 + (a+d)^2 = 194$ $\Rightarrow (8-d)^2 + 8^2 + (8+d)^2 = 194$ $\Rightarrow d^2 = 1 \Rightarrow d = \pm 1$ ∴ Numbers are 7, 8, 9 or 9,8,7	½ ½ **1** ½ ½
27.	Prove that $\sqrt{5}$ is an irrational number.	
Sol.	Let $\mathbf{\sqrt{5}}$ be a rational number. $\therefore \mathbf{\sqrt{5} = \frac{p}{q}}$, where q≠0 and let p & q be co-prime. $5q^2 = p^2 \Rightarrow p^2$ is divisible by 5 $\Rightarrow$ p is divisible by 5 ----- (i) $\Rightarrow p = 5a$, where 'a' is some integer $25a^2 = 5q^2 \Rightarrow q^2 = 5a^2 \Rightarrow q^2$ is divisible by 5 $\Rightarrow$ q is divisible by 5 ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are co-prime. $\therefore \mathbf{\sqrt{5}}$ is an irrational number.	½ **1** **1** ½

28(a).	In the given figure, PQ is tangent to a circle centred at O and $\angle BAQ = 30°$; show that BP = BQ.  	
Sol.	 Join OQ OQ=OA $\Rightarrow \angle 2 = 30^0$ $\angle 3 = 90^0 - 30^0 = 60^0$ $\angle 4 = 90^0 - 60^0 = 30^0$ $\angle 6 = \angle 1 + \angle 2 = 60^0$ Hence $\angle 5 = 90^0 - 60^0 = 30^0 = \angle 4$ $\therefore$ BP=BQ	½ ½ ½ ½ ½ ½
	OR	

28(b).	In the given figure, AB, BC, CD and DA are tangents to the circle with centre O forming a quadrilateral ABCD. Show that $\angle AOB + \angle COD = 180°$  	
Sol.	 Join OP, OQ, OR and OS $\Delta POB \cong \Delta QOB$ $\Rightarrow \angle 1 = \angle 2$ Similarly $\angle 3 = \angle 4, \angle 5 = \angle 6, \angle 7 = \angle 8$ Now, $\angle 1+\angle 2+\angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$ $\Rightarrow 2(\angle 1+\angle 8 + \angle 4 + \angle 5) = 360°$ $\therefore \angle AOB + \angle COD = 180°$	½ **1** ½ ½ ½

29. Prove that $\frac{1+\sec\theta-\tan\theta}{1+\sec\theta+\tan\theta}=\frac{1-\sin\theta}{\cos\theta}$.

Sol.

$$\text{LHS} = \frac{(\sec^2\theta-\tan^2\theta)+(\sec\theta-\tan\theta)}{1+\sec\theta+\tan\theta}$$

$$= \frac{(\sec\theta-\tan\theta)(\sec\theta+\tan\theta+1)}{1+\sec\theta+\tan\theta}$$

$$= \sec\theta-\tan\theta$$

$$= \frac{1}{\cos\theta}-\frac{\sin\theta}{\cos\theta}$$

$$= \frac{1-\sin\theta}{\cos\theta} = \text{RHS}$$

1 **1** **1**

30. In a test, the marks obtained by 100 students (out of 50) are given below :

Marks obtained :	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
Number of students :	12	23	34	25	6

Find the mean marks of the students.

Sol.

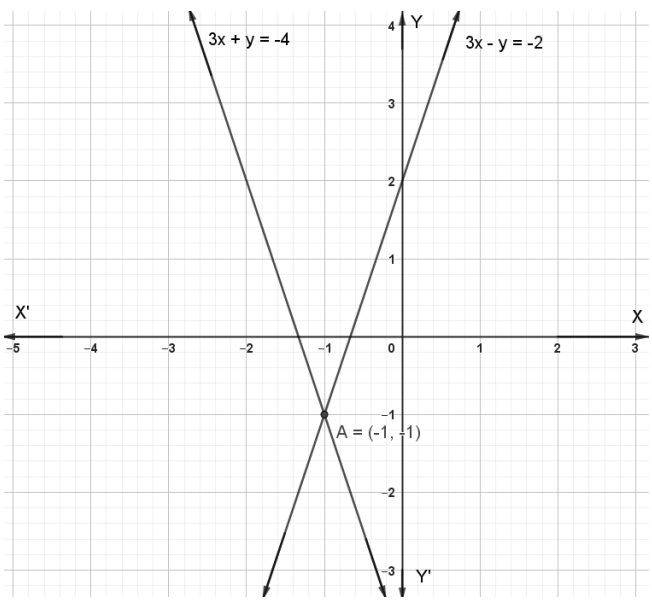
Marks Obtained	Number of students ($\mathbf{f_i}$)	$\mathbf{x_i}$	$\mathbf{f_ix_i}$
0 – 10	12	5	60
10 – 20	23	15	345
20 – 30	34	25	850
30 – 40	25	35	875
40 – 50	6	45	270
Total	100		2400

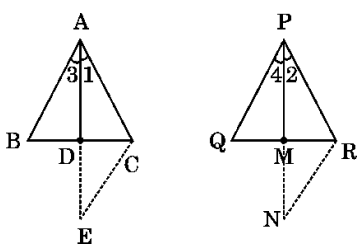
1½ marks for correct table

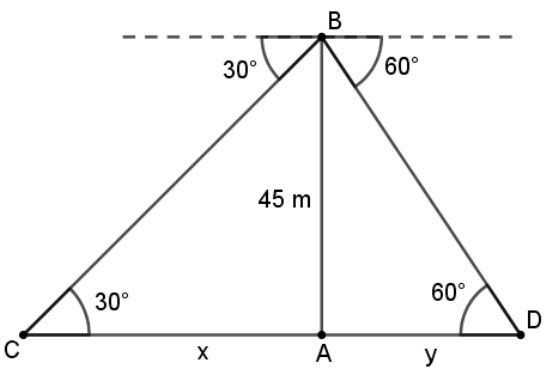
$$\text{Mean} = \frac{2400}{100}$$

$$= 24$$

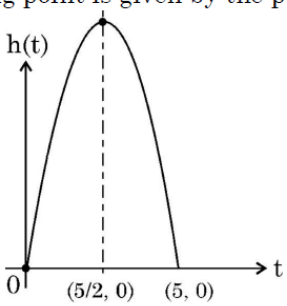
1 **½**

31.	In a 2-digit number, the digit at the unit's place is 5 less than the digit at the ten's place. The product of the digits is 36. Find the number.	
Sol.	Let digit at ten's place be x then digit at unit's place = $\mathbf{x-5}$ $x(x-5) = 36$ $\Rightarrow x^2 - 5x - 36 = 0$ $(x-9)(x+4) = 0$ $x \neq -4$ so, $x = 9$ $\therefore$ Required number is 94	½ ½ ½ ½ ½ ½
	SECTION D **This section consists of 4 questions of 5 marks each.**	
32(a).	Using graphical method, solve the following system of equations : $3x + y + 4 = 0$ and $3x - y + 2 = 0$	
Sol.	 Correct solution $\mathbf{x = -1, y = -1}$	**2 marks for each correct line** **1**
	OR	

32(b).	Tara scored 40 marks in a test, getting 3 marks for each right answer and losing 1 mark for each wrong answer. Had 4 marks been awarded for each correct answer and 2 marks been deducted for each wrong answer, then Tara would have scored 50 marks. Assuming that Tara attempted all questions, find the total number of questions in the test.	
Sol.	Let number of correct answers be x and number of incorrect answers be y $3x - y = 40$ $4x - 2y = 50$ Solving, we get $x = 15$, $y = 5$ $\therefore$ Total number of questions = 20	 **1½** **1½** **1** **1**
33(a).	If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then prove that the other two sides are divided in the same ratio.	
Sol.	Correct Given, to prove, figure, construction Correct proof	**½ ×4=2** **3**
	OR	
33(b).	Sides AB and AC and median AD to ΔABC are respectively proportional to sides PQ and PR and median PM of another triangle PQR. Show that $\Delta ABC \sim \Delta PQR$.	
Sol.	 Correct figure	 **1**

	Produce AD to E such that AD = DE and join EC Produce PM to N such that PM = MN and join NR $\Delta ADB \cong \Delta EDC$ $\therefore$ AB = EC Similarly, PQ=NR Since, $\frac{AB}{PQ} = \frac{AC}{PR} = \frac{AD}{PM}$ $\Rightarrow \frac{EC}{NR} = \frac{AC}{PR} = \frac{\frac{AE}{2}}{\frac{PN}{2}}$ $\therefore \Delta AEC \sim \Delta PNR$ $\Rightarrow \angle 1 = \angle 2$ Similarly, $\angle 3 = \angle 4$ Hence $\angle 1 + \angle 3 = \angle 2 + \angle 4$ or $\angle A = \angle P$ Also, $\frac{AB}{PQ} = \frac{AC}{PR}$ $\therefore \Delta ABC \sim \Delta PQR$	½ **1** **1** ½ ½ ½
34.	From the top of a 45 m high light house, the angles of depression of two ships, on the opposite side of it, are observed to be 30° and 60°. If the line joining the ships passes through the foot of the light house, find the distance between the ships. (Use $\sqrt{3} = 1.73$)	
Sol.	 Let AB be the light house and C and D be positions of ships.	**1 mark for correct figure**

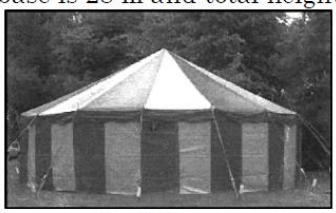
	$\tan 60° = \sqrt{3} = \frac{45}{y}$ $\Rightarrow y = 15\sqrt{3}$ $\tan 30° = \frac{1}{\sqrt{3}} = \frac{45}{x}$ $\Rightarrow x = 45\sqrt{3}$ Distance between two ships = x+y = $60\sqrt{3}$ $= 60 \times 1.73 = 103.8$ m	**1** **½** **1** **½** **1**
35.	The perimeter of a certain sector of a circle of radius 5.6 m is 20.0 m. Find the area of the sector.	
Sol.	$2r + \frac{2\pi r\theta}{360} = 20$ $\Rightarrow 11.2 + 2 \times \frac{22}{7} \times 5.6 \times \frac{\theta}{360} = 20$ Solving, we get $\theta = 90°$ $\therefore$ Area of sector = $\frac{22}{7} \times 5.6 \times 5.6 \times \frac{90}{360}$ $= 24.64\ m^2$	**2** **1** **1** **1**
	SECTION E **This section consists of 3 case based questions of 4 marks each.**	

36.	A ball is thrown in the air so that t seconds after it is thrown, its height h metre above its starting point is given by the polynomial $h = 25t - 5t^2$.  Observe the graph of the polynomial and answer the following questions : (i) Write zeroes of the given polynomial. **1** (ii) Find the maximum height achieved by ball. **1** (iii) (a) After throwing upward, how much time did the ball take to reach to the height of 30 m ? **2** **OR** (iii) (b) Find the two different values of t when the height of the ball was 20 m. **2**	
Sol.	(i) Zeroes of the polynomial are 0 and 5	**1**
	(ii) Maximum height achieved by ball	
	$= 25 \times \frac{5}{2} - 5 \times \left(\frac{5}{2}\right)^2$	½
	$= \frac{125}{4}$ or 31.25 m	½
	(iii) (a) $-5t^2 + 25t = 30$	½
	$\Rightarrow t^2 - 5t + 6 = 0$	½
	$\Rightarrow (t-2)(t-3) = 0$	½
	$t \neq 3,\ t = 2$	½
	OR	
	(iii) (b) $-5t^2 + 25t = 20$	½
	$\Rightarrow t^2 - 5t + 4 = 0$	½
	$\Rightarrow (t-4)(t-1) = 0$	½
	$\Rightarrow t = 4, 1$	½

37.

The word 'circus' has the same root as 'circle'. In a closed circular area, various entertainment acts including human skill and animal training are presented before the crowd.

A circus tent is cylindrical upto a height of 8 m and conical above it. The diameter of the base is 28 m and total height of tent is 18.5 m.



Based on the above, answer the following questions :

(i) Find slant height of the conical part. **1**

(ii) Determine the floor area of the tent. **1**

(iii) (a) Find area of the cloth used for making tent. **2**

OR

(iii) (b) Find total volume of air inside an empty tent. **2**

Sol.

(i) Height of conical part $= 18.5 - 8 = 10.5$ m **½**

Radius of conical part $= 14$ m

Slant height $= \sqrt{(10.5)^2 + (14)^2} = 17.5$ m **½**

(ii) Floor area $= \frac{22}{7} \times 14 \times 14 = 616\ \text{m}^2$ **1**

(iii) (a) Area of cloth used

$= 2 \times \frac{22}{7} \times 14 \times 8 + \frac{22}{7} \times 14 \times 17.5$ **1**

$= 1474\ \text{m}^2$ **1**

OR

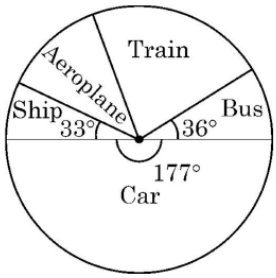
(iii) (b) Volume of air inside the tent

$= \frac{22}{7} \times 14 \times 14 \times 8 + \frac{1}{3} \times \frac{22}{7} \times 14 \times 14 \times 10.5$ **1**

$= 7084\ \text{m}^3$ **1**

38.

In a survey on holidays, 120 people were asked to state which type of transport they used on their last holiday. The following pie chart shows the results of the survey.



Observe the pie chart and answer the following questions :

(i) If one person is selected at random, find the probability that he/she travelled by bus or ship. **1**

(ii) Which is most favourite mode of transport and how many people used it ? **1**

(iii) (a) A person is selected at random. If the probability that he did not use train is 4/5, find the number of people who used train. **2**

OR

(iii) (b) The probability that randomly selected person used aeroplane is 7/60. Find the revenue collected by air company at the rate of ₹ 5,000 per person. **2**

Sol.

(i) P (travelling by bus or ship) = $\frac{36+33}{360} = \frac{69}{360}$ or $\frac{23}{120}$ **1**

(ii) Car **½**

Number of people who used car = $\frac{177}{360} \times 120 = 59$ **½**

(iii) (a) P (person used train)= $1 - \frac{4}{5} = \frac{1}{5}$ **1**

∴ Number of people who used train = $\frac{120}{5} = 24$ **1**

OR

(iii) (b) Number of people who used aeroplane = $\frac{7}{60} \times 120 = 14$ **1**

∴ Revenue generated= $14 \times 5000 = ₹\ 70{,}000$ **1**

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This Question Paper is divided into **FIVE** Sections – **Section A, B, C, D** and **E**.*

(iii) *In Section–**A**, questions number **1** to **18** are Multiple Choice Questions (MCQs) and question number **19** & **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section–**B**, questions number **21** to **25** are Very Short-Answer (VSA) type questions, carrying **2** marks each.*

(v) *In Section–**C**, questions number **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In Section–**D**, questions number **32** to **35** are Long Answer (LA) type questions, carrying **5** marks each.*

(vii) *In Section–**E**, questions number **36** to **38** are Case Study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section–**B**, 2 questions in Section–**C**, 2 questions in Section–**D** and 3 questions in Section–**E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **not** allowed.*

SECTION – A

20 × 1 = 20

This section consists of **20** questions of **1** mark each.

1. The pair of linear equations $x + 2y + 5 = 0$ and $-3x = 6y - 1$ has **1**

(A) unique solution (B) exactly two solutions

(C) infinitely many solutions (D) no solution

2. The common difference of the A.P. **1**

$\frac{1}{2x}, \frac{1-4x}{2x}, \frac{1-8x}{2x}$, ...is :

(A) $-2x$ (B) -2

(C) 2 (D) $2x$

3. Two dice are thrown together. The probability that they show different numbers is : **1**

(A) 1/6 (B) 5/6

(C) 1/3 (D) 2/3

4. The probability of guessing the correct answer to a certain test question is $\frac{x}{6}$. If the probability of not guessing the correct answer to this question is $\frac{2}{3}$, then the value of x is : **1**

(A) 2 (B) 3

(C) 4 (D) 6

5. If $a = 2^2 \times 3^x$, $b = 2^2 \times 3 \times 5$, $c = 2^2 \times 3 \times 7$ and LCM (a, b, c) = 3780, then x is equal to **1**

(A) 1 (B) 2

(C) 3 (D) 0

6. The zeroes of the quadratic polynomial $2x^2 - 3x - 9$ are : **1**

(A) $3, \frac{-3}{2}$ (B) $-3, \frac{-3}{2}$

(C) $-3, \frac{3}{2}$ (D) $3, \frac{3}{2}$

7. From a point on the ground, which is 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 60°. The height (in metres) of the tower is : **1**

(A) $10\sqrt{3}$ (B) $30\sqrt{3}$

(C) 60 (D) 30

8. If $\cos\theta = \frac{\sqrt{3}}{2}$ and $\sin\phi = \frac{1}{2}$, then $\tan(\theta + \phi)$ is : **1**

(A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$

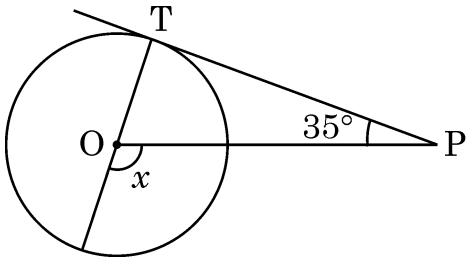
(C) 1 (D) not defined

9. Maximum number of common tangents that can be drawn to two circles intersecting at two distinct points is : **1**

(A) 4 (B) 3

(C) 2 (D) 1

10. In the given figure, if PT is a tangent to a circle with centre O and $\angle TPO = 35°$, then the measure of $\angle x$ is : **1**



(A) 110° (B) 115°

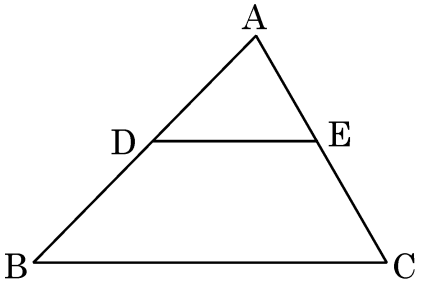
(C) 120° (D) 125°

11. If the diagonals of a quadrilateral divide each other proportionally, then it is a : **1**

(A) parallelogram (B) rectangle

(C) square (D) trapezium

12. In Δ ABC, DE || BC (as shown in the figure). If AD = 2 cm, BD = 3 cm, BC = 7.5 cm, then the length of DE (in cm) is : **1**



(A) 2.5 (B) 3

(C) 5 (D) 6

13. Given HCF (2520, 6600) = 40, LCM (2520, 6600) = 252 × k, then the value of k is : **1**

(A) 1650 (B) 1600

(C) 165 (D) 1625

14. A pair of irrational numbers whose product is a rational number is : **1**

(A) $(\sqrt{16}, \sqrt{4})$ (B) $(\sqrt{5}, \sqrt{2})$

(C) $(\sqrt{3}, \sqrt{27})$ (D) $(\sqrt{36}, \sqrt{2})$

15. If a digit is chosen at random from the digits 1, 2, 3, 4, 5, 6, 7, 8, 9; then the probability that this digit is an odd prime number is : **1**

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$

(C) $\frac{4}{9}$ (D) $\frac{5}{9}$

16. The mean of five observations is 15. If the mean of first three observations is 14 and that of the last three observations is 17, then the third observation is **1**

(A) 20 (B) 19

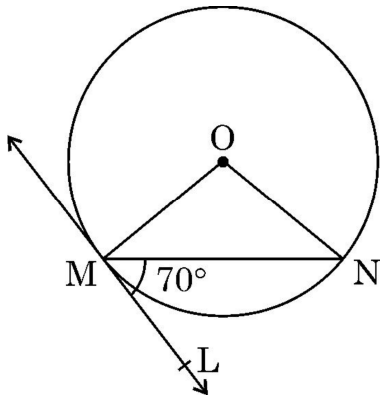
(C) 18 (D) 17

17. Perimeter of a sector of a circle whose central angle is 90° and radius 7 cm is : **1**

(A) 35 cm (B) 11 cm

(C) 22 cm (D) 25 cm

18. In the given figure, O is the centre of the circle. MN is the chord and the tangent ML at point M makes an angle of 70° with MN. The measure of $\angle MON$ is : **1**



(A) 120° (B) 140°

(C) 70° (D) 90°

Directions : Questions number **19** and **20** are Assertion and Reason based questions carrying **1** mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. **Assertion (A)** : The point which divides the line segment joining the points A (1, 2) and B(–1, 1) internally in the ratio 1 : 2 is $\left(\frac{-1}{3}, \frac{5}{3}\right)$ **1**

Reason (R) : The coordinates of the point which divides the line segment joining the points A (x_1, y_1) and B(x_2, y_2) in the ratio $m_1 : m_2$ are $\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$

20. **Assertion (A)** : In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball, he does not hit the boundary is $\frac{4}{5}$. **1**

Reason (R) : P(E) + P(not E) = 1

SECTION – B

This section consists of **5** questions of **2** marks each.

21. One card is drawn at random from a well shuffled deck of 52 cards. Find the probability that the card drawn

(i) is queen of hearts;

(ii) is not a jack. **1 + 1**

22. (a) If $2x + y = 13$ and $4x - y = 17$, find the value of $(x - y)$. **2**

OR

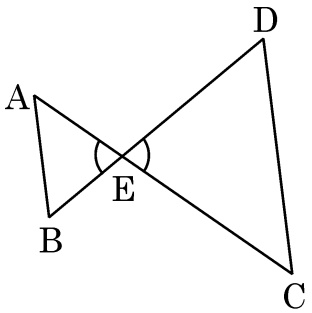
(b) Sum of two numbers is 105 and their difference is 45. Find the numbers. **2**

23. (a) Find a relation between x and y such that the point P(x, y) is equidistant from the points A(7, 1) and B(3, 5). **2**

OR

(b) Points A(–1, y) and B(5, 7) lie on a circle with centre O(2, –3y) such that AB is a diameter of the circle. Find the value of y. Also, find the radius of the circle. **2**

24. In the given figure, $\frac{EA}{EC} = \frac{EB}{ED}$, prove that $\Delta EAB \sim \Delta ECD$ **2**



25. Evaluate : $\frac{\cos 45° + \sin 60°}{\sec 30° + \text{cosec } 30°}$. **2**

SECTION – C

This section consists of **6** questions of **3** marks each.

26. (a) If the sum of first 7 terms of an A.P. is 49 and that of first 17 terms is 289, find the sum of its first 20 terms. **3**

OR

(b) The ratio of the 10^{th} term to its 30^{th} term of an A.P. is 1 : 3 and the sum of its first six terms is 42. Find the first term and the common difference of A.P. **3**

27. Find the zeroes of the quadratic polynomial $x^2 - 15$ and verify the relationship between the zeroes and the coefficients of the polynomial. **3**

28. Solve the following system of linear equations graphically : **3**

$x - y + 1 = 0$

$x + y = 5$

29. (a) Find the ratio in which the line segment joining the points (5, 3) and (–1, 6) is divided by Y-axis. **3**

OR

(b) P(–2, 5) and Q(3, 2) are two points. Find the coordinates of the point R on line segment PQ such that PR = 2QR. **3**

30. Prove that $\frac{\sin\theta - 2\sin^3\theta}{2\cos^3\theta - \cos\theta} = \tan\theta$. **3**

31. Prove that the tangents drawn at the end points of a chord of a circle makes equal angles with the chord. **3**

SECTION – D

This section consists of **4** questions of **5** marks each.

32. (a) In a flight of 2800 km, an aircraft was slowed down due to bad weather. Its average speed is reduced by 100 km/h and by doing so, the time of flight is increased by 30 minutes. Find the original duration of the flight. **5**

OR

(b) The denominator of a fraction is one more than twice the numerator. If the sum of the fraction and its reciprocal is $2\frac{16}{21}$, find the fraction. **5**

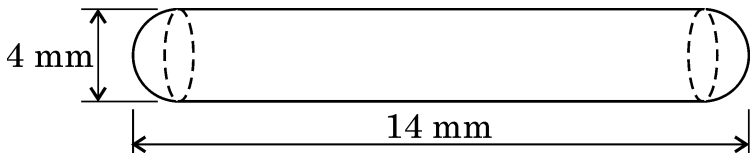
33. State and prove Basic Proportionality theorem. **5**

34. From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower. **5**

35. (a) A solid iron pole consists of a solid cylinder of height 200 cm and base diameter 28 cm, which is surmounted by another cylinder of height 50 cm and radius 7 cm. Find the mass of the pole, given that 1 cm^3 of iron has approximately 8 g mass. **5**

OR

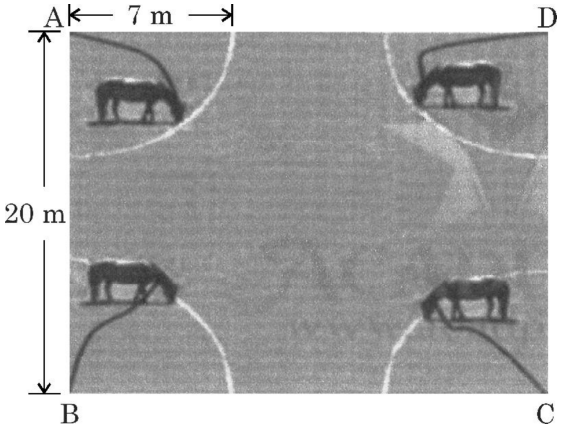
(b) A medicine capsule is in the shape of a cylinder with two hemispheres stuck to each of its ends. The length of the entire capsule is 14 mm and the diameter of the capsule is 4 mm, find its surface area. Also, find its volume. **5**



SECTION – E

This section consists of **3** case study based questions of **4** marks each :

36. A stable owner has four horses. He usually tie these horses with 7 m long rope to pegs at each corner of a square shaped grass field of 20 m length, to graze in his farm. But tying with rope sometimes results in injuries to his horses, so he decided to build fence around the area so that each horse can graze.



Based on the above, answer the following questions :

(i) Find the area of the square shaped grass field. **1**

(ii) (a) Find the area of the total field in which these horses can graze. **2**

OR

(b) If the length of the rope of each horse is increased from 7 m to 10 m, find the area grazed by one horse. (Use $\pi = 3.14$) **2**

(iii) What is area of the field that is left ungrazed, if the length of the rope of each horse is 7 cm ? **1**

37. Vocational training complements traditional education by providing practical skills and hands-on experience. While education equips individuals with a broad knowledge base, vocational training focuses on job-specific skills, enhancing employability thus making the student self-reliant. Keeping this in view, a teacher made the following table giving the frequency distribution of students/adults undergoing vocational training from the training institute.

Age (in years)	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54
Number of participants	62	132	96	37	13	11	10	4

From the above answer the following questions :

(i) What is the lower limit of the modal class of the above data ? **1**

(ii) (a) Find the median class of the above data. **2**

OR

(b) Find the number of participants of age less than 50 years who undergo vocational training. **2**

(iii) Give the empirical relationship between mean, median and mode. **1**

38. Teaching Mathematics through activities is a powerful approach that enhances students' understanding and engagement. Keeping this in mind, Ms. Mukta planned a prime number game for class 5 students. She announces the number 2 in her class and asked the first student to multiply it by a prime number and then pass it to second student. Second student also multiplied it by a prime number and passed it to third student. In this way by multiplying to a prime number, the last student got 173250.

Now, Mukta asked some questions as given below to the students :

(i) What is the least prime number used by students ? **1**

(ii) (a) How many students are in the class ? **2**

OR

(b) What is the highest prime number used by students ? **2**

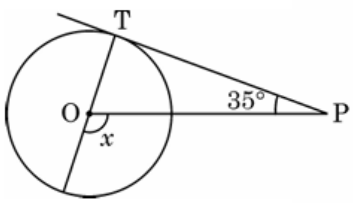
(iii) Which prime number has been used maximum times ? **1**

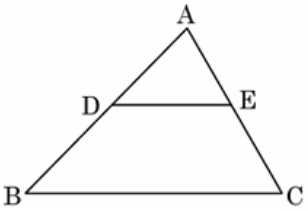
———————

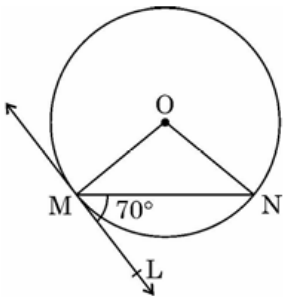
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/3/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section consists of 20 questions of 1 marks each.	
1.	The pair of linear equations $x + 2y + 5 = 0$ and $-3x = 6y - 1$ has (A) unique solution (B) exactly two solutions (C) infinitely many solutions (D) no solution	
Sol.	(D) no solution	1
2.	The common difference of the A.P. $\frac{1}{2x}, \frac{1-4x}{2x}, \frac{1-8x}{2x}$ .....is : (A) $-2x$ (B) -2 (C) 2 (D) $2x$	
Sol.	(B) -2	1
3.	Two dice are thrown together. The probability that they show different numbers is : (A) 1/6 (B) 5/6 (C) 1/3 (D) 2/3	
Sol.	(B) 5/6	1

4.	The probability of guessing the correct answer to a certain test question is $\frac{x}{6}$. If the probability of not guessing the correct answer to this question is $\frac{2}{3}$, then the value of x is : (A) 2 (B) 3 (C) 4 (D) 6	
Sol.	(A) 2	1
5.	If $a = 2^2 \times 3^x$, $b = 2^2 \times 3 \times 5$, $c = 2^2 \times 3 \times 7$ and LCM (a, b, c) = 3780, then x is equal to (A) 1 (B) 2 (C) 3 (D) 0	
Sol.	(C) 3	1
6.	The zeroes of the quadratic polynomial $2x^2 - 3x - 9$ are : (A) $3, \frac{-3}{2}$ (B) $-3, \frac{-3}{2}$ (C) $-3, \frac{3}{2}$ (D) $3, \frac{3}{2}$	
Sol.	(A) $3, \frac{-3}{2}$	1
7.	From a point on the ground, which is 30 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 60°. The height (in metres) of the tower is : (A) $10\sqrt{3}$ (B) $30\sqrt{3}$ (C) 60 (D) 30	
Sol.	(B) $30\sqrt{3}$	1

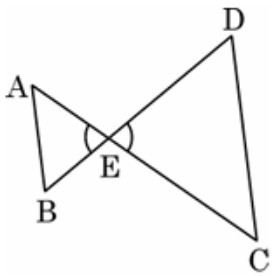
8.	If $\cos\theta = \frac{\sqrt{3}}{2}$ and $\sin\phi = \frac{1}{2}$, then $\tan(\theta + \phi)$ is : (A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$ (C) 1 (D) not defined	
Sol.	(A) $\sqrt{3}$	1
9.	Maximum number of common tangents that can be drawn to two circles intersecting at two distinct points is : (A) 4 (B) 3 (C) 2 (D) 1	
Sol.	(C) 2	1
10.	In the given figure, if PT is a tangent to a circle with centre O and $\angle TPO = 35°$, then the measure of $\angle x$ is :  (A) 110° (B) 115° (C) 120° (D) 125°	
Sol.	(D) 125°	1
11.	If the diagonals of a quadrilateral divide each other proportionally, then it is a : (A) parallelogram (B) rectangle (C) square (D) trapezium	
Sol.	(D) trapezium	1

12.	In Δ ABC, DE || BC (as shown in the figure). If AD = 2 cm, BD = 3 cm, BC = 7.5 cm, then the length of DE (in cm) is :  (A) 2.5 (B) 3 (C) 5 (D) 6	
Sol.	(B) 3	1
13.	Given HCF (2520, 6600) = 40, LCM (2520, 6600) = 252 × k, then the value of k is : (A) 1650 (B) 1600 (C) 165 (D) 1625	
Sol.	(A) 1650	1
14.	A pair of irrational numbers whose product is a rational number is : (A) $(\sqrt{16}, \sqrt{4})$ (B) $(\sqrt{5}, \sqrt{2})$ (C) $(\sqrt{3}, \sqrt{27})$ (D) $(\sqrt{36}, \sqrt{2})$	
Sol.	(C) $(\sqrt{3}, \sqrt{27})$	1
15.	If a digit is chosen at random from the digits 1, 2, 3, 4, 5, 6, 7, 8, 9; then the probability that this digit is an odd prime number is : (A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{4}{9}$ (D) $\frac{5}{9}$	
Sol.	(A) $\frac{1}{3}$	1
16.	The mean of five observations is 15. If the mean of first three observations is 14 and that of the last three observations is 17, then the third observation is (A) 20 (B) 19 (C) 18 (D) 17	
Sol.	(C) 18	1

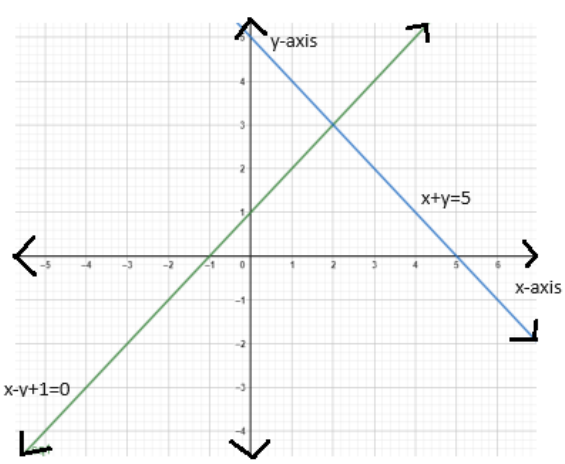
17.	Perimeter of a sector of a circle whose central angle is 90° and radius 7 cm is : (A) 35 cm (B) 11 cm (C) 22 cm (D) 25 cm	
Sol.	(D) 25 cm	1
18.	In the given figure, O is the centre of the circle. MN is the chord and the tangent ML at point M makes an angle of 70° with MN. The measure of ∠MON is :  (A) 120° (B) 140° (C) 70° (D) 90°	
Sol.	(B)140°	1
	Directions : Questions number **19** and **20** are Assertion and Reason based questions carrying **1** mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	

19.	**Assertion (A)** : The point which divides the line segment joining the points A (1, 2) and B(–1, 1) internally in the ratio 1 : 2 is $\left(\frac{-1}{3}, \frac{5}{3}\right)$ **Reason (R)** : The coordinates of the point which divides the line segment joining the points A (x_1, y_1) and B(x_2, y_2) in the ratio $m_1 : m_2$ are $\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$	
Sol.	(D) Assertion (A) is false , but Reason(R) is true.	1
20.	**Assertion (A)** : In a cricket match, a batsman hits a boundary 9 times out of 45 balls he plays. The probability that in a given ball, he does not hit the boundary is $\frac{4}{5}$. **Reason (R)** : P(E) + P(not E) = 1	
Sol.	(A) Both Assertion (A) and Reason(R) are true and Reason (R) is the correct explanation of the Assertion (A).	1
	SECTION B This section consists of 5 questions of 2 marks each.	
21.	One card is drawn at random from a well shuffled deck of 52 cards. Find the probability that the card drawn (i) is queen of hearts; (ii) is not a jack.	
Sol.	Total outcomes = 52 (i) P (card is queen of hearts) = $\frac{1}{52}$ (ii) P (not a jack) = $\frac{48}{52}$ or $\frac{12}{13}$	1 1
22(a).	If $2x + y = 13$ and $4x – y = 17$, find the value of $(x – y)$.	
Sol.	$2x + y = 13$ ---- (i) $4x – y = 17$ ---- (ii)	

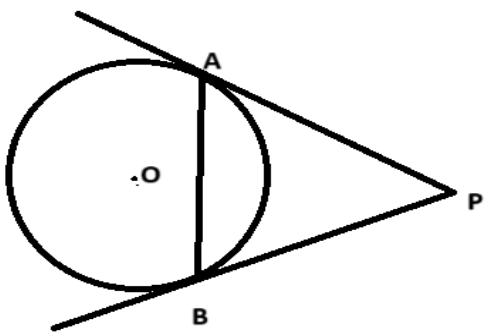
	Solving (i) and (ii) $x = 5$ & $y = 3$ $x - y = 2$	 1½ ½
	OR	
22(b).	Sum of two numbers is 105 and their difference is 45. Find the numbers.	
Sol.	Let the numbers be x, y (x > y) $x + y = 105$ ……. (i) $x - y = 45$ ……. (ii) on solving (i) and (ii) $\Rightarrow x = 75$ & $y = 30$ $\therefore$ Numbers are 75, 30	 ½ ½ 1
23(a)	Find a relation between x and y such that the point P(x, y) is equidistant from the points A(7, 1) and B(3, 5).	
Sol.	PA= PB $\Rightarrow PA^2 = PB^2$ $(x-7)^2 + (y-1)^2 = (x-3)^2 + (y-5)^2$ $\Rightarrow -8x + 8y + 16 = 0$ or $x - y - 2 = 0$	 1 1
23(b).	Points A(–1, y) and B(5, 7) lie on a circle with centre O(2, –3y) such that AB is a diameter of the circle. Find the value of y. Also, find the radius of the circle.	
Sol.	Centre O (2, – 3y) is the mid point of AB $\therefore \frac{y+7}{2} = -3y$ $\Rightarrow y = -1$ Radius = OB = $\sqrt{(5-2)^2 + (7-3)^2} = 5$	 ½ ½ 1

24.	In the given figure, $\frac{EA}{EC}=\frac{EB}{ED}$, prove that $\Delta EAB \sim \Delta ECD$  	
Sol.	In ΔEAB and ΔECD $\frac{EA}{EC}=\frac{EB}{ED}$ $\angle AEB=\angle CED$ $\Delta EAB \sim \Delta ECD$	 1 1
25.	Evaluate : $\frac{\cos 45°+\sin 60°}{\sec 30°+\operatorname{cosec} 30°}$.	
Sol.	$\frac{cos45^{\circ}+sin60^{\circ}}{sec30^{\circ}+cosec30^{\circ}}$ $=\frac{\frac{1}{\sqrt{2}}+\frac{\sqrt{3}}{2}}{\frac{2}{\sqrt{3}}+2}$ $=\frac{2\sqrt{3}+3\sqrt{2}}{4\sqrt{2}(1+\sqrt{3})}$	 1½ ½

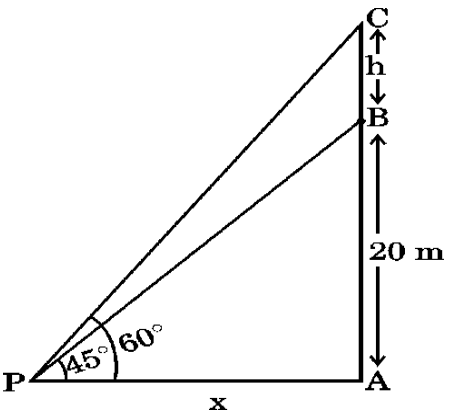
	SECTION C This section consists of 6 questions of 3 marks each.	
26(a).	If the sum of first 7 terms of an A.P. is 49 and that of first 17 terms is 289, find the sum of its first 20 terms.	
Sol.	Let a be the first term and d be the common difference. $\frac{7}{2}(2a + 6d) = 49$ $a + 3d = 7$.....(i) $S_{17} = 289$ $\frac{17}{2}(2a + 16d) = 289$ $a + 8d = 17$.....(ii) solving (i) and (ii) $d = 2$ & $a = 1$ $S_{20} = \frac{20}{2}[2(1)+19(2)]$ $= 400$	½ ½ 1 ½ ½
	OR	
26(b).	The ratio of the 10th term to its 30th term of an A.P. is 1 : 3 and the sum of its first six terms is 42. Find the first term and the common difference of A.P.	
Sol.	Let a be the first term and d be the common difference. $\frac{a + 9d}{a + 29d} = \frac{1}{3}$ $\Longrightarrow a = d$ .....(i) $\frac{6}{2}(2a + 5d) = 42$ $\Rightarrow 2a + 5d = 14$ ……..(ii) Solving (i) and (ii)	½ ½ ½ ½

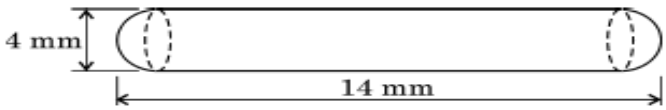
	a = 2 and d = 2	½ + ½
27.	Find the zeroes of the quadratic polynomial $x^2 - 15$ and verify the relationship between the zeroes and the coefficients of the polynomial.	
Sol.	Let $P(x) = x^2 - 15$ $= (x - \sqrt{15})(x + \sqrt{15})$ $\therefore$ Zeroes of P(x) are $-\sqrt{15}$ and $\sqrt{15}$ Verification- Sum of zeroes = $-\sqrt{15} + \sqrt{15} = \frac{0}{1} = \frac{-\text{ coefficient of x}}{\text{coefficient of } x^2}$ Product of zeroes = $-\sqrt{15} \times \sqrt{15} = -15 = \frac{-15}{1} = \frac{\text{costant term}}{\text{coefficient of } x^2}$	1 1 ½ ½
28.	Solve the following system of linear equations graphically : $x - y + 1 = 0$ $x + y = 5$	
Sol.	 Correct graph Solution is x = 2, y = 3	2 1

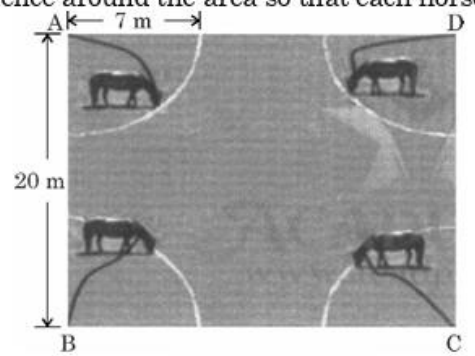
29(a).	Find the ratio in which the line segment joining the points (5, 3) and (–1, 6) is divided by Y-axis.	
Sol.	Let the line segment divides y-axis at (0, y). Let the required ratio be k : 1 $\therefore \quad 0 = \frac{(-1)k+5(1)}{k+1}$ $\Rightarrow \quad k = 5$ Hence ratio is 5 : 1	½ 1 1 ½
	OR	
29(b).	P(–2, 5) and Q(3, 2) are two points. Find the coordinates of the point R on line segment PQ such that PR = 2QR.	
Sol.	Let coordinates of R be (x, y) . PR : RQ = 2 : 1 $x = \frac{2(3)+1(-2)}{2+1} = \frac{4}{3}$ $y = \frac{2(2)+1(5)}{2+1} = 3$ $\therefore$ Cordinates of the point R $(\frac{4}{3}, 3)$	 ½ 1 1 ½
30.	Prove that $\frac{\sin\theta - 2\sin^3\theta}{2\cos^3\theta - \cos\theta} = \tan\theta$.	

Sol.	L.H.S = $\frac{\sin\theta-2\sin^3\theta}{2\cos^3\theta-\cos\theta}$ $=\frac{\sin\theta(1-2\sin^2\theta)}{\cos\theta(2\cos^2\theta-1)}$ $=\frac{\tan\theta(1-2\sin^2\theta)}{[2(1-\sin^2\theta)-1]}$ $=\frac{\tan\theta(1-2\sin^2\theta)}{(1-2\sin^2\theta)}$ $=\tan\theta$ = R.H.S.	½ 1 1 ½
31.	Prove that the tangents drawn at the end points of a chord of a circle makes equal angles with the chord.	
Sol.	Correct figure  Let AB be the chord of circle. In ΔPAB PA = PB ∠PAB = ∠PBA	1 1 1
	SECTION D This section consists of 4 questions of 5 marks each.	
32(a).	In a flight of 2800 km, an aircraft was slowed down due to bad weather. Its average speed is reduced by 100 km/h and by doing so, the time of flight is increased by 30 minutes. Find the original duration of the flight.	

Sol.	Let original speed of aircraft be x km/hr. A.T.Q. $\frac{2800}{x-100} - \frac{2800}{x} = \frac{1}{2}$ $\Longrightarrow x^2 - 100x - 560000 = 0$ $\Longrightarrow (x - 800)(x + 700) = 0$ $x \neq -700$ So, $x = 800$ Original Duration $= \frac{2800}{800} = \frac{7}{2}$ hrs or 3 hrs 30 min.	 2 ½ 1 ½ 1
	OR	
32(b).	The denominator of a fraction is one more than twice the numerator. If the sum of the fraction and its reciprocal is $2\frac{16}{21}$, find the fraction.	
Sol.	Let numerator be x , then denominator be (2x + 1) Fraction = $\frac{x}{2x+1}$ A.T.Q. $\frac{x}{2x+1} + \frac{2x+1}{x} = \frac{58}{21}$ $\Longrightarrow \quad 11x^2 - 26x - 21 = 0$ $\Longrightarrow (x - 3)(11x + 7) = 0$ $x \neq -\frac{7}{11}$ So, $x = 3$ $\therefore$ Fraction = $\frac{3}{7}$	 ½ ½ 1½ ½ 1 ½ ½
33.	State and prove Basic Proportionality theorem.	
Sol.	For correct statement For correct given, to prove, construction and figure For correct Proof	1 4×½ = 2 2

34.	From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.	
Sol.	 Correct Figure. In ΔBPA $\tan 45° = 1 = \frac{20}{x}$ $\Rightarrow$ x = 20 m ……(i) Now, In ΔCPA $\tan 60° = \sqrt{3} = \frac{h+20}{x}$ $\Rightarrow$ $h + 20 = x\sqrt{3}$ ……..(ii) Solving (i) and (ii) $h = 20(\sqrt{3} - 1)$ m ∴ Height of the tower is $20(\sqrt{3} - 1)$ m.	1 1 ½ 1 ½ 1
35(a).	A solid iron pole consists of a solid cylinder of height 200 cm and base diameter 28 cm, which is surmounted by another cylinder of height 50 cm and radius 7 cm. Find the mass of the pole, given that 1 cm^3 of iron has approximately 8 g mass.	
Sol.	Radius of lower cylinder = 14 cm Volume of pole = $\frac{22}{7} \times 14 \times 14 \times 200 + \frac{22}{7} \times 7 \times 7 \times 50$ = 130900 cm^3	½ 1+1 1 1

	Mass of the pole= 8 ×130900 =1047200 gm or 1047.2 kg	½
	OR	
35(b).	A medicine capsule is in the shape of a cylinder with two hemispheres stuck to each of its ends. The length of the entire capsule is 14 mm and the diameter of the capsule is 4 mm, find its surface area. Also, find its volume.  	
Sol.	Radius of hemisphere= radius of cylinder = 2 mm Length of cylindrical part = 14 – 4 = 10 mm. Surface area of the capsule = CSA of cylinder + 2(CSA of hemisphere) $= 2\times \frac{22}{7} \times 2 \times 10 + 2\times 2 \times \frac{22}{7} \times 2 \times 2$ $= 176\ mm^2$ Volume of the capsule = volume of cylinder + 2(volume of hemisphere) $= \frac{22}{7} \times 2 \times 2 \times 10 + 2 \times \frac{2}{3} \times \frac{22}{7} \times 2 \times 2 \times 2$ $= \frac{3344}{21}\ mm^3$ or $159.24\ mm^3$	½ ½ 1 1 1 1
	SECTION E This section consists of 3 case-study based questions of 4 marks each.	

36.	A stable owner has four horses. He usually tie these horses with 7 m long rope to pegs at each corner of a square shaped grass field of 20 m length, to graze in his farm. But tying with rope sometimes results in injuries to his horses, so he decided to build fence around the area so that each horse can graze.  Based on the above, answer the following questions : (i) Find the area of the square shaped grass field. (ii) (a) Find the area of the total field in which these horses can graze. **OR** (b) If the length of the rope of each horse is increased from 7 m to 10 m, find the area grazed by one horse. (Use $\pi = 3.14$) (iii) What is area of the field that is left ungrazed, if the length of the rope of each horse is 7 cm ?	
Sol.	(i) Area of square shaped grass field = 400 m^2 (ii) (a) area of total field that horses can graze = $4 \times \frac{1}{4} \times \frac{22}{7} \times 7 \times 7$ = 154 m^2 OR (ii) (b) area grazed by one horse = $\frac{1}{4} \times 3.14 \times 10 \times 10$ = 78.5 m^2 (iii) Area of the field left ungrazed = area of square field - area of field in which horses can graze. Area of field in which horses can graze = $4 \times \frac{1}{4} \times \frac{22}{7} \times 7 \times 7$ = 154 cm^2 Area of the field left ungrazed = 400 – 0.0154 = 399.9846 m^2	1 1 1 1 1 ½ ½

37.	Vocational training complements traditional education by providing practical skills and hands-on experience. While education equips individuals with a broad knowledge base, vocational training focuses on job-specific skills, enhancing employability thus making the student self-reliant. Keeping this in view, a teacher made the following table giving the frequency distribution of students/adults undergoing vocational training from the training institute. **Age (in years)** / **Number of participants** 15-19: 62; 20-24: 132; 25-29: 96; 30-34: 37; 35-39: 13; 40-44: 11; 45-49: 10; 50-54: 4 From the above answer the following questions : (i) What is the lower limit of the modal class of the above data ? (ii) (a) Find the median class of the above data. **OR** (b) Find the number of participants of age less than 50 years who undergo vocational training. (iii) Give the empirical relationship between mean, median and mode.	
Sol.	(i) Modal class is 19.5 – 24.5 Lowe limit =19.5	1

(ii) (a)

Age (in years)	14.5-19.5	19.5-24.5	24.5-29.5	29.5-34.5	34.5-39.5	39.5-44.5	44.5-49.5	49.5-54.5
Number of participants	62	132	96	37	13	11	10	4
cf	62	194	290	327	340	351	361	365

Correct table 1

$\frac{n}{2} = \frac{365}{2} = 182.5$ ½

median class = 19.5 – 24.5 ½

OR

(ii) (b) 62 + 132 + 96 + 37 + 13 + 11 + 10 = 361 2

(iii) 3median = mode + 2 mean 1

38.

	Teaching Mathematics through activities is a powerful approach that enhances students' understanding and engagement. Keeping this in mind, Ms. Mukta planned a prime number game for class 5 students. She announces the number 2 in her class and asked the first student to multiply it by a prime number and then pass it to second student. Second student also multiplied it by a prime number and passed it to third student. In this way by multiplying to a prime number, the last student got 173250. Now, Mukta asked some questions as given below to the students : (i) What is the least prime number used by students ? (ii) (a) How many students are in the class ? **OR** (b) What is the highest prime number used by students ? (iii) Which prime number has been used maximum times ?	
Sol.	$173250= 2 \times 5^3 \times 3^2 \times 7 \times 11$ (i) 3 (ii) (a) $173250= 2 \times 5^3 \times 3^2 \times 7 \times 11$ Number of students in the class = 3 + 2 + 1 + 1 = 7 OR (ii) (b) $173250= 2 \times 5^3 \times 3^2 \times 7 \times 11$ Highest prime number used by students = 11 (iii) 5	1 1 1 1 1 1

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **not** allowed.*

SECTION A

This section comprises Multiple Choice Questions (MCQs) of 1 mark each. *20×1=20*

1. If $ax + by = a^2 - b^2$ and $bx + ay = 0$, then the value of $x + y$ is :

(A) $a^2 - b^2$ (B) $a + b$

(C) $a - b$ (D) $a^2 + b^2$

2. The HCF of two numbers 65 and 104 is 13. If LCM of 65 and 104 is 40x, then the value of x is :

(A) 5 (B) 13

(C) 40 (D) 8

3. If a polynomial p(x) is given by $p(x) = x^2 - 5x + 6$, then the value of $p(1) + p(4)$ is :

(A) 0 (B) 4

(C) 2 (D) – 4

4. If the discriminant of the quadratic equation $3x^2 - 2x + c = 0$ is 16, then the value of c is :

(A) 1 (B) 0

(C) – 1 (D) $\sqrt{2}$

5. If an arc subtends an angle of 90° at the centre of a circle, then the ratio of its length to the circumference of the circle is :

(A) 2 : 3 (B) 1 : 4

(C) 4 : 1 (D) 1 : 3

6. The area of the sector of a circle of radius 12 cm is 60π cm^2. The central angle of this sector is :

(A) 120° (B) 6°

(C) 75° (D) 150°

7. If the difference of mode and median of a data is 24, then the difference of its median and mean is :

(A) 12 (B) 24

(C) 8 (D) 36

8. Two dice are tossed simultaneously. The probability of getting odd numbers on both the dice is :

(A) $\frac{6}{36}$ (B) $\frac{3}{36}$

(C) $\frac{12}{36}$ (D) $\frac{9}{36}$

9. The ratio of total surface area of a solid hemisphere to the square of its radius is :

(A) $2\pi : 1$ (B) $4\pi : 1$

(C) $3\pi : 1$ (D) $1 : 4\pi$

10. If $\sin\theta = 1$, then the value of $\frac{1}{2}\sin\left(\frac{\theta}{2}\right)$ is :

(A) $\frac{1}{2\sqrt{2}}$ (B) $\frac{1}{\sqrt{2}}$

(C) $\frac{1}{2}$ (D) 0

11. Two lines are given to be parallel. The equation of one of these lines is $5x - 3y = 2$. The equation of the second line can be :

(A) $-15x - 9y = 5$ (B) $15x + 9y = 5$

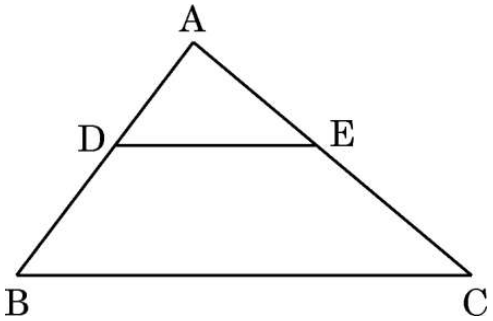
(C) $9x - 15y = 6$ (D) $-15x + 9y = 5$

12. Three numbers in A.P. have the sum 30. What is its middle term ?

(A) 4 (B) 10

(C) 16 (D) 8

13. In Δ ABC, DE || BC (as shown in the figure). If AD = 4 cm, AB = 9 cm and AC = 13·5 cm, then the length of EC is :



(A) 6 cm (B) 7·5 cm

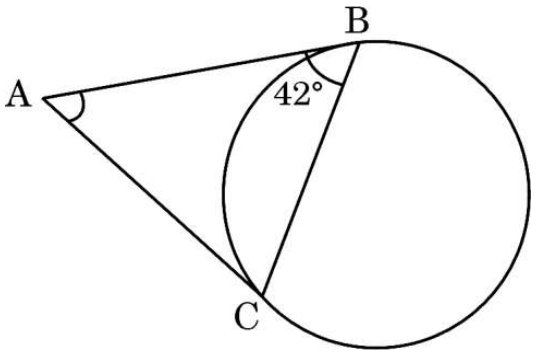
(C) 9 cm (D) 5·7 cm

14. At some time of the day, the length of the shadow of a tower is equal to its height. Then, the Sun's altitude at that time is :

(A) 30° (B) 45°

(C) 60° (D) 90°

15. In the given figure, AB and AC are tangents to the circle. If $\angle$ ABC = 42°, then the measure of $\angle$ BAC is :



(A) 96° (B) 42°

(C) 106° (D) 86°

16. The fourth vertex D of a parallelogram ABCD whose three vertices are A(– 2, 3), B(6, 7) and C(8, 3) is :

(A) (0, 1) (B) (0, – 1)

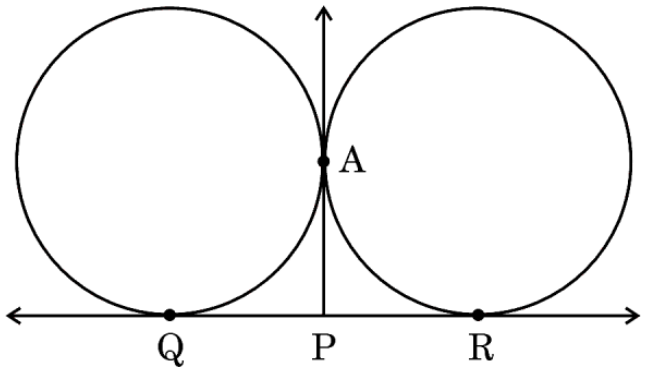
(C) (– 1, 0) (D) (1, 0)

17. For an event E, if P(E) + $P(\overline{E})$ = q, then the value of $q^2 - 4$ is :

(A) – 3 (B) 3

(C) 5 (D) – 5

18. In the given figure, QR is a common tangent to the two given circles touching externally at A. The tangent at A meets QR at P. If AP = 4·2 cm, then the length of QR is :



(A) 4·2 cm (B) 2·1 cm

(C) 8·4 cm (D) 6·3 cm

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* Mid-point of a line segment divides the line segment in the ratio 1 : 1.

Reason (R) : The ratio in which the point $(-3, k)$ divides the line segment joining the points $(-5, 4)$ and $(-2, 3)$ is 1 : 2.

20. *Assertion (A) :* If the circumference of a circle is 176 cm, then its radius is 28 cm.

Reason (R): Circumference = $2\pi \times$ radius of a circle.

SECTION B

This section comprises Very Short Answer (VSA) type questions of 2 marks each. *5×2=10*

21. Three bells toll at intervals of 9, 12 and 15 minutes respectively. If they start tolling together, after what time will they next toll together ?

22. (a) The minute hand of a clock is 14 cm long. Find the area on the face of the clock described by the minute hand in 5 minutes.

OR

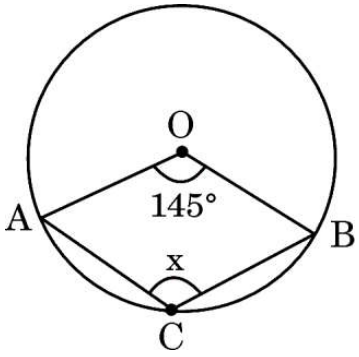
(b) Find the length of the arc of a circle which subtends an angle of 60° at the centre of the circle of radius 42 cm.

23. (a) Evaluate : $\dfrac{5\cos^2 60° + 4\sec^2 30° - \tan^2 45°}{\sin^2 30° + \sin^2 60°}$

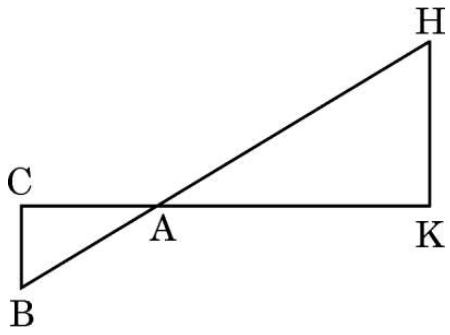
OR

(b) If $\sin(A - B) = \dfrac{1}{2}$, $\cos(A + B) = \dfrac{1}{2}$; $0 < A + B \leq 90°$, $A > B$; find $\angle A$ and $\angle B$.

24. In the given figure, O is the centre of the circle. If $\angle$ AOB = 145°, then find the value of x.



25. In the given figure, Δ AHK $\sim$ Δ ABC. If AK = 8 cm, BC = 3·2 cm and HK = 6·4 cm, then find the length of AC.



SECTION C

This section comprises Short Answer (SA) type questions of 3 marks each. *6×3=18*

26. Prove that $\frac{\sin\theta - \cos\theta + 1}{\sin\theta + \cos\theta - 1} = \frac{1}{\sec\theta - \tan\theta}$

27. (a) Three coins are tossed simultaneously. What is the probability of getting

(i) at least one head ?

(ii) exactly two tails ?

(iii) at most one tail ?

OR

(b) A box contains 90 discs which are numbered 1 to 90. If one disc is drawn at random from the box, find the probability that it bears a :

(i) 2-digit number less than 40.

(ii) number divisible by 5 and greater than 50.

(iii) a perfect square number.

28. Rehana went to a bank to withdraw ₹ 2,000. She asked the cashier to give her ₹ 50 and ₹ 100 notes only. Rehana got 25 notes in all. Find how many notes of ₹ 50 and ₹ 100 did she receive.

29. (a) Find the zeroes of the polynomial $4x^2 + 4x - 3$ and verify the relationship between zeroes and coefficients of the polynomial.

OR

(b) If α and β are the zeroes of the polynomial $x^2 + x - 2$, then find the value of $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$.

30. Prove that $\frac{2 - \sqrt{3}}{5}$ is an irrational number, given that $\sqrt{3}$ is an irrational number.

31. Prove that the parallelogram circumscribing a circle is a rhombus.

SECTION D

This section comprises Long Answer (LA) type questions of 5 marks each. *4×5=20*

32. Two pillars of equal lengths stand on either side of a road which is 100 m wide, exactly opposite to each other. At a point on the road between the pillars, the angles of elevation of the tops of the pillars are 60° and 30°. Find the length of each pillar and distance of the point on the road from the pillars. (Use $\sqrt{3}$ = 1·732)

33. (a) E is a point on the side AD produced of a parallelogram ABCD and BE intersects CD at F. Show that Δ ABE ~ Δ CFB.

OR

(b) Sides AB, BC and the median AD of Δ ABC are respectively proportional to sides PQ, QR and the median PM of another Δ PQR. Prove that Δ ABC ~ Δ PQR.

34. (a) A train travels a distance of 90 km at a constant speed. Had the speed been 15 km/h more, it would have taken 30 minutes less for the journey. Find the original speed of the train.

OR

(b) Find the value of 'c' for which the quadratic equation

$$(c + 1)x^2 - 6(c + 1)x + 3(c + 9) = 0;\ c \neq -1$$

has real and equal roots.

35. The following table shows the ages of the patients admitted in a hospital during a year :

Age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
Number of patients	6	11	21	23	14	5

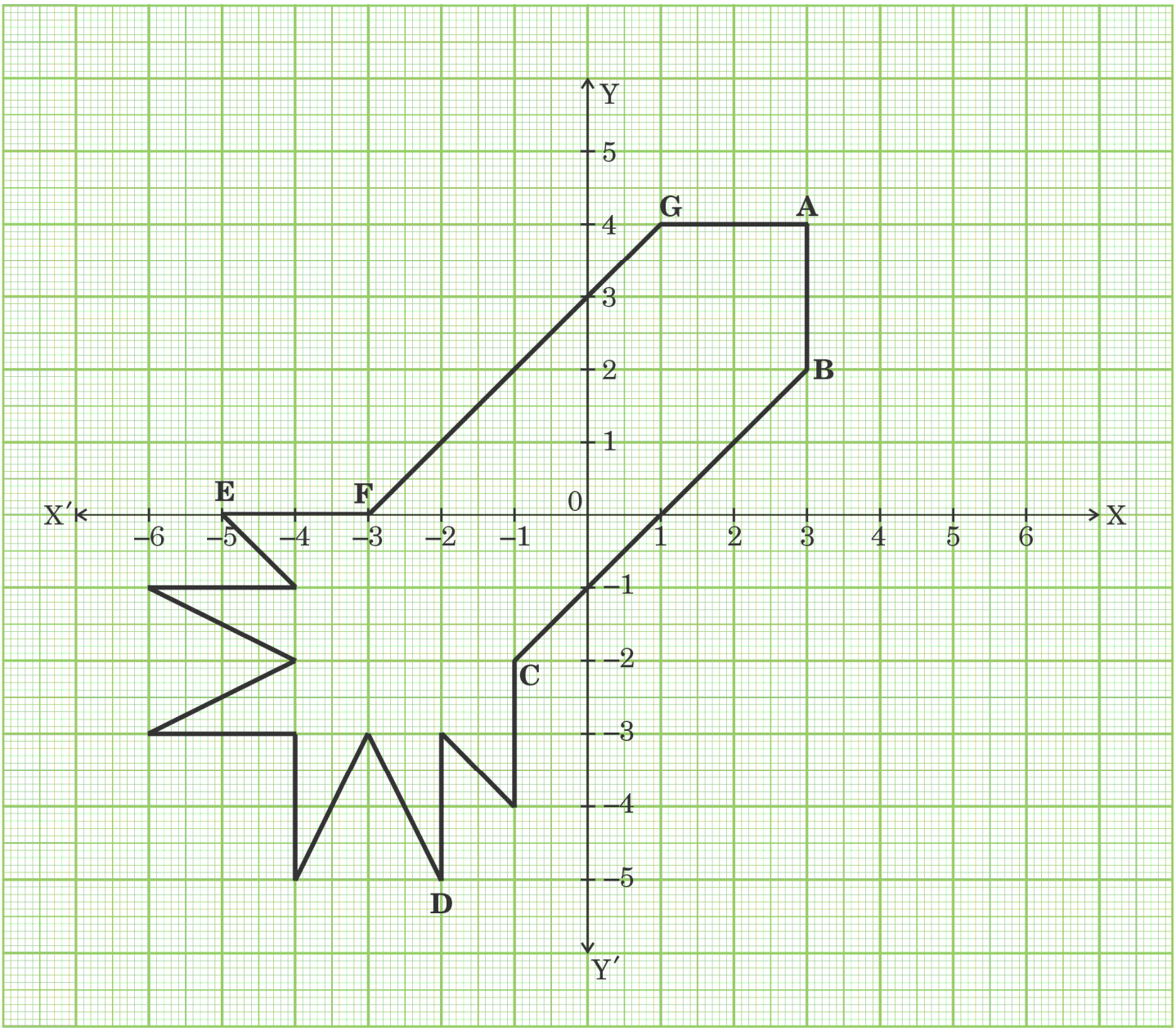
Find the mode and mean of the data given above.

SECTION E

This section comprises 3 case study based questions of 4 marks each. *3×4=12*

Case Study – 1

36. Ryan, from a very young age, was fascinated by the twinkling of stars and the vastness of space. He always dreamt of becoming an astronaut one day. So he started to sketch his own rocket designs on the graph sheet. One such design is given below :



Based on the above, answer the following questions :

(i) Find the mid-point of the segment joining F and G. *1*

(ii) (a) What is the distance between the points A and C ? *2*

OR

(b) Find the coordinates of the point which divides the line segment joining the points A and B in the ratio 1 : 3 internally. *2*

(iii) What are the coordinates of the point D ? *1*

Case Study – 2

37. Treasure Hunt is an exciting and adventurous game where participants follow a series of clues/numbers/maps to discover hidden treasures. Players engage in a thrilling quest, solving puzzles and riddles to unveil the location of the coveted prize.

While playing a treasure hunt game, some clues (numbers) are hidden in various spots collectively forming an A.P. If the number on the n^{th} spot is $20 + 4n$, then answer the following questions to help the players in spotting the clues :

(i) Which number is on first spot ? *1*

(ii) (a) Which spot is numbered as 112 ? *2*

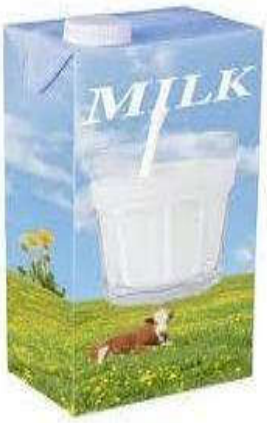
OR

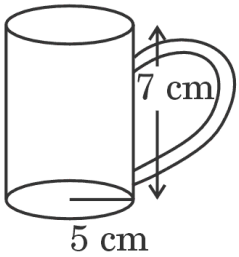
(b) What is the sum of all the numbers on the first 10 spots ? *2*

(iii) Which number is on the $(n - 2)^{th}$ spot ? *1*

Case Study – 3

38. Tamper-proof tetra-packed milk guarantees both freshness and security. This milk ensures uncompromised quality, preserving the nutritional values within and making it a reliable choice for health-conscious individuals.





500 mL milk is packed in a cuboidal container of dimensions 15 cm × 8 cm × 5 cm. These milk packets are then packed in cuboidal cartons of dimensions 30 cm × 32 cm × 15 cm.

Based on the above given information, answer the following questions :

(i) Find the volume of the cuboidal carton. *1*

(ii) (a) Find the total surface area of a milk packet. *2*

OR

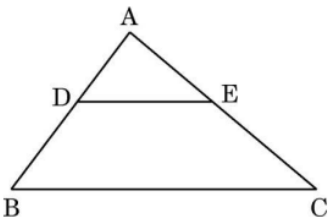
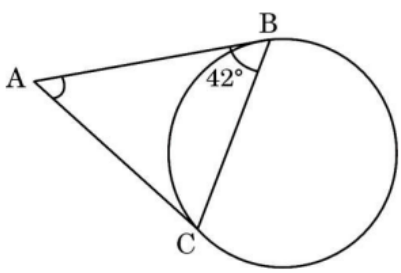
(b) How many milk packets can be filled in a carton ? *2*

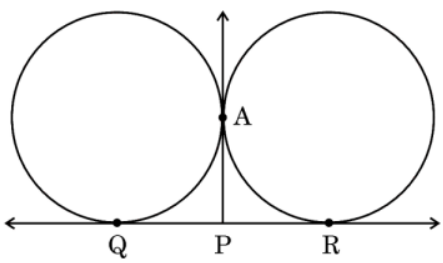
(iii) How much milk can the cup (as shown in the figure) hold ? *1*

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/4/1)

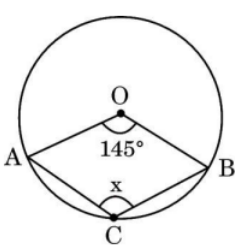
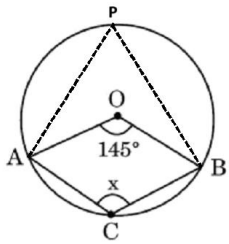
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section comprises Multiple Choice Questions (MCQs) of 1 mark each	
1.	If $ax + by = a^2 - b^2$ and $bx + ay = 0$, then the value of $x + y$ is : (A) $a^2 - b^2$ (B) $a + b$ (C) $a - b$ (D) $a^2 + b^2$	
Sol.	(C) a – b	1
2.	The HCF of two numbers 65 and 104 is 13. If LCM of 65 and 104 is 40x, then the value of x is : (A) 5 (B) 13 (C) 40 (D) 8	
Sol.	(B) 13	1
3.	If a polynomial p(x) is given by $p(x) = x^2 - 5x + 6$, then the value of $p(1) + p(4)$ is : (A) 0 (B) 4 (C) 2 (D) – 4	
Sol.	(B) 4	1
4.	If the discriminant of the quadratic equation $3x^2 - 2x + c = 0$ is 16, then the value of c is : (A) 1 (B) 0 (C) – 1 (D) $\sqrt{2}$	
Sol.	(C) -1	1
5.	If an arc subtends an angle of 90° at the centre of a circle, then the ratio of its length to the circumference of the circle is : (A) 2 : 3 (B) 1 : 4 (C) 4 : 1 (D) 1 : 3	
Sol.	(B) 1:4	1

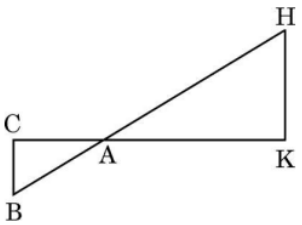
6.	The area of the sector of a circle of radius 12 cm is 60π cm^2. The central angle of this sector is : (A) 120° (B) 6° (C) 75° (D) 150°	
Sol.	(D) 150°	1
7.	If the difference of mode and median of a data is 24, then the difference of its median and mean is : (A) 12 (B) 24 (C) 8 (D) 36	
Sol.	(A) 12	1
8.	Two dice are tossed simultaneously. The probability of getting odd numbers on both the dice is : (A) $\frac{6}{36}$ (B) $\frac{3}{36}$ (C) $\frac{12}{36}$ (D) $\frac{9}{36}$	
Sol.	(D) $\frac{9}{36}$	1
9.	The ratio of total surface area of a solid hemisphere to the square of its radius is : (A) $2\pi : 1$ (B) $4\pi : 1$ (C) $3\pi : 1$ (D) $1 : 4\pi$	
Sol.	(C) 3π:1	1
10.	If $\sin\theta = 1$, then the value of $\frac{1}{2}\sin\left(\frac{\theta}{2}\right)$ is : (A) $\frac{1}{2\sqrt{2}}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{2}$ (D) 0	
Sol.	(A) $\frac{1}{2\sqrt{2}}$	1
11.	Two lines are given to be parallel. The equation of one of these lines is $5x - 3y = 2$. The equation of the second line can be : (A) $-15x - 9y = 5$ (B) $15x + 9y = 5$ (C) $9x - 15y = 6$ (D) $-15x + 9y = 5$	
Sol.	(D) $-15x + 9y = 5$	1

12.	Three numbers in A.P. have the sum 30. What is its middle term ? (A) 4 (B) 10 (C) 16 (D) 8	
Sol.	(B) 10	1
13.	In Δ ABC, DE $\|\|$ BC (as shown in the figure). If AD = 4 cm, AB = 9 cm and AC = 13·5 cm, then the length of EC is :  (A) 6 cm (B) 7·5 cm (C) 9 cm (D) 5·7 cm	
Sol.	(B) 7.5 cm	1
14.	At some time of the day, the length of the shadow of a tower is equal to its height. Then, the Sun's altitude at that time is : (A) 30° (B) 45° (C) 60° (D) 90°	
Sol.	(B) 45°	1
15.	In the given figure, AB and AC are tangents to the circle. If $\angle$ ABC = 42°, then the measure of $\angle$ BAC is :  (A) 96° (B) 42° (C) 106° (D) 86°	
Sol.	(A) 96°	1

16.	The fourth vertex D of a parallelogram ABCD whose three vertices are A(– 2, 3), B(6, 7) and C(8, 3) is : (A) (0, 1) (B) (0, –1) (C) (–1, 0) (D) (1, 0)	
Sol.	(B) (0,-1)	1
17.	For an event E, if P(E) + P($\bar{E}$) = q, then the value of $q^2 - 4$ is : (A) – 3 (B) 3 (C) 5 (D) – 5	
Sol.	(A) -3	1
18.	In the given figure, QR is a common tangent to the two given circles touching externally at A. The tangent at A meets QR at P. If AP = 4·2 cm, then the length of QR is :  (A) 4·2 cm (B) 2·1 cm (C) 8·4 cm (D) 6·3 cm	
Sol.	(C) 8.4 cm	1
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* Mid-point of a line segment divides the line segment in the ratio 1 : 1. *Reason (R) :* The ratio in which the point (– 3, k) divides the line segment joining the points (– 5, 4) and (– 2, 3) is 1 : 2.	
Sol.	(C) Assertion (A) is true but Reason (R) is false	1

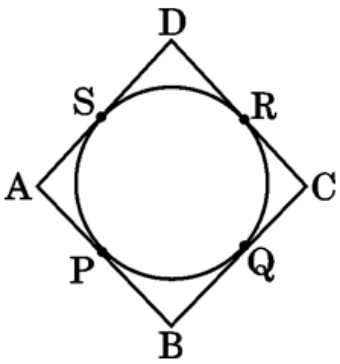
20.	*Assertion (A) :* If the circumference of a circle is 176 cm, then its radius is 28 cm. *Reason (R):* Circumference = $2\pi \times$ radius of a circle.	
Sol.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	1
	SECTION B This section comprises Very Short Answer (VSA) type questions of 2 marks each.	
21.	Three bells toll at intervals of 9, 12 and 15 minutes respectively. If they start tolling together, after what time will they next toll together ?	
Sol.	$9 = 3^2$ $12 = 2^2 \times 3$ $15 = 3 \times 5$ L.C.M = $2^2 \times 3^2 \times 5 = 180$ Three bells will toll together after 180 min.	1 1
22. (a)	The minute hand of a clock is 14 cm long. Find the area on the face of the clock described by the minute hand in 5 minutes.	
Sol.	Angle subtended in 5 min. = 30° Area described by minute hand = $\frac{30}{360} \times \frac{22}{7} \times 14 \times 14$ $= \frac{154}{3}$ cm^2 or 51.33 cm^2 approx.	½ 1 ½
	OR	
22. (b)	Find the length of the arc of a circle which subtends an angle of 60° at the centre of the circle of radius 42 cm.	
Sol.	Length of arc = $2 \times \frac{22}{7} \times 42 \times \frac{60}{360}$ = 44 cm	1½ ½

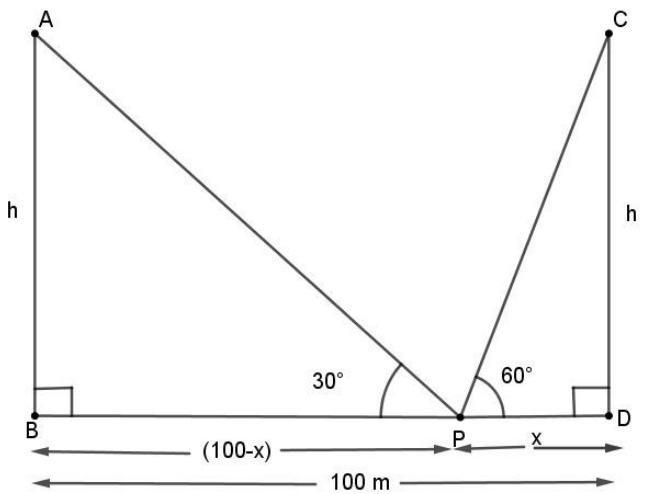
23. (a)	Evaluate : $\frac{5\cos^2 60° + 4\sec^2 30° - \tan^2 45°}{\sin^2 30° + \sin^2 60°}$	
Sol.	$\frac{5\left(\frac{1}{2}\right)^2+4\left(\frac{2}{\sqrt{3}}\right)^2-(1)^2}{\left(\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}$ $= \frac{67}{12}$	1½ ½
	OR	
23.(b)	If $\sin(A - B) = \frac{1}{2}$, $\cos(A + B) = \frac{1}{2}$; $0 < A + B \leq 90°$, $A > B$; find $\angle A$ and $\angle B$.	
Sol.	$\sin(A - B) = \sin 30°$ $A - B = 30°$ --------(i) $\cos(A+B) = \cos 60°$ $A + B = 60°$ ---------(ii) Solving (i) and (ii) $A = 45°$, $B = 15°$	½ ½ 1
24.	In the given figure, O is the centre of the circle. If $\angle AOB = 145°$, then find the value of x. 	
Sol.	 Take a point P on circumference and join AP & BP.	½

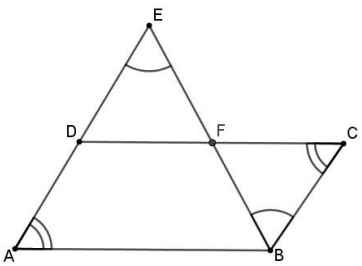
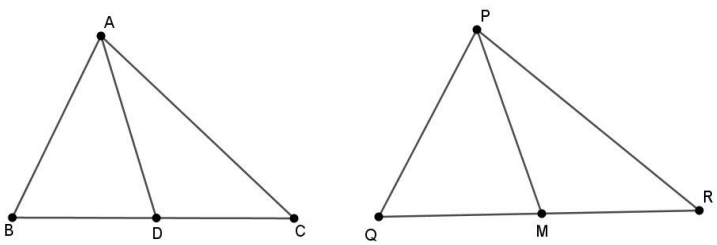
	$\angle APB = \frac{1}{2} \times 145° = 72.5°$ $\angle APB + \angle ACB = 180°$ $\Rightarrow \angle ACB = 107.5°$ or $x = 107.5°$	½ ½ ½
25.	In the given figure, Δ AHK ~ Δ ABC. If AK = 8 cm, BC = 3·2 cm and HK = 6·4 cm, then find the length of AC.  	
Sol.	$\because \Delta AHK \sim \Delta ABC$ (given) $\therefore \frac{HK}{BC} = \frac{AK}{AC}$ $\Rightarrow \frac{6.4}{3.2} = \frac{8.0}{AC}$ $\Rightarrow$ AC = 4 cm	 1 1
	SECTION C This section comprises Short Answer (SA) type questions of 3 marks each.	
26.	Prove that $\frac{\sin\theta - \cos\theta + 1}{\sin\theta + \cos\theta - 1} = \frac{1}{\sec\theta - \tan\theta}$	
Sol.	L.H.S = $\frac{\sin\theta - \cos\theta + 1}{\sin\theta + \cos\theta - 1}$ Divide Numerator and Denominator by cos θ. $= \frac{\tan\theta - 1 + \sec\theta}{\tan\theta + 1 - \sec\theta}$ $= \frac{\tan\theta - 1 + \sec\theta}{(\tan\theta - \sec\theta) + (\sec^2\theta - \tan^2\theta)}$ $= \frac{\tan\theta - 1 + \sec\theta}{(\sec\theta - \tan\theta)(\tan\theta + \sec\theta - 1)}$ $= \frac{1}{\sec\theta - \tan\theta}$ = R.H.S	 1 1 ½ ½

27.(a)	Three coins are tossed simultaneously. What is the probability of getting (i) at least one head ? (ii) exactly two tails ? (iii) at most one tail ?	
Sol.	Total number of outcomes = 8 (i) P (at least one head) = $\frac{7}{8}$ (ii) P (exactly 2 tails) = $\frac{3}{8}$ (iii) P (at most one tail) = $\frac{4}{8}$ or $\frac{1}{2}$	 1 1 1
	OR	
27.(b)	A box contains 90 discs which are numbered 1 to 90. If one disc is drawn at random from the box, find the probability that it bears a : (i) 2-digit number less than 40. (ii) number divisible by 5 and greater than 50. (iii) a perfect square number.	
Sol.	Total outcomes = 90 (i) P (2 digit number less than 40) = $\frac{30}{90}$ or $\frac{1}{3}$ (ii) P (a number divisible by 5 and greater than 50) = $\frac{8}{90}$ or $\frac{4}{45}$ (iii) P (a perfect square number) = $\frac{9}{90}$ or $\frac{1}{10}$	 1 1 1
28	Rehana went to a bank to withdraw ₹ 2,000. She asked the cashier to give her ₹ 50 and ₹ 100 notes only. Rehana got 25 notes in all. Find how many notes of ₹ 50 and ₹ 100 did she receive.	
Sol.	Let number of ₹50 notes = x and number of ₹100 notes = y Here x + y = 25 ------(i) 50x + 100y = 2000 or x + 2y = 40 -------(ii)	 1 1

	Solving eq.(i) and eq.(ii), we get x = 10 and y = 15 Therefore 10 notes of ₹50 and 15 notes of ₹100 are received.	½ + ½
29.(a)	Find the zeroes of the polynomial $4x^2 + 4x - 3$ and verify the relationship between zeroes and coefficients of the polynomial.	
Sol.	$P(x) = 4x^2 + 4x - 3$ $= (2x + 3)(2x - 1)$ $\therefore$ Zeroes of the polynomial are $\frac{-3}{2}$, $\frac{1}{2}$ Sum of Zeroes $= \frac{-3}{2} + \frac{1}{2} = \frac{-3+1}{2} = -1 = \frac{-4}{4} = \frac{-(\text{coefficient of } x)}{(\text{coefficient of } x^2)}$ Product of Zeroes $= \frac{-3}{2} \times \frac{1}{2} = \frac{-3}{4} = \frac{\text{constant term}}{\text{coefficient of } x^2}$	1 1 ½ ½
	OR	
29(b).	If α and β are the zeroes of the polynomial $x^2 + x - 2$, then find the value of $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$.	
Sol.	Here $\alpha + \beta = -1$ and $\alpha\beta = -2$ $\frac{\alpha}{\beta} + \frac{\beta}{\alpha} = \frac{\alpha^2 + \beta^2}{\alpha\beta} = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$ $= \frac{(-1)^2 - 2(-2)}{-2} = -\frac{5}{2}$	1 1 1
30.	Prove that $\frac{2-\sqrt{3}}{5}$ is an irrational number, given that $\sqrt{3}$ is an irrational number.	
Sol.	Assuming $\frac{2-\sqrt{3}}{5}$ to be a rational number. $\Rightarrow \frac{2-\sqrt{3}}{5} = \frac{p}{q}$,where p and q are integers & $q \neq 0$ $\Rightarrow \sqrt{3} = \frac{2q-5p}{q}$ Here RHS is rational but LHS is irrational. Therefore our assumption is wrong.	½ 1 ½ ½

	Hence $\frac{2-\sqrt{3}}{5}$ is an irrational number.	½
31.	**Prove that the parallelogram circumscribing a circle is a rhombus.**	
Sol.	Correct figure 	½
	AP = AS -----(i) BP = BQ -----(ii) CR = CQ -----(iii) DR = DS -----(iv)	1
	Adding (i), (ii), (iii) & (iv) AP + BP + CR + DR = AS + BQ + CQ + DS $\Rightarrow$ AB + CD = AD + BC	1
	But ABCD is a parallelogram $\Rightarrow$AB = CD and AD = BC $\therefore$ 2AB = 2AD or AB = AD	½
	Hence, ABCD is a rhombus.	

	SECTION D This section comprises Long Answer (LA) type questions of 5 marks each.	
32.	Two pillars of equal lengths stand on either side of a road which is 100 m wide, exactly opposite to each other. At a point on the road between the pillars, the angles of elevation of the tops of the pillars are 60° and 30°. Find the length of each pillar and distance of the point on the road from the pillars. (Use $\sqrt{3}$ = 1·732)	
Sol.	Correct figure  Let AB and CD are two pillars of equal length h m and let P be the point on road x m away from pillar CD. In ΔCDP $\tan 60° = \sqrt{3} = \frac{h}{x}$ $\Rightarrow h = \sqrt{3}\, x$ ------(i) In ΔABP, $\tan 30° = \frac{1}{\sqrt{3}} = \frac{h}{100-x}$ $\Rightarrow h = \frac{100-x}{\sqrt{3}}$ -------(ii) Solving eq.(i) and eq.(ii) x = 25	1 1 ½ 1 ½ ½

	and h = $25\sqrt{3}$ = 25 × 1.732 = 43.3 The length of each pillar is 43.3 m and the distance of the point on the road from pillars is 75 m and 25 m respectively.	½
33.(a)	**E is a point on the side AD produced of a parallelogram ABCD and BE intersects CD at F. Show that Δ ABE ~ Δ CFB.**	
Sol.	Correct figure  In ΔABE and ΔCFB ∠EAB = ∠BCF ∠AEB = ∠CBF ⇒ ΔABE ~ ΔCFB	2 1 1 1
	OR	
33.(b)	**Sides AB, BC and the median AD of Δ ABC are respectively proportional to sides PQ, QR and the median PM of another Δ PQR. Prove that Δ ABC ~ Δ PQR.**	
Sol.	Correct figure  $\because \frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$ $\therefore \frac{AB}{PQ} = \frac{2BD}{2QM} = \frac{AD}{PM}$	1 1

	$\Rightarrow \frac{AB}{PQ} = \frac{BD}{QM} = \frac{AD}{PM}$ -------(i)	
	$\Rightarrow \Delta ABD \sim \Delta PQM$	1
	$\Rightarrow \angle B = \angle Q$ -----(ii)	1
	In ΔABC and ΔPQR	
	$\frac{AB}{PQ} = \frac{BC}{QR}$	
	$\angle B = \angle Q$	
	$\therefore \Delta ABC \sim \Delta PQR$	1
34(a).	A train travels a distance of 90 km at a constant speed. Had the speed been 15 km/h more, it would have taken 30 minutes less for the journey. Find the original speed of the train.	
Sol.	Let the original speed be x km/h	
	New speed = (x + 15) km/h	½
	A.T.Q.	
	$\frac{90}{x} - \frac{90}{x+15} = \frac{1}{2}$	1½
	$\Rightarrow x^2 + 15x - 2700 = 0$	1
	$\Rightarrow$(x + 60) (x - 45) = 0	1
	$x \neq -60$, x = 45	1
	The original speed of the train = 45km/h	
	OR	
34(b).	Find the value of 'c' for which the quadratic equation $(c + 1)x^2 - 6(c + 1)x + 3(c + 9) = 0;\ c \neq -1$ has real and equal roots.	
Sol.	For real and equal roots,	
	$\{-6(c + 1)\}^2 - 4(c + 1) \times 3(c + 9) = 0$	2
	$\Rightarrow$ 12(c + 1) (2c – 6) = 0	2
	$c \neq -1$ So, c = 3	1

35.

The following table shows the ages of the patients admitted in a hospital during a year :

Age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
Number of patients	6	11	21	23	14	5

Find the mode and mean of the data given above.

Sol.

Age (in years)	No. of patients (f_i)	Mid point (x_i)	$x_i f_i$
5 – 15	6	10	60
15 - 25	11	20	220
25 - 35	21	30	630
35 - 45	23	40	920
45 - 55	14	50	700
55 - 65	5	60	300
Total	80		2830

Correct table 1½

$\Rightarrow$ Mean $= \frac{2830}{80}$ ½

$= 35.375$ ½

Modal class = (35 - 45) ½

$\Rightarrow Mode = 35 + (\frac{23-21}{2\times23-21-14}) \times h$ 1

$= 36.81$ 1

Therefore, mode and mean of given data are 36.81 years and 35.375 years respectively.

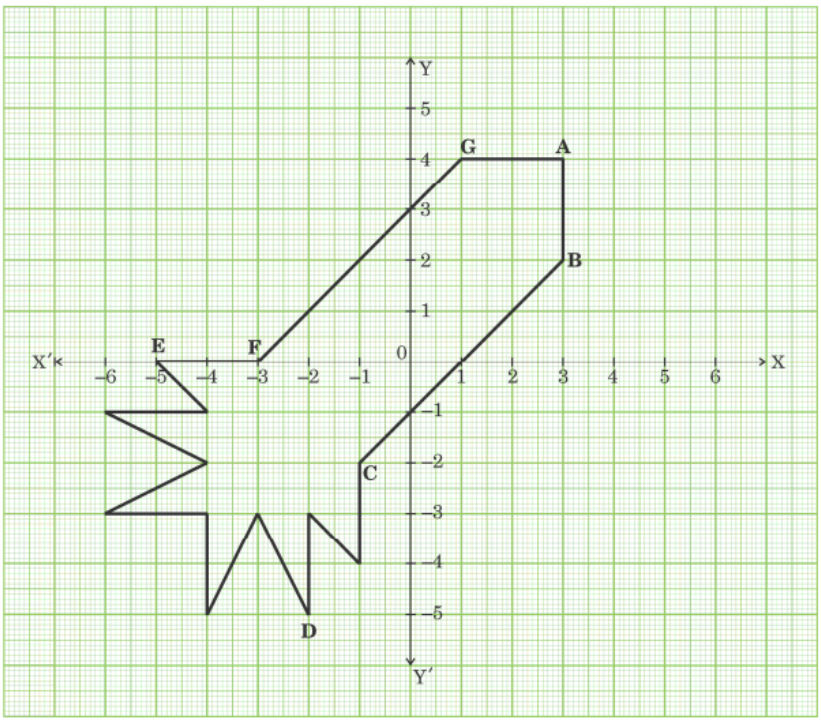
SECTION E

This section comprises 3 case-study based questions of 4 marks each.

36.

Case Study - 1

Ryan, from a very young age, was fascinated by the twinkling of stars and the vastness of space. He always dreamt of becoming an astronaut one day. So he started to sketch his own rocket designs on the graph sheet. One such design is given below :



Based on the above, answer the following questions :

(i) Find the mid-point of the segment joining F and G.

(ii) (a) What is the distance between the points A and C ?

OR

(b) Find the coordinates of the point which divides the line segment joining the points A and B in the ratio 1 : 3 internally.

(iii) What are the coordinates of the point D ?

Sol.

(i) Mid point of FG is $\left(\frac{-3+1}{2}, \frac{0+4}{2}\right) = (-1,2)$ 1

(ii) (a) AC = $\sqrt{(-1-3)^2 + (-2-4)^2}$ 1

= $\sqrt{52}$ or $2\sqrt{13}$ 1

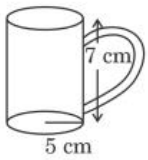
OR

(ii) (b) The coordinates of required point are $\left(\frac{1\times3+3\times3}{1+3}, \frac{1\times2+3\times4}{1+3}\right)$ 1

i.e. $\left(3, \frac{7}{2}\right)$ 1

(iii) D(-2, -5) 1

37.	**Case Study – 2** Treasure Hunt is an exciting and adventurous game where participants follow a series of clues/numbers/maps to discover hidden treasures. Players engage in a thrilling quest, solving puzzles and riddles to unveil the location of the coveted prize. While playing a treasure hunt game, some clues (numbers) are hidden in various spots collectively forming an A.P. If the number on the n^{th} spot is $20 + 4n$, then answer the following questions to help the players in spotting the clues : (i) Which number is on first spot ? (ii) (a) Which spot is numbered as 112 ? **OR** (b) What is the sum of all the numbers on the first 10 spots ? (iii) Which number is on the $(n - 2)^{th}$ spot ?	
Sol.	(i) Number on the first spot = $20 + 4 \times 1 = 24$ (ii) (a) $20 + 4n = 112$ $\Rightarrow n = 23$ OR (ii) (b) $d = 4$ $S_{10} = \frac{10}{2}[2 \times 24 + 9 \times 4]$ $= 420$ (iii) Number on the $(n - 2)^{th}$ spot $= 20 + 4(n - 2)$ $= 12 + 4n$	1 1 1 ½ 1 ½ 1

38.	**Case Study – 3** Tamper-proof tetra-packed milk guarantees both freshness and security. This milk ensures uncompromised quality, preserving the nutritional values within and making it a reliable choice for health-conscious individuals.  500 mL milk is packed in a cuboidal container of dimensions 15 cm × 8 cm × 5 cm. These milk packets are then packed in cuboidal cartons of dimensions 30 cm × 32 cm × 15 cm. Based on the above given information, answer the following questions : (i) Find the volume of the cuboidal carton. (ii) (a) Find the total surface area of a milk packet. **OR** (b) How many milk packets can be filled in a carton ? (iii) How much milk can the cup (as shown in the figure) hold ?	
Sol.	(i) Volume of cuboidal carton = 30×32×15 = 14400 cm^3 (ii)(a) Total surface area of milk packet = 2(15×8+8×5+5×15) = 470 cm^2 OR (ii) (b) Number of milk packets in carton = $\frac{30\times32\times15}{15\times8\times5}$ = 24 (iii) Capacity of the cup = $\frac{22}{7}$ × 5 × 5 × 7 = 550 cm^3 or 550 ml	½ ½ 1 1 1 1 ½ ½

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are Multiple Choice Questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

This section comprises Multiple Choice Questions (MCQs) of 1 mark each. *20×1=20*

1. The next (4^{th}) term of the A.P. $\sqrt{18}$, $\sqrt{50}$, $\sqrt{98}$, ... is :

(A) $\sqrt{128}$ (B) $\sqrt{140}$

(C) $\sqrt{162}$ (D) $\sqrt{200}$

2. If $\frac{x}{3} = 2 \sin A$, $\frac{y}{3} = 2 \cos A$, then the value of $x^2 + y^2$ is :

(A) 36 (B) 9

(C) 6 (D) 18

3. If $4 \sec \theta - 5 = 0$, then the value of $\cot \theta$ is :

(A) $\frac{3}{4}$ (B) $\frac{4}{5}$

(C) $\frac{5}{3}$ (D) $\frac{4}{3}$

4. Which out of the following type of straight lines will be represented by the system of equations $3x + 4y = 5$ and $6x + 8y = 7$?

(A) Parallel

(B) Intersecting

(C) Coincident

(D) Perpendicular to each other

5. The ratio of the sum and product of the roots of the quadratic equation $5x^2 - 6x + 21 = 0$ is :

(A) 5 : 21 (B) 2 : 7

(C) 21 : 5 (D) 7 : 2

6. For the data 2, 9, $x + 6$, $2x + 3$, 5, 10, 5; if the mean is 7, then the value of x is :

(A) 9 (B) 6

(C) 5 (D) 3

7. One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 7 is :

(A) $\frac{1}{7}$ (B) $\frac{1}{8}$

(C) $\frac{1}{5}$ (D) $\frac{7}{40}$

8. The perimeter of the sector of a circle of radius 21 cm which subtends an angle of $60°$ at the centre of circle, is :

(A) 22 cm (B) 43 cm

(C) 64 cm (D) 462 cm

9. The length of an arc of a circle with radius 12 cm is 10π cm. The angle subtended by the arc at the centre of the circle, is :

(A) $120°$ (B) $6°$

(C) $75°$ (D) $150°$

10. The greatest number which divides 281 and 1249, leaving remainder 5 and 7 respectively, is :

(A) 23 (B) 276

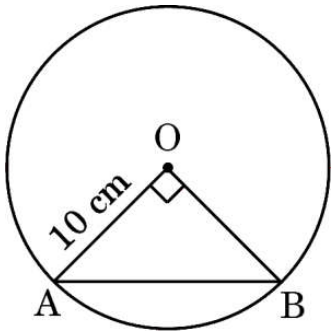
(C) 138 (D) 69

11. The number of terms in the A.P. 3, 6, 9, 12, ..., 111 is :

(A) 36 (B) 40

(C) 37 (D) 30

12. A chord of a circle of radius 10 cm subtends a right angle at its centre. The length of the chord (in cm) is :



(A) $5\sqrt{2}$ (B) $10\sqrt{2}$

(C) $\frac{5}{\sqrt{2}}$ (D) 5

13. The LCM of three numbers 28, 44, 132 is :

(A) 258 (B) 231

(C) 462 (D) 924

14. If the product of two co-prime numbers is 553, then their HCF is :

(A) 1 (B) 553

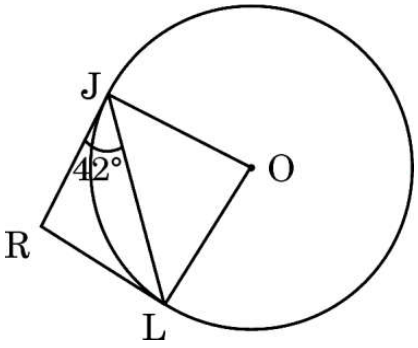
(C) 7 (D) 79

15. If α and β are the zeroes of the polynomial $p(x) = kx^2 - 30x + 45k$ and $\alpha + \beta = \alpha\beta$, then the value of k is :

(A) $-\frac{2}{3}$ (B) $-\frac{3}{2}$

(C) $\frac{3}{2}$ (D) $\frac{2}{3}$

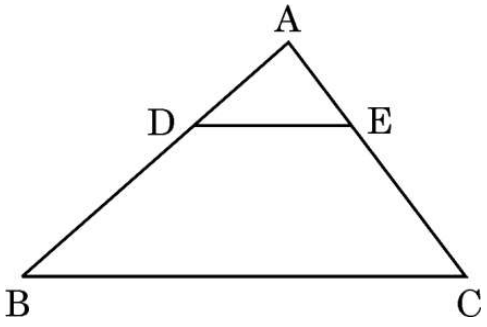
16. In the given figure, RJ and RL are two tangents to the circle. If $\angle RJL = 42°$, then the measure of $\angle JOL$ is :



(A) 42° (B) 84°

(C) 96° (D) 138°

17. In the given figure, in ΔABC, DE || BC. If AD = 2·4 cm, DB = 4 cm and AE = 2 cm, then the length of AC is :



(A) $\frac{10}{3}$ cm (B) $\frac{3}{10}$ cm

(C) $\frac{16}{3}$ cm (D) 1·2 cm

18. If a vertical pole of length 7·5 m casts a shadow 5 m long on the ground and at the same time, a tower casts a shadow 24 m long, then the height of the tower is :

(A) 20 m (B) 40 m

(C) 60 m (D) 36 m

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* ABCD is a trapezium with DC || AB. E and F are points on AD and BC respectively, such that EF || AB. Then $\frac{AE}{ED} = \frac{BF}{FC}$.

Reason (R) : Any line parallel to parallel sides of a trapezium divides the non-parallel sides proportionally.

20. *Assertion (A) :* Degree of a zero polynomial is not defined.

Reason (R): Degree of a non-zero constant polynomial is 0.

SECTION B

This section comprises Very Short Answer (VSA) type questions of 2 marks each. *5×2=10*

21. (a) If two tangents inclined at an angle of 60° are drawn to a circle of radius 3 cm, then find the length of each tangent.

OR

(b) Prove that the tangents drawn at the ends of a diameter of a circle are parallel.

22. Evaluate :

$$\frac{2 \tan 30° \cdot \sec 60° \cdot \tan 45°}{1 - \sin^2 60°}$$

23. If α, β are zeroes of the polynomial $p(x) = 5x^2 - 6x + 1$, then find the value of $\alpha + \beta + \alpha\beta$.

24. (a) Find the ratio in which the point P(– 4, 6) divides the line segment joining the points A(– 6, 10) and B(3, – 8).

OR

(b) Prove that the points (3, 0), (6, 4) and (– 1, 3) are the vertices of an isosceles triangle.

25. A carton consists of 60 shirts of which 48 are good, 8 have major defects and 4 have minor defects. Nigam, a trader, will accept the shirts which are good but Anmol, another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. Find the probability that it is acceptable to Anmol.

SECTION C

This section comprises Short Answer (SA) type questions of 3 marks each. *6×3=18*

26. (a) Prove that $\sqrt{3}$ is an irrational number.

OR

(b) Prove that $\left(\sqrt{2} + \sqrt{3}\right)^2$ is an irrational number, given that $\sqrt{6}$ is an irrational number.

27. (a) If the sum of the first 14 terms of an A.P. is 1050 and the first term is 10, then find the 20^{th} term and the n^{th} term.

OR

(b) The first term of an A.P. is 5, the last term is 45 and the sum of all the terms is 400. Find the number of terms and the common difference of the A.P.

28. Prove that the parallelogram circumscribing a circle is a rhombus.

29. Prove that :

$$\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A} = 1 + \sec A \operatorname{cosec} A$$

30. Three unbiased coins are tossed simultaneously. Find the probability of getting :

(i) at least one head.

(ii) exactly one tail.

(iii) two heads and one tail.

31. An arc of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding major sector. (Use $\pi = 3{\cdot}14$)

SECTION D

This section comprises Long Answer (LA) type questions of 5 marks each. *4×5=20*

32. (a) Find the value of 'k' for which the quadratic equation $(k + 1)x^2 - 6(k + 1)x + 3(k + 9) = 0$, $k \neq -1$ has real and equal roots.

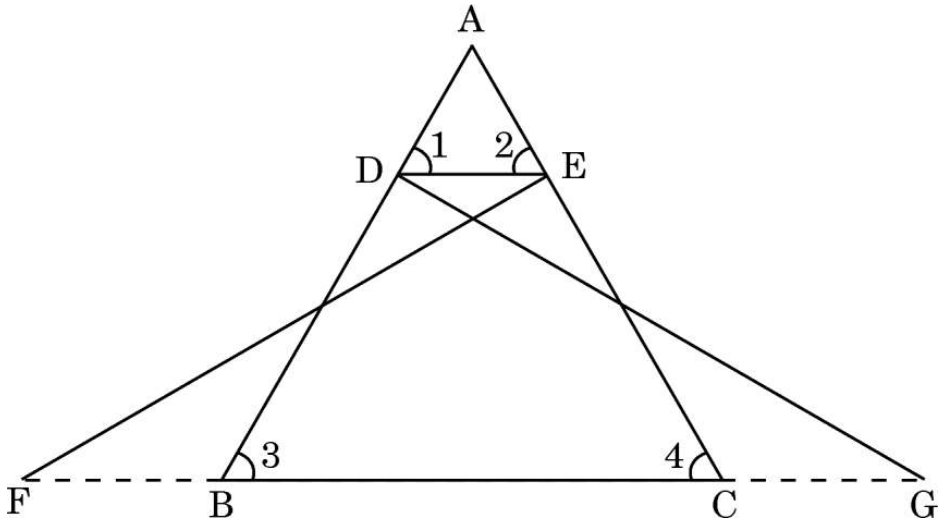
OR

(b) The age of a man is twice the square of the age of his son. Eight years hence, the age of the man will be 4 years more than three times the age of his son. Find their present ages.

33. From a point on a bridge across the river, the angles of depressions of the banks on opposite sides of the river are 30° and 60° respectively. If the bridge is at a height of 4 m from the banks, find the width of the river.

34. (a) In the given figure, $\Delta FEC \cong \Delta GDB$ and $\angle 1 = \angle 2$.

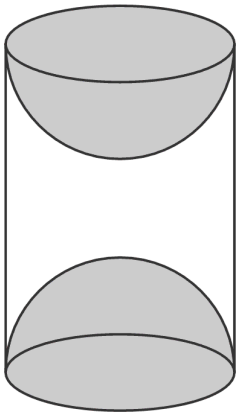
Prove that $\Delta ADE \sim \Delta ABC$.



OR

(b) Sides AB and AC and median AD of a ΔABC are respectively proportional to sides PQ and PR and median PM of another ΔPQR. Show that $\Delta ABC \sim \Delta PQR$.

35. A wooden article was made by scooping out a hemisphere from each end of a solid cylinder, as shown in the figure. If the height of the cylinder is 5·8 cm and its base is of radius 2·1 cm, find the total surface area of the article.



SECTION E

This section comprises 3 case study based questions of 4 marks each. *3×4=12*

Case Study – 1

36. Essel World is one of India's largest amusement parks that offers a diverse range of thrilling rides, water attractions and entertainment options for visitors of all ages. The park is known for its iconic "Water Kingdom" section, making it a popular destination for family outings and fun-filled adventure. The ticket charges for the park are ₹ 150 per child and ₹ 250 per adult.

On a day, the cashier of the park found that 300 tickets were sold and an amount of ₹ 55,000 was collected.

Based on the above, answer the following questions :

(i) If the number of children visited be x and the number of adults visited be y, then write the given situation algebraically. *1*

(ii) (a) How many children visited the amusement park that day ? *2*

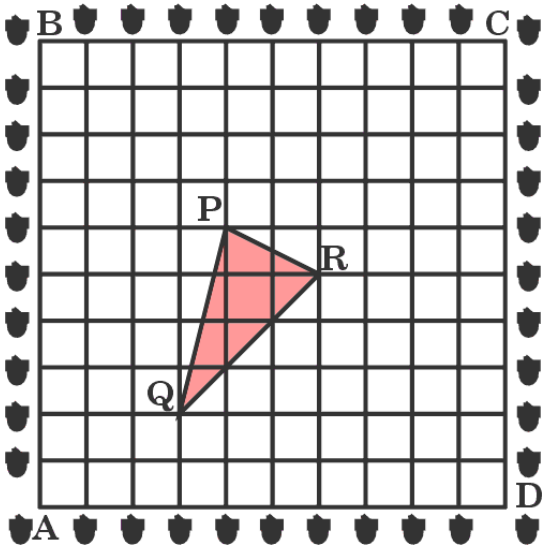
OR

(b) How many adults visited the amusement park that day ? *2*

(iii) How much amount will be collected if 250 children and 100 adults visit the amusement park ? *1*

Case Study – 2

37. A garden is in the shape of a square. The gardener grew saplings of Ashoka tree on the boundary of the garden at the distance of 1 m from each other. He wants to decorate the garden with rose plants. He chose a triangular region inside the garden to grow rose plants. In the above situation, the gardener took help from the students of class 10. They made a chart for it which looks like the given figure.



Based on the above, answer the following questions :

(i) If A is taken as origin, what are the coordinates of the vertices of Δ PQR ? *1*

(ii) (a) Find distances PQ and QR. *2*

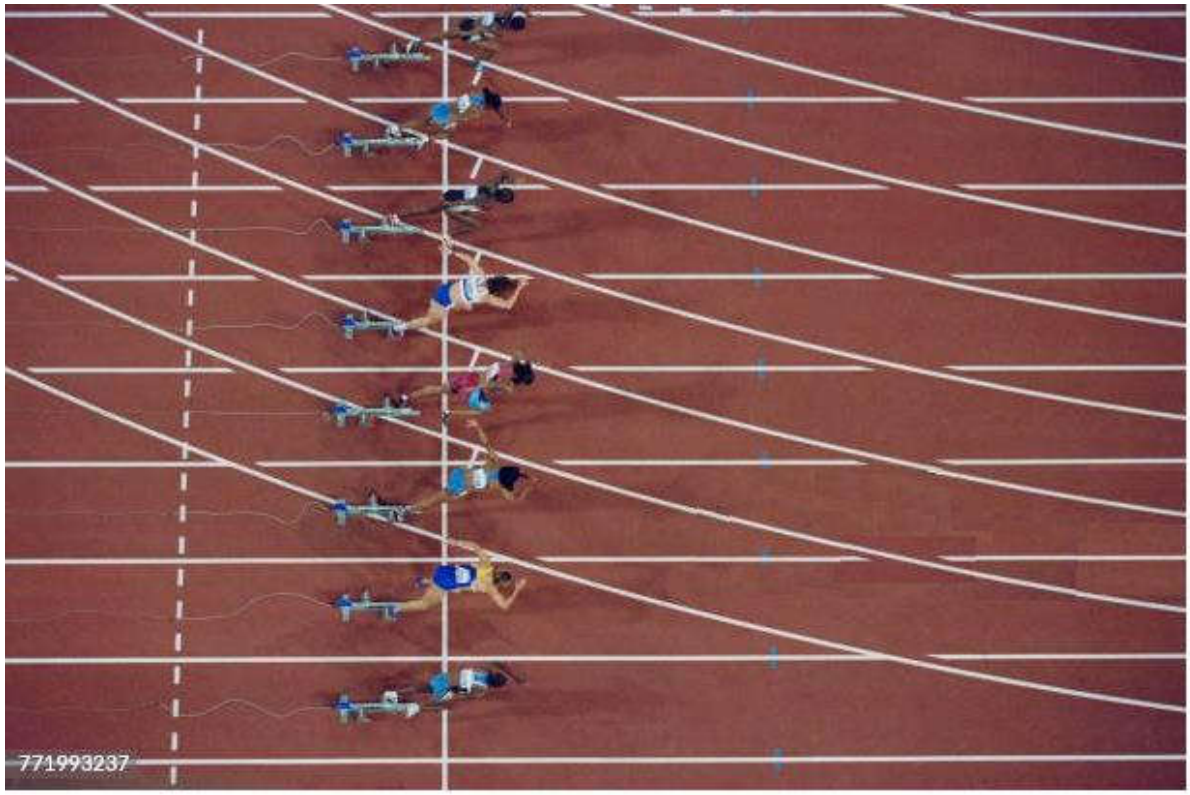
OR

(b) Find the coordinates of the point which divides the line segment joining points P and R in the ratio 2 : 1 internally. *2*

(iii) Find out if Δ PQR is an isosceles triangle. *1*

Case Study – 3

38. Activities like running or cycling reduce stress and the risk of mental disorders like depression. Running helps build endurance. Children develop stronger bones and muscles and are less prone to gain weight. The physical education teacher of a school has decided to conduct an inter school running tournament in his school premises. The time taken by a group of students to run 100 m, was noted as follows :



Time (in seconds)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Number of students	8	10	13	6	3

Based on the above, answer the following questions :

(i) What is the median class of the above given data ? *1*

(ii) (a) Find the mean time taken by the students to finish the race. *2*

OR

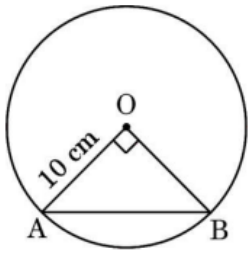
(b) Find the mode of the above given data. *2*

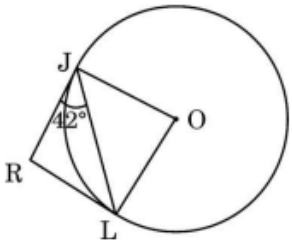
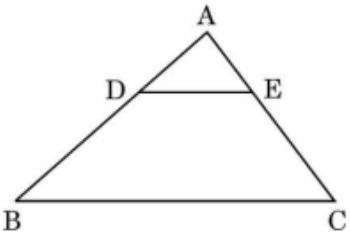
(iii) How many students took time less than 60 seconds ? *1*

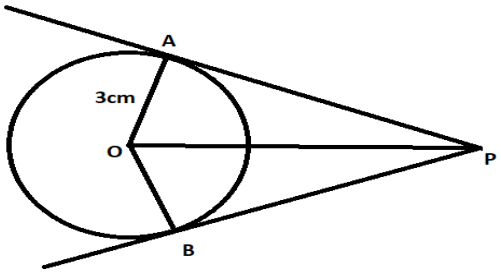
MARKING SCHEME
MATHEMATICS (SUBJECT CODE- 041)
PAPER CODE: 30/5/1

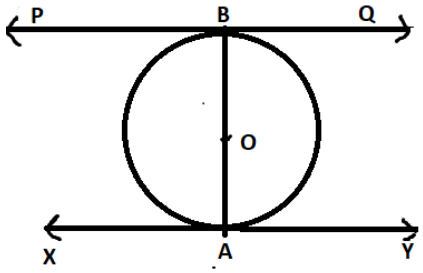
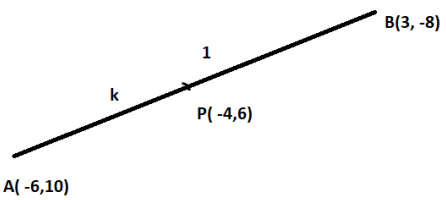
Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A **This section comprises Multiple Choice Questions (MCQs) of 1 mark each**	
1.	The next (4^{th}) term of the A.P. $\sqrt{18}$, $\sqrt{50}$, $\sqrt{98}$, ... is : (A) $\sqrt{128}$ (B) $\sqrt{140}$ (C) $\sqrt{162}$ (D) $\sqrt{200}$	
Sol.	(C) $\sqrt{162}$	1
2.	If $\frac{x}{3} = 2 \sin A$, $\frac{y}{3} = 2 \cos A$, then the value of $x^2 + y^2$ is : (A) 36 (B) 9 (C) 6 (D) 18	
Sol.	(A) 36	1
3.	If $4 \sec \theta - 5 = 0$, then the value of $\cot \theta$ is : (A) $\frac{3}{4}$ (B) $\frac{4}{5}$ (C) $\frac{5}{3}$ (D) $\frac{4}{3}$	
Sol.	(D) $\frac{4}{3}$	1
4.	Which out of the following type of straight lines will be represented by the system of equations $3x + 4y = 5$ and $6x + 8y = 7$? (A) Parallel (B) Intersecting (C) Coincident (D) Perpendicular to each other	
Sol.	(A) Parallel	1
5.	The ratio of the sum and product of the roots of the quadratic equation $5x^2 - 6x + 21 = 0$ is : (A) 5 : 21 (B) 2 : 7 (C) 21 : 5 (D) 7 : 2	
Sol.	(B) 2:7	1

6.	For the data 2, 9, x + 6, 2x + 3, 5, 10, 5; if the mean is 7, then the value of x is : (A) 9 (B) 6 (C) 5 (D) 3	
Sol.	(D) 3	1
7.	One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 7 is : (A) $\frac{1}{7}$ (B) $\frac{1}{8}$ (C) $\frac{1}{5}$ (D) $\frac{7}{40}$	
Sol.	(B) $\frac{1}{8}$	1
8.	The perimeter of the sector of a circle of radius 21 cm which subtends an angle of 60° at the centre of circle, is : (A) 22 cm (B) 43 cm (C) 64 cm (D) 462 cm	
Sol.	(C) 64 cm	1
9.	The length of an arc of a circle with radius 12 cm is 10π cm. The angle subtended by the arc at the centre of the circle, is : (A) 120° (B) 6° (C) 75° (D) 150°	
Sol.	(D) 150^0	1
10.	The greatest number which divides 281 and 1249, leaving remainder 5 and 7 respectively, is : (A) 23 (B) 276 (C) 138 (D) 69	
Sol.	(C) 138	1
11.	The number of terms in the A.P. 3, 6, 9, 12, ..., 111 is : (A) 36 (B) 40 (C) 37 (D) 30	
Sol.	(C) 37	1

12.	A chord of a circle of radius 10 cm subtends a right angle at its centre. The length of the chord (in cm) is :  (A) $5\sqrt{2}$ (B) $10\sqrt{2}$ (C) $\frac{5}{\sqrt{2}}$ (D) 5	
Sol.	(B) $10\sqrt{2}$	1
13.	The LCM of three numbers 28, 44, 132 is : (A) 258 (B) 231 (C) 462 (D) 924	
Sol.	(D) 924	1
14.	If the product of two co-prime numbers is 553, then their HCF is : (A) 1 (B) 553 (C) 7 (D) 79	
Sol.	(A) 1	1
15.	If α and β are the zeroes of the polynomial $p(x) = kx^2 - 30x + 45k$ and $\alpha + \beta = \alpha\beta$, then the value of k is : (A) $-\frac{2}{3}$ (B) $-\frac{3}{2}$ (C) $\frac{3}{2}$ (D) $\frac{2}{3}$	
Sol.	(D) $\frac{2}{3}$	1

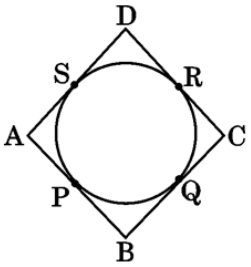
16.	In the given figure, RJ and RL are two tangents to the circle. If $\angle RJL = 42°$, then the measure of $\angle JOL$ is :  (A) 42° (B) 84° (C) 96° (D) 138°	
Sol.	(B) 84^0	1
17.	In the given figure, in Δ ABC, DE $\|\|$ BC. If AD = 2·4 cm, DB = 4 cm and AE = 2 cm, then the length of AC is :  (A) $\frac{10}{3}$ cm (B) $\frac{3}{10}$ cm (C) $\frac{16}{3}$ cm (D) 1·2 cm	
Sol.	(C) $\frac{16}{3}$ cm	1
18.	If a vertical pole of length 7·5 m casts a shadow 5 m long on the ground and at the same time, a tower casts a shadow 24 m long, then the height of the tower is : (A) 20 m (B) 40 m (C) 60 m (D) 36 m	
Sol.	(D) 36 m	1
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	

19.	*Assertion (A) :* ABCD is a trapezium with DC || AB. E and F are points on AD and BC respectively, such that EF || AB. Then $\frac{AE}{ED} = \frac{BF}{FC}$. *Reason (R) :* Any line parallel to parallel sides of a trapezium divides the non-parallel sides proportionally.	
Sol.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).	1
20.	*Assertion (A) :* Degree of a zero polynomial is not defined. *Reason (R):* Degree of a non-zero constant polynomial is 0.	
Sol.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).	1
	SECTION- B **This section comprises Very Short Answer (VSA) type questions of 2 marks each**	
21.(a)	If two tangents inclined at an angle of 60° are drawn to a circle of radius 3 cm, then find the length of each tangent.	
Sol.	Correct Figure  $\angle$ APO = 30^0 tan $30^0 = \frac{1}{\sqrt{3}} = \frac{3}{AP}$ AP = $3\sqrt{3}$ cm	½ ½ ½ ½
	OR	

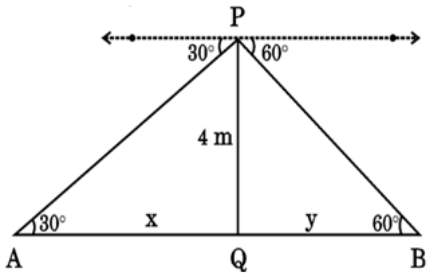
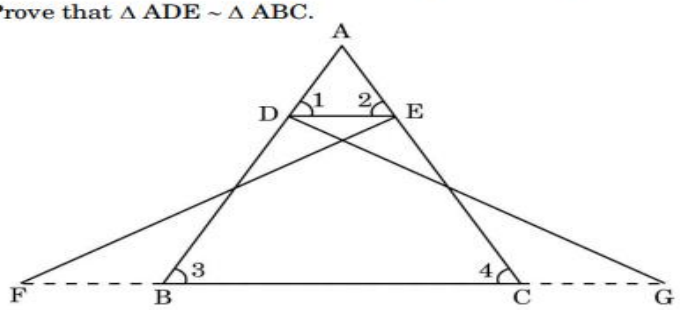
21.(b)	**Prove that the tangents drawn at the ends of a diameter of a circle are parallel.**	
Sol.	Correct Figure  $\angle$ OAY = $\angle$ OBP = 90^0 But they are forming alternate interior angles Therefore, PQ || XY	½ ½ 1
22.	**Evaluate :** $\frac{2\tan 30^\circ \cdot \sec 60^\circ \cdot \tan 45^\circ}{1-\sin^2 60^\circ}$	
Sol.	$\frac{2\times\frac{1}{\sqrt{3}}\times 2\times 1}{1-\frac{3}{4}}$ $= \frac{16}{\sqrt{3}}$ or $\frac{16\sqrt{3}}{3}$	1½ ½
23.	**If α, β are zeroes of the polynomial $p(x) = 5x^2 - 6x + 1$, then find the value of $\alpha + \beta + \alpha\beta$.**	
Sol.	$\alpha + \beta = \frac{6}{5}$ $\alpha\beta = \frac{1}{5}$ $\alpha + \beta + \alpha\beta = \frac{6}{5} + \frac{1}{5} = \frac{7}{5}$	½ ½ 1
24.(a)	**Find the ratio in which the point P(– 4, 6) divides the line segment joining the points A(– 6, 10) and B(3, – 8).**	
Sol.	Let the ratio be k:1 $-4 = \frac{3k-6}{k+1}$ $\Rightarrow$ k = $\frac{2}{7}$ $\therefore$ required ratio is 2 : 7  	1 ½ ½
	OR	

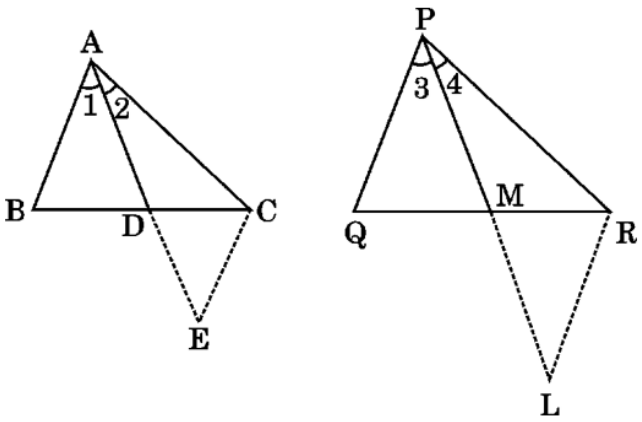
24.(b)	**Prove that the points (3, 0), (6, 4) and (– 1, 3) are the vertices of an isosceles triangle.**	
Sol.	Let A(3,0) , B(6,4) , C(-1, 3) AB = $\sqrt{(3-6)^2 + (0-4)^2} = 5$ BC = $\sqrt{(6+1)^2 + (4-3)^2} = \sqrt{50}$ CA = $\sqrt{(3+1)^2 + (0-3)^2} = 5$ As, AB = AC $\Rightarrow$ ABC is an isosceles triangle	 ½ ½ ½ ½
25.	**A carton consists of 60 shirts of which 48 are good, 8 have major defects and 4 have minor defects. Nigam, a trader, will accept the shirts which are good but Anmol, another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. Find the probability that it is acceptable to Anmol.**	
Sol.	Number of Shirts without major defects = 52 P(Anmol will accept the shirt) = $\frac{52}{60}$ or $\frac{13}{15}$	½ 1½
	SECTION- C **This section comprises Short Answer (SA) type questions of 3 marks each.**	
26.(a)	**Prove that $\sqrt{3}$ is an irrational number.**	
Sol.	Let $\sqrt{3}$ be a rational number. $\therefore \sqrt{3} = \frac{p}{q}$, where q≠0 and p & q are coprime. $3q^2 = p^2 \Longrightarrow p^2$ is divisible by 3 $\Longrightarrow$ p is divisible by 3----- (i) $\Longrightarrow$ p = 3a, where 'a' is a postive integer $9a^2 = 3q^2 \Longrightarrow q^2 = 3a^2 \Longrightarrow q^2$ is divisible by 3 $\Longrightarrow$ q is divisible by 3 ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are coprime. $\therefore \sqrt{3}$ is an irrational number.	 ½ 1 1 ½
	OR	

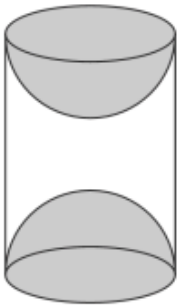
26.(b)	**Prove that $\left(\sqrt{2}+\sqrt{3}\right)^2$ is an irrational number, given that $\sqrt{6}$ is an irrational number.**	
Sol.	$(\sqrt{2}+\sqrt{3})^2 = 2+3+2\sqrt{6} = 5+2\sqrt{6}$ Let us assume, to the contrary, that $5+2\sqrt{6}$ is rational $\therefore 5+2\sqrt{6} = \frac{a}{b}$; a, b are integers, $b \neq 0$ $\therefore \sqrt{6} = \frac{a-5b}{2b}$ RHS is a rational number, whereas LHS is an irrational number. $\therefore$ Our assumption is wrong. $\Rightarrow 5+2\sqrt{6} = (\sqrt{2}+\sqrt{3})^2$ is an irrational number	1 ½ ½ ½ ½
27.(a)	**If the sum of the first 14 terms of an A.P. is 1050 and the first term is 10, then find the 20^{th} term and the n^{th} term.**	
Sol.	$\frac{14}{2}(20+13d) = 1050$ $\Rightarrow$ d = 10 $\therefore a_{20} = 10 + 19 \times 10 = 200$ $a_n = 10 + (n-1)\,10 = 10n$	1 1 ½ ½
	OR	
27. (b)	**The first term of an A.P. is 5, the last term is 45 and the sum of all the terms is 400. Find the number of terms and the common difference of the A.P.**	
Sol.	$a = 5, a_n = 45, S_n = 400$ $\frac{n}{2}(5+45) = 400$ $\Rightarrow$ n = 16 $5 + 15d = 45$ $\Rightarrow d = \frac{40}{15}$ or $\frac{8}{3}$	1 1 ½ ½

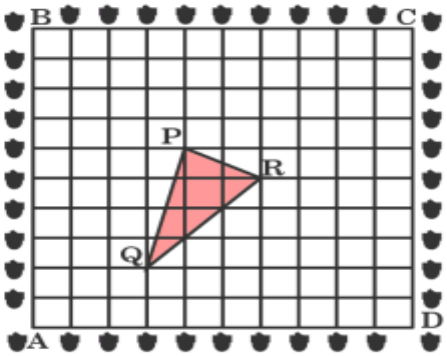
28.	**Prove that the parallelogram circumscribing a circle is a rhombus.**	
Sol.	Correct figure  $\therefore$ AP = AS BP = BQ CR = CQ DR = DS Adding, (AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ) $\Rightarrow$ AB + CD = AD + BC Now AB = CD and AD = BC $\Rightarrow$ 2 AB = 2 BC $\Rightarrow$ AB = BC $\Rightarrow$ ABCD is a rhombus	½ 1 1 ½
29.	**Prove that :** $\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A} = 1 + \sec A \operatorname{cosec} A$	
Sol.	LHS = $\frac{\frac{sinA}{cosA}}{\frac{(\sin A - cosA)}{sinA}} + \frac{\frac{cosA}{sinA}}{\frac{(\cos A - sinA)}{cosA}}$ $= \frac{1}{(sinA-cosA)}\left[\frac{sin^2A}{cosA} - \frac{cos^2A}{sinA}\right]$ $= \frac{1}{(sinA-cosA)} \times \frac{(sinA-cosA)(sin^2A+cos^2A+sinA\,cosA)}{sinAcosA}$ $= \frac{1}{sinAcosA} + 1$ $= 1 + secA\ cosecA$ = RHS	½ 1 1 ½

30.	Three unbiased coins are tossed simultaneously. Find the probability of getting : (i) at least one head. (ii) exactly one tail. (iii) two heads and one tail.	
Sol.	Total number of possible outcomes = 8 (i) P(at least one head) = $\frac{7}{8}$ (ii) P (exactly one tail) = $\frac{3}{8}$ (iii) P (2 heads and one tail) = $\frac{3}{8}$	 1 1 1
31.	An arc of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding major sector. (Use $\pi = 3{\cdot}14$)	
Sol.	Area of circle = $3.14 \times 10 \times 10 = 314$ cm^2 Area of minor sector = $\frac{3.14 \times 10 \times 10 \times 90}{360} = \frac{157}{2}$ cm^2 or 78.5 cm^2 Area of major sector = $314 - 78.5 = 235.5$ cm^2	1 1 1
	SECTION- D **This section comprises Long Answer (LA) type questions of 5 marks each.**	
32.(a)	Find the value of 'k' for which the quadratic equation $(k + 1)x^2 - 6(k + 1)x + 3(k + 9) = 0, k \neq -1$ has real and equal roots.	
Sol.	For real and equal roots, $D = b^2 - 4ac = 0$ $36 (k + 1)^2 - 4 (k + 1) \times 3 (k + 9) = 0$ $\Rightarrow k^2 - 2k - 3 = 0$ $\Rightarrow (k - 3) (k + 1) = 0$ $k \neq -1$ So, $k = 3$	 2 1½ 1 ½
	OR	
32.(b)	The age of a man is twice the square of the age of his son. Eight years hence, the age of the man will be 4 years more than three times the age of his son. Find their present ages.	
Sol.	Let present age of son = x years and present age of man = $2x^2$ years A.T.Q. $3(x + 8) + 4 = 2x^2 + 8$	 1 1

	$\Rightarrow 2x^2 - 3x - 20 = 0$	1
	$\Rightarrow (2x + 5)(x - 4) = 0$	1
	$x \neq -\frac{5}{2}$ So, $x = 4$	½
	Present age of son = 4 years	
	Present age of man = 32 years	½
33.	From a point on a bridge across the river, the angles of depressions of the banks on opposite sides of the river are 30° and 60° respectively. If the bridge is at a height of 4 m from the banks, find the width of the river.	
Sol.	Correct Figure	1
		
	Let AB be the width of river	
	In right Δ PAQ,	
	$\tan 30° = \frac{1}{\sqrt{3}} = \frac{4}{x}$	1
	$\Rightarrow 4\sqrt{3} = x$	½
	In right Δ PBQ,	
	$\tan 60° = \sqrt{3} = \frac{4}{y}$	1
	$\Rightarrow y = \frac{4}{\sqrt{3}}$	½
	Width of river = $x + y = 4\sqrt{3} + \frac{4}{\sqrt{3}} = \frac{16}{3}\sqrt{3}$ m	1
34.(a)	In the given figure, Δ FEC ≅ Δ GDB and ∠ 1 = ∠ 2. Prove that Δ ADE ~ Δ ABC. 	
Sol.	Δ FEC ≅ Δ GDB	
	Therefore, ∠3 = ∠4	1

	In Δ ABC, $\angle 3 = \angle 4$ $\therefore$ AB = AC ……(i) In Δ ADE, $\angle 1 = \angle 2$ AD = AE ……(ii) Dividing (ii) by (i) $\frac{AD}{AB} = \frac{AE}{AC}$ $\Rightarrow$ DE $\|\|$ BC $\angle 1 = \angle 3$ and $\angle 2 = \angle 4$ $\therefore$ Δ ADE ~ Δ ABC	1 1 1 1
	OR	
34.(b)	**Sides AB and AC and median AD of a Δ ABC are respectively proportional to sides PQ and PR and median PM of another Δ PQR. Show that Δ ABC ~ Δ PQR.**	
Sol.	Correct figure  Produce AD to E such that AD = DE and join EC. Produce PM to L such that PM = ML and join LR. $\therefore$ Δ ABD ≅ Δ ECD $\therefore$ AB = EC Similarly, PQ = LR $\frac{AB}{PQ} = \frac{AC}{PR} = \frac{AD}{PM}$ $\frac{EC}{LR} = \frac{AC}{PR} = \frac{2AD}{2PM} = \frac{AE}{PL}$ $\therefore$ Δ AEC ~ Δ PLR	1 ½ 1 1

	$\Rightarrow \angle 2 = \angle 4$ Similarly, $\angle 1 = \angle 3$ Adding both, $\angle BAC = \angle QPR$ $\therefore \Delta ABC \sim \Delta PQR$	½ ½ ½
35.	A wooden article was made by scooping out a hemisphere from each end of a solid cylinder, as shown in the figure. If the height of the cylinder is 5·8 cm and its base is of radius 2·1 cm, find the total surface area of the article. 	
Sol.	CSA of cylinder $= 2 \times \frac{22}{7} \times 2.1 \times 5.8$ $= 76.56 \text{ cm}^2$ CSA of two hemisphere $= 4 \times \frac{22}{7} \times 2.1 \times 2.1$ $= 55.44 \text{ cm}^2$ Total Surface Area of article $= 76.56 + 55.44 = 132 \text{ cm}^2$	1 1 1 1 1
	SECTION-E **This section comprises 3 case study based questions of 4 marks each.**	
36.	**Case Study – 1** Essel World is one of India's largest amusement parks that offers a diverse range of thrilling rides, water attractions and entertainment options for visitors of all ages. The park is known for its iconic "Water Kingdom" section, making it a popular destination for family outings and fun-filled adventure. The ticket charges for the park are ₹ 150 per child and ₹ 250 per adult. On a day, the cashier of the park found that 300 tickets were sold and an amount of ₹ 55,000 was collected.	

	Based on the above, answer the following questions : (i) If the number of children visited be x and the number of adults visited be y, then write the given situation algebraically. (ii) (a) How many children visited the amusement park that day ? **OR** (b) How many adults visited the amusement park that day ? (iii) How much amount will be collected if 250 children and 100 adults visit the amusement park ?	
Sol.	i) $x + y = 300$ ……(i) $150x + 250y = 55000$……..(ii) (ii) (a) Solving equation (i) and (ii) Number of children visited park (x) = 200 OR (b) Solving equation (i) and (ii) Number of adults visited park (y) = 100 (iii) Amount collected = $250 \times 150 + 100 \times 250 =$ ₹ 62500	½ ½ 2 2 1
37.	**Case Study – 2** A garden is in the shape of a square. The gardener grew saplings of Ashoka tree on the boundary of the garden at the distance of 1 m from each other. He wants to decorate the garden with rose plants. He chose a triangular region inside the garden to grow rose plants. In the above situation, the gardener took help from the students of class 10. They made a chart for it which looks like the given figure.  Based on the above, answer the following questions : (i) If A is taken as origin, what are the coordinates of the vertices of Δ PQR ? (ii) (a) Find distances PQ and QR. **OR** (b) Find the coordinates of the point which divides the line segment joining points P and R in the ratio 2 : 1 internally. (iii) Find out if Δ PQR is an isosceles triangle.	
Sol.	(i) P (4, 6) , Q (3, 2), R (6, 5)	1

	(ii) (a) PQ = $\sqrt{(4-3)^2 + (6-2)^2} = \sqrt{17}$	1
	QR = $\sqrt{(3-6)^2 + (2-5)^2} = \sqrt{18}$	1
	OR	
	(b) The coordinate of required point are $\left(\frac{6\times2+1\times4}{3}, \frac{5\times2+1\times6}{3}\right)$	1
	i.e. $\left(\frac{16}{3}, \frac{16}{3}\right)$	1
	(iii) PQ = $\sqrt{(4-3)^2 + (6-2)^2} = \sqrt{17}$	
	QR = $\sqrt{(3-6)^2 + (2-5)^2} = \sqrt{18}$	
	PR = $\sqrt{(4-6)^2 + (6-5)^2} = \sqrt{5}$	½
	PQ ≠ QR ≠ PR	½
	Δ PQR is not isosceles	
38.	**Case Study – 3** Activities like running or cycling reduce stress and the risk of mental disorders like depression. Running helps build endurance. Children develop stronger bones and muscles and are less prone to gain weight. The physical education teacher of a school has decided to conduct an inter school running tournament in his school premises. The time taken by a group of students to run 100 m, was noted as follows : 	

Time (in seconds)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Number of students	8	10	13	6	3

Based on the above, answer the following questions :

(i) What is the median class of the above given data ?

(ii) (a) Find the mean time taken by the students to finish the race.

OR

(b) Find the mode of the above given data.

(iii) How many students took time less than 60 seconds ?

Time (in sec)	Number of students (f)	x_i	cf	$f_i x_i$
0 – 20	8	10	8	80
20 – 40	10	30	18	300
40 – 60	13	50	31	650
60 – 80	6	70	37	420
80 – 100	3	90	40	270
Total	40			1720

Sol.

(i) Correct Cummulative Frequency ½

Median class = 40 – 60 ½

(ii) (a) Correct table for x_i and $f_i x_i$ 1½

Mean = $\frac{1720}{40} = 43$ ½

OR

(b) Modal class = 40-60 ½

Mode = $40 + \frac{(13-10)}{(26-10-6)} \times 20$ 1

$= 46$ ½

(iii) 31 students took time less than 60 seconds 1

* * *

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A**, **B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take* $\pi = \frac{22}{7}$ *wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

This section comprises Multiple Choice Questions (MCQs) of 1 mark each. *20×1=20*

1. If x = 5 is a solution of the quadratic equation $2x^2 + (k - 1)x + 10 = 0$, then the value of k is :

(A) 11 (B) – 11

(C) 13 (D) – 13

2. Two positive integers m and n are expressed as $m = p^5q^2$ and $n = p^3q^4$, where p and q are prime numbers. The LCM of m and n is :

(A) p^8q^6 (B) p^3q^2

(C) p^5q^4 (D) $p^5q^2 + p^3q^4$

3. The pair of equations $x = 2a$ and $y = 3b$ ($a, b \neq 0$) graphically represents straight lines which are :

(A) coincident (B) parallel

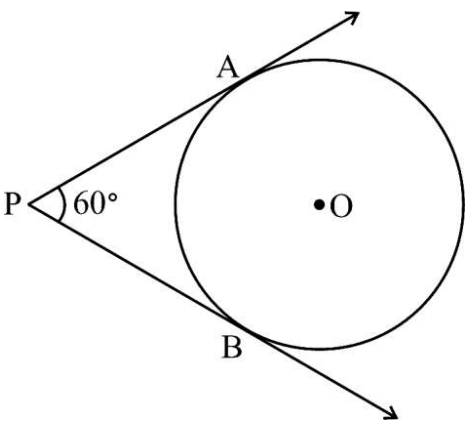
(C) intersecting at (2a, 3b) (D) intersecting at (3b, 2a)

4. If $k + 7$, $2k - 2$ and $2k + 6$ are three consecutive terms of an A.P., then the value of k is :

(A) 15 (B) 17

(C) 5 (D) 1

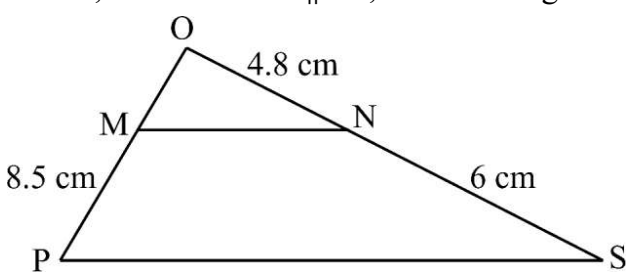
5. In the given figure, PA and PB are two tangents drawn to the circle with centre O and radius 5 cm. If $\angle APB = 60°$, then the length of PA is :



(A) $\frac{5}{\sqrt{3}}$ cm (B) $5\sqrt{3}$ cm

(C) $\frac{10}{\sqrt{3}}$ cm (D) 10 cm

6. In the given figure, if M and N are points on the sides OP and OS respectively of ΔOPS, such that $MN \parallel PS$, then the length of OP is :



(A) 6.8 cm (B) 17 cm

(C) 15.3 cm (D) 9.6 cm

7. All queens, jacks and aces are removed from a pack of 52 playing cards. The remaining cards are well-shuffled and one card is picked up at random from it. The probability of that card to be a king is :

(A) $\frac{1}{10}$ (B) $\frac{1}{13}$

(C) $\frac{3}{10}$ (D) $\frac{3}{13}$

8. PQ is a diameter of a circle with centre O(2, – 4). If the coordinates of the point P are (– 4, 5), then the coordinates of the point Q will be :

(A) (– 3, 4.5) (B) (– 1, 0.5)

(C) (4, – 5) (D) (8, – 13)

9. The value of $\left(\sin^2 \theta + \frac{1}{1+\tan^2 \theta} \right)$ is :

(A) 0 (B) 2

(C) 1 (D) – 1

10. A cap is cylindrical in shape, surmounted by a conical top. If the volume of the cylindrical part is equal to that of the conical part, then the ratio of the height of the cylindrical part to the height of the conical part is :

(A) 1 : 2 (B) 1 : 3

(C) 2 : 1 (D) 3 : 1

11. The 7^{th} term from the end of the A.P. : – 8, – 5, – 2, ..., 49 is :

(A) 67 (B) 13

(C) 31 (D) 10

12. The diagonals of a rhombus ABCD intersect at O. Taking 'O' as the centre, an arc of radius 6 cm is drawn intersecting OA and OD at E and F respectively. The area of the sector OEF is :

(A) 9π cm^2 (B) 3π cm^2

(C) 12π cm^2 (D) 18π cm^2

13. The probability of getting a chocolate flavoured ice cream at random, in a lot of 600 ice creams is 0.055. The number of chocolate flavoured ice creams in the lot is :

(A) 33 (B) 55

(C) 11 (D) 44

14. If $\tan^2\theta + \cot^2\alpha = 2$, where $\theta = 45°$ and $0° \le \alpha \le 90°$, then the value of α is :

(A) 30° (B) 45°

(C) 60° (D) 90°

15. The point on x-axis which is equidistant from the points (5, – 3) and (4, 2) is :

(A) (4.5, 0) (B) (7, 0)

(C) (0.5, 0) (D) (– 7, 0)

16. If the length of an arc of a circle subtending an angle 60° at its centre is 22 cm, then the radius of the circle is :

(A) $\sqrt{21}$ cm (B) 21 cm

(C) $\sqrt{42}$ cm (D) 42 cm

17. If the length of the shadow on the ground of a pole is $\sqrt{3}$ times the height of the pole, then the angle of elevation of the Sun is :

(A) 30° (B) 45°

(C) 60° (D) 90°

18. Two dice are thrown at the same time and the product of the numbers appearing on them is noted. The probability that the product of the numbers lies between 8 and 13 is :

(A) $\frac{7}{36}$ (B) $\frac{5}{36}$

(C) $\frac{2}{9}$ (D) $\frac{1}{4}$

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

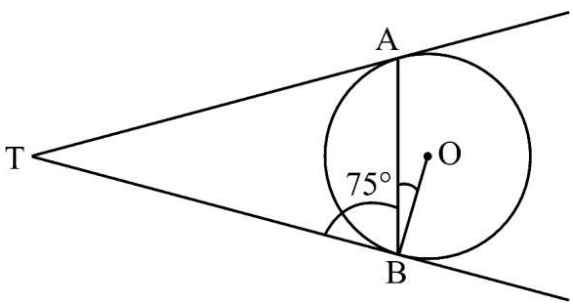
(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A)* : If the graph of a polynomial intersects the x-axis at exactly two points, then the number of zeroes of that polynomial is 2.

Reason (R) : The number of zeroes of a polynomial is equal to the number of points where the graph of the polynomial intersects x-axis.

20. *Assertion (A)* : TA and TB are two tangents drawn from an external point T to a circle with centre 'O'. If $\angle$ TBA = 75° then $\angle$ ABO = 25°.

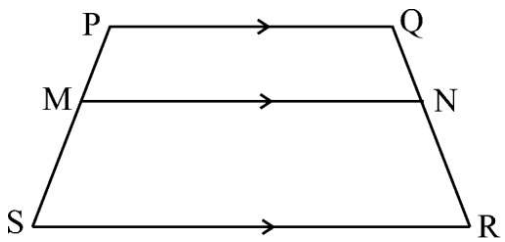


Reason (R) : The tangent drawn at any point of a circle is perpendicular to the radius through the point of contact.

SECTION B

This section comprises Very Short Answer (VSA) type questions of 2 marks each. $5 \times 2 = 10$

21. PQRS is a trapezium with PQ ‖ SR. If M and N are two points on the non-parallel sides PS and QR respectively, such that MN is parallel to PQ, then show that $\frac{PM}{MS} = \frac{QN}{NR}$.

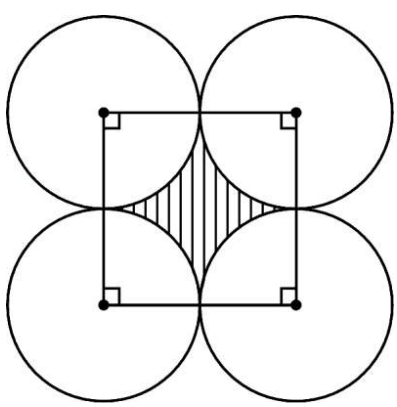


22. Prove that $7 - 3\sqrt{5}$ is an irrational number, given that $\sqrt{5}$ is an irrational number.

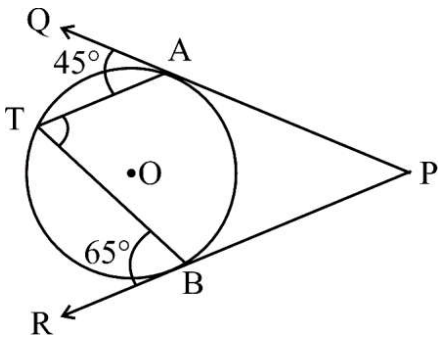
23. (a) A chord is subtending an angle of 90° at the centre of a circle of radius 14 cm. Find the area of the corresponding minor segment of the circle.

OR

(b) Find the area of the shaded region if length of radius of each circle is 7 cm. Each circle touches the other two externally.



24. In the given figure, PAQ and PBR are tangents to the circle with centre 'O' at the points A and B respectively. If T is a point on the circle such that $\angle$ QAT = 45° and $\angle$ TBR = 65°, then find $\angle$ ATB.



25. (a) If $\cos(A + B) = \frac{1}{2}$ and $\tan(A - B) = \frac{1}{\sqrt{3}}$, where $0 \leq A + B \leq 90°$, then find the value of sec (2A – 3B).

OR

(b) Find the value of x such that,

$3\tan^2 60° - x\sin^2 45° + \frac{3}{4}\sec^2 30° = 2\,\text{cosec}^2 30°$

SECTION C

This section comprises Short Answer (SA) type questions of 3 marks each. *6×3=18*

26. The government rescued 100 people after a train accident. Their ages were recorded in the following table. Find their mean age.

Age (in years)	Number of people rescued
10 – 20	9
20 – 30	14
30 – 40	15
40 – 50	21
50 – 60	23
60 – 70	12
70 – 80	6

27. Prove that :

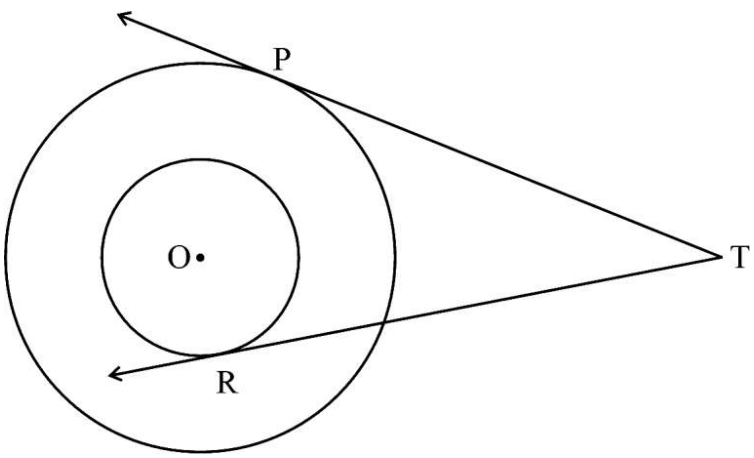
$$\left(\frac{1+\tan^2 A}{1+\cot^2 A}\right) = \frac{(1-\tan A)^2}{(1-\cot A)^2}$$

28. (a) If a hexagon PQRSTU circumscribes a circle, prove that,

$$PQ + RS + TU = QR + ST + UP$$

OR

(b) In the given figure, two concentric circles have radii 3 cm and 5 cm. Two tangents TR and TP are drawn to the circles from an external point T such that TR touches the inner circle at R and TP touches the outer circle at P. If $TR = 4\sqrt{10}$ cm, then find the length of TP.



29. Find a quadratic polynomial whose sum of the zeroes is 8 and difference of the zeroes is 2.

30. (a) The sum of the digits of a 2-digit number is 12. Seven times the number is equal to four times the number obtained by reversing the order of the digits. Find the number.

OR

(b) Find the values of x and y from the following pair of linear equations :

$$62x + 43y = 167$$

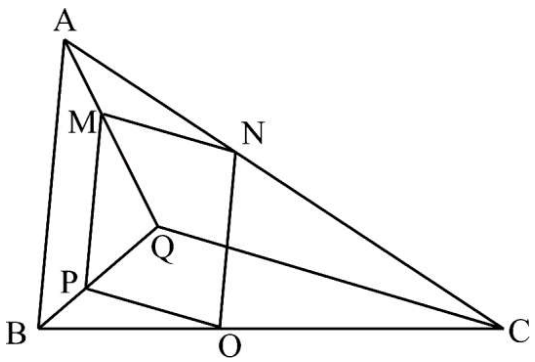
$$43x + 62y = 148$$

31. A school has invited 42 Mathematics teachers, 56 Physics teachers and 70 Chemistry teachers to attend a Science workshop. Find the minimum number of tables required, if the same number of teachers are to sit at a table and each table is occupied by teachers of the same subject.

SECTION D

This section comprises Long Answer (LA) type questions of 5 marks each. *4×5=20*

32. In the given figure, MNOP is a parallelogram and AB ‖ MP. Prove that QC ‖ PO.



33. An age-wise list of number of literate people in a block is prepared in the following table. There are total 100 people and their median age is 41.5 years. Information about two groups are missing, which are denoted by x and y. Find the value of x and y.

Age (in years)	Number of literate people
10 – 20	15
20 – 30	x
30 – 40	12
40 – 50	20
50 – 60	y
60 – 70	8
70 – 80	10

34. (a) If Nidhi were 7 years younger than what she actually is, then the square of her age (in years) would be 1 more than 5 times her actual age. What is her present age ?

OR

(b) A shopkeeper buys a number of books for ₹ 1,800. If he had bought 15 more books for the same amount, then each book would have cost him ₹ 20 less. Find how many books he bought initially.

35. (a) The largest possible hemisphere is drilled out from a wooden cubical block of side 21 cm such that the base of the hemisphere is on one of the faces of the cube. Find :

(i) the volume of wood left in the block,

(ii) the total surface area of the remaining solid.

OR

(b) A solid toy is in the form of a hemisphere surmounted by a right circular cone. Ratio of the radius of the cone to its slant height is 3 : 5. If the volume of the toy is 240π cm^3, then find the total height of the toy.

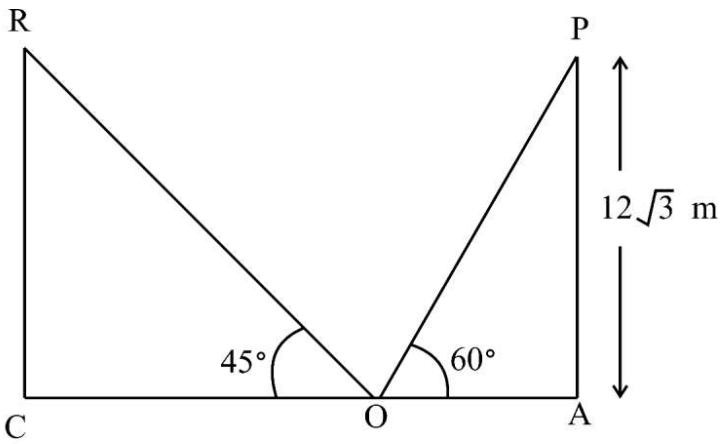
SECTION E

This section comprises 3 case study based questions of 4 marks each. *3×4=12*

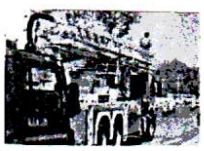
Case Study – 1

36. Due to short circuit, a fire has broken out in New Home Complex. Two buildings, namely X and Y have mainly been affected. The fire engine has arrived and it has been stationed at a point which is in between the two buildings. A ladder at point O is fixed in front of the fire engine.

The ladder inclined at an angle 60° to the horizontal is leaning against the wall of the terrace (top) of the building Y. The foot of the ladder is kept fixed and after some time it is made to lean against the terrace (top) of the opposite building X at an angle of 45° with the ground. Both the buildings along with the foot of the ladder, fixed at 'O' are in a straight line.



(Building X)



(Building Y)

Based on the above given information, answer the following questions :

(i) Find the length of the ladder. *1*

(ii) Find the distance of the building Y from point 'O', i.e. OA. *1*

(iii) (a) Find the horizontal distance between the two buildings. *2*

OR

(b) Find the height of the building X. *2*

Case Study – 2

37. A school has decided to plant some endangered trees on 51st World Environment Day in the nearest park. They have decided to plant those trees in few concentric circular rows such that each succeeding row has 20 more trees than the previous one. The first circular row has 50 trees.

Based on the above given information, answer the following questions :

(i) How many trees will be planted in the 10th row ? *1*

(ii) How many more trees will be planted in the 8th row than in the 5th row ? *1*

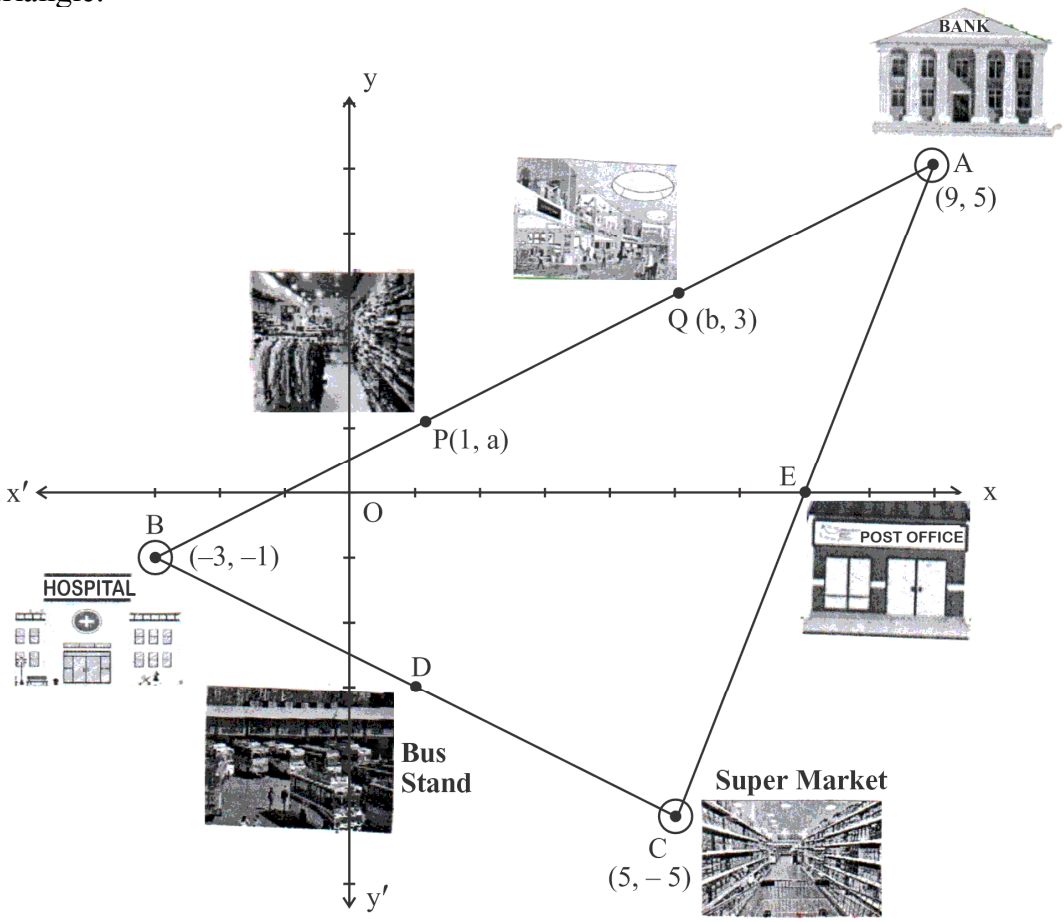
(iii) (a) If 3200 trees are to be planted in the park, then how many rows are required ? *2*

OR

(b) If 3200 trees are to be planted in the park, then how many trees are still left to be planted after the 11th row ? *2*

Case Study – 3

38. Partha, a software engineer, lives in Jerusalem for his work. He lives in the most convenient area of the city from where bank, hospital, post office and supermarket can be easily accessed. In the graph, the bank is plotted as A(9, 5), hospital as B(– 3, – 1) and supermarket as C(5, – 5) such that A, B, C form a triangle.



Based on the above given information, answer the following questions :

(i) Find the distance between the bank and the hospital. *1*

(ii) In between the bank and the supermarket, there is a post office plotted at E which is their mid-point. Find the coordinates of E. *1*

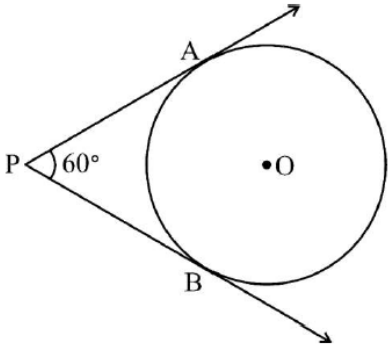
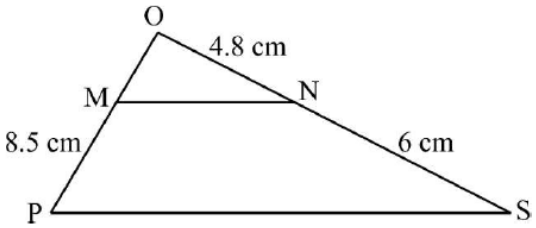
(iii) (a) In between the hospital and the supermarket, there is a bus stop plotted as D, which is their mid-point. If Partha wants to reach the bus stand from the bank, then how much distance does he need to cover ? *2*

OR

(b) P and Q are two different garment shops lying between the bank and the hospital, such that BP = PQ = QA. If the coordinates of P and Q are (1, a) and (b, 3) respectively, then find the values of 'a' and 'b'. *2*

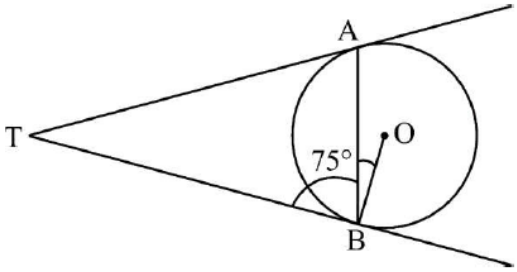
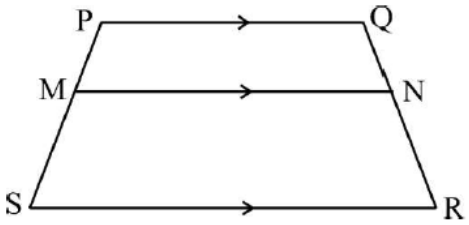
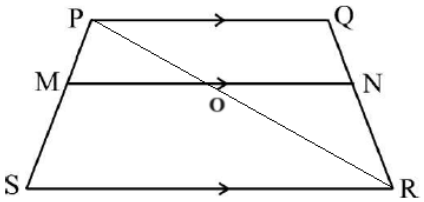
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/S/1)

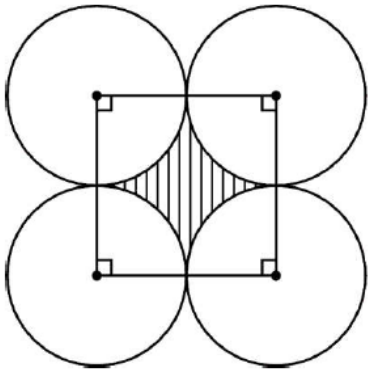
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **This section comprises Multiple Choice Questions (MCQs) 1 mark each.**	
1	If x = 5 is a solution of the quadratic equation $2x^2 + (k - 1)x + 10 = 0$, then the value of k is : (A) 11 (B) – 11 (C) 13 (D) – 13	
Sol.	(B) -11	**1**
2	Two positive integers m and n are expressed as $m = p^5q^2$ and $n = p^3q^4$, where p and q are prime numbers. The LCM of m and n is : (A) p^8q^6 (B) p^3q^2 (C) p^5q^4 (D) $p^5q^2 + p^3q^4$	
Sol.	(C) p^5q^4	**1**
3	The pair of equations x = 2a and y = 3b (a, b ≠ 0) graphically represents straight lines which are : (A) coincident (B) parallel (C) intersecting at (2a, 3b) (D) intersecting at (3b, 2a)	
Sol.	(C) intersecting at (2a, 3b)	**1**
4	If k + 7, 2k – 2 and 2k + 6 are three consecutive terms of an A.P., then the value of k is : (A) 15 (B) 17 (C) 5 (D) 1	
Sol.	(B) 17	**1**

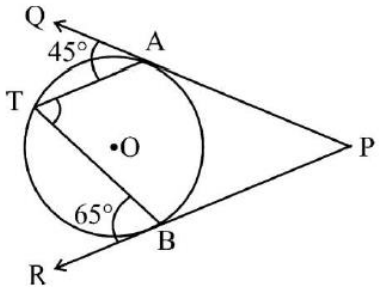
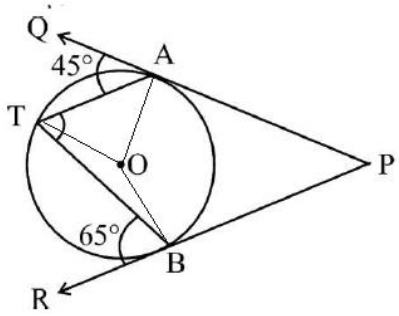
5	In the given figure, PA and PB are two tangents drawn to the circle with centre O and radius 5 cm. If $\angle APB = 60°$, then the length of PA is :  (A) $\frac{5}{\sqrt{3}}$ cm (B) $5\sqrt{3}$ cm (C) $\frac{10}{\sqrt{3}}$ cm (D) 10 cm	
Sol.	(B) $5\sqrt{3}$ cm	**1**
6	In the given figure, if M and N are points on the sides OP and OS respectively of ΔOPS, such that MN $\parallel$ PS, then the length of OP is :  (A) 6.8 cm (B) 17 cm (C) 15.3 cm (D) 9.6 cm	
Sol.	(C) 15.3 cm	**1**
7	All queens, jacks and aces are removed from a pack of 52 playing cards. The remaining cards are well-shuffled and one card is picked up at random from it. The probability of that card to be a king is : (A) $\frac{1}{10}$ (B) $\frac{1}{13}$ (C) $\frac{3}{10}$ (D) $\frac{3}{13}$	
Sol.	(A) $\frac{1}{10}$	**1**
8	PQ is a diameter of a circle with centre O(2, – 4). If the coordinates of the point P are (– 4, 5), then the coordinates of the point Q will be : (A) (– 3, 4.5) (B) (– 1, 0.5) (C) (4, – 5) (D) (8, – 13)	
Sol.	(D) (8, −13)	**1**

9	The value of $\left(\sin^2 \theta + \frac{1}{1+\tan^2 \theta} \right)$ is : (A) 0 (B) 2 (C) 1 (D) – 1	
Sol.	(C) 1	**1**
10	A cap is cylindrical in shape, surmounted by a conical top. If the volume of the cylindrical part is equal to that of the conical part, then the ratio of the height of the cylindrical part to the height of the conical part is : (A) 1 : 2 (B) 1 : 3 (C) 2 : 1 (D) 3 : 1	
Sol.	(B) 1: 3	**1**
11	The 7^{th} term from the end of the A.P. : – 8, – 5, – 2, ..., 49 is : (A) 67 (B) 13 (C) 31 (D) 10	
Sol.	(C) 31	**1**
12	The diagonals of a rhombus ABCD intersect at O. Taking 'O' as the centre, an arc of radius 6 cm is drawn intersecting OA and OD at E and F respectively. The area of the sector OEF is : (A) 9π cm^2 (B) 3π cm^2 (C) 12π cm^2 (D) 18π cm^2	
Sol.	(A) 9π cm^2	**1**
13	The probability of getting a chocolate flavoured ice cream at random, in a lot of 600 ice creams is 0.055. The number of chocolate flavoured ice creams in the lot is : (A) 33 (B) 55 (C) 11 (D) 44	
Sol.	(A) 33	**1**
14	If $\tan^2 \theta + \cot^2 \alpha = 2$, where $\theta = 45°$ and $0° \leq \alpha \leq 90°$, then the value of α is : (A) 30° (B) 45° (C) 60° (D) 90°	
Sol.	(B) 45°	**1**

15	The point on x-axis which is equidistant from the points (5, – 3) and (4, 2) is : (A) (4.5, 0) (B) (7, 0) (C) (0.5, 0) (D) (– 7, 0)	
Sol.	(B) (7, 0)	**1**
16	If the length of an arc of a circle subtending an angle 60° at its centre is 22 cm, then the radius of the circle is : (A) $\sqrt{21}$ cm (B) 21 cm (C) $\sqrt{42}$ cm (D) 42 cm	
Sol.	(B) 21 cm	**1**
17	If the length of the shadow on the ground of a pole is $\sqrt{3}$ times the height of the pole, then the angle of elevation of the Sun is : (A) 30° (B) 45° (C) 60° (D) 90°	
Sol.	(A) 30°	**1**
18	Two dice are thrown at the same time and the product of the numbers appearing on them is noted. The probability that the product of the numbers lies between 8 and 13 is : (A) $\frac{7}{36}$ (B) $\frac{5}{36}$ (C) $\frac{2}{9}$ (D) $\frac{1}{4}$	
Sol.	(A) $\frac{7}{36}$	**1**
	Directions : In Question **19** and **20**, **Assertion (A)** and **Reason (R)** are given. Select the correct option from the following : (A) Both Assertion (A) and Reason (R) are true. Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true. Reason (R) does not give correct explanation of (A). (C) Assertion (A) is true but Reason (R) is not true. (D) Assertion (A) is not true but Reason (R) is true.	

19	*Assertion (A)* : If the graph of a polynomial intersects the x-axis at exactly two points, then the number of zeroes of that polynomial is 2. *Reason (R)* : The number of zeroes of a polynomial is equal to the number of points where the graph of the polynomial intersects x-axis.	
Sol.	(A) Both Assertion (A) and Reason (R) are true. Reason (R) is the correct explanation of Assertion (A)	**1**
20	*Assertion (A)* : TA and TB are two tangents drawn from an external point T to a circle with centre 'O'. If $\angle$ TBA = 75° then $\angle$ ABO = 25°.  *Reason (R)* : The tangent drawn at any point of a circle is perpendicular to the radius through the point of contact.	
Sol.	(D) Assertion (A) is not true but Reason (R) is true.	**1**
	SECTION B **This section comprises of Very Short Answer (VSA) type questions of 2 marks each.**	
21	PQRS is a trapezium with PQ ∥ SR. If M and N are two points on the non-parallel sides PS and QR respectively, such that MN is parallel to PQ, then show that $\frac{PM}{MS} = \frac{QN}{NR}$. 	
Sol.	Join PR  PQ ∥ SR and MN ∥ PQ ⇒ MN ∥ SR In Δ PSR, $\frac{PM}{MS} = \frac{PO}{OR}$ … (i) In Δ PQR, $\frac{PO}{OR} = \frac{QN}{NR}$ … (ii) From (i) and (ii), $\frac{PM}{MS} = \frac{QN}{NR}$	½ ½ ½ ½

22	Prove that $7 - 3\sqrt{5}$ is an irrational number, given that $\sqrt{5}$ is an irrational number.	
Sol.	Assuming $7 - 3\sqrt{5}$ to be a rational number. Let $7 - 3\sqrt{5} = \frac{a}{b}$ where a and b are integers & $b \neq 0$ $\Rightarrow \sqrt{5} = \frac{7b-a}{3b}$ Here RHS is rational but LHS is irrational. Therefore our assumption is wrong. Hence, $7 - 3\sqrt{5}$ is an irrational number.	½ **1** ½
23(a)	A chord is subtending an angle of 90° at the centre of a circle of radius 14 cm. Find the area of the corresponding minor segment of the circle.	
Sol.	Area of minor segment $= \pi \times 14^2 \times \frac{1}{4} - \frac{1}{2} \times 14^2$ $= (154 - 98) = 56$ Hence, area of minor segment $= 56\ \text{cm}^2$	**1** **1**
	OR	
23(b)	Find the area of the shaded region if length of radius of each circle is 7 cm. Each circle touches the other two externally. 	
Sol.	Side of square $= 14$ cm Area of shaded region = area of square – area of 4 quadrants $= 14^2 - 4 \times \frac{22}{7} \times 7^2 \times \frac{90}{360}$ $= (196 - 154) = 42$ Hence, area of shaded region $= 42\ \text{cm}^2$	½ **1** ½

24	In the given figure, PAQ and PBR are tangents to the circle with centre 'O' at the points A and B respectively. If T is a point on the circle such that $\angle$ QAT = 45° and $\angle$ TBR = 65°, then find $\angle$ ATB.  	
Sol.	Join OA, OB and OT  Now $\angle ATO = \angle TAO = 90° - 45 = 45°$ and $\angle BTO = \angle TBO = 90° - 65° = 25°$ $\Rightarrow \angle ATB = \angle ATO + \angle BTO$ $= 45° + 25° = 70°$	½ ½ ½ ½
25(a)	If cos (A + B) = $\frac{1}{2}$ and tan (A – B) = $\frac{1}{\sqrt{3}}$, where $0 \leq$ A + B $\leq 90°$, then find the value of sec (2A – 3B).	
Sol.	$\cos(A + B) = \frac{1}{2} \Rightarrow$ A + B = 60° … (i) $\tan(A - B) = \frac{1}{\sqrt{3}} \Rightarrow$ A – B = 30° … (ii) Solving (i) and (ii), we get $A = 45°$ and $B = 15°$ $\Rightarrow \sec(2A - 3B) = \sec(90° - 45°)$ $= \sec 45° = \sqrt{2}$	½ ½ ½ ½
	OR	
25(b)	Find the value of x such that, $3 \tan^2 60° - x \sin^2 45° + \frac{3}{4} \sec^2 30° = 2 \operatorname{cosec}^2 30°$	
Sol.	$3 \tan^2 60° - x \sin^2 45° + \frac{3}{4}\sec^2 30° = 2 \operatorname{cosec}^2 30°$ $\Rightarrow 3(\sqrt{3})^2 - x\left(\frac{1}{\sqrt{2}}\right)^2 + \frac{3}{4}\left(\frac{2}{\sqrt{3}}\right)^2 = 2(2)^2$ $\Rightarrow 9 - \frac{x}{2} + 1 = 8$ $\Rightarrow x = 4$	**1** **1**
	SECTION C **This section comprises of Short Answer (SA) type questions of 3 marks each.**	

26

The government rescued 100 people after a train accident. Their ages were recorded in the following table. Find their mean age.

Age (in years)	Number of people rescued
10 – 20	9
20 – 30	14
30 – 40	15
40 – 50	21
50 – 60	23
60 – 70	12
70 – 80	6

Sol.

Age (in years)	Number of people rescued (f_i)	x_i	u_i	f_iu_i
10-20	9	15	-3	-27
20-30	14	25	-2	-28
30-40	15	35	-1	-15	**1½ marks for correct table**
40-50	21	45	0	0
50-60	23	55	1	23
60-70	12	65	2	24
70-80	6	75	3	18
Total	100			-5

Mean Age $= 45 + \frac{(-5)}{100} \times 10$ **1**

$= 44.5$ **½**

Hence, mean age is 44.5 years

27

Prove that :

$$\left(\frac{1+\tan^2 A}{1+\cot^2 A}\right) = \frac{(1-\tan A)^2}{(1-\cot A)^2}$$

LHS $= \frac{1+tan^2A}{1+\frac{1}{tan^2A}}$ **1**

$= tan^2A$ **½**

RHS $= \frac{(1-\tan A)^2}{\left(1-\frac{1}{\tan A}\right)^2}$ **1**

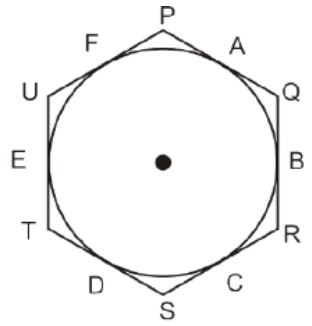
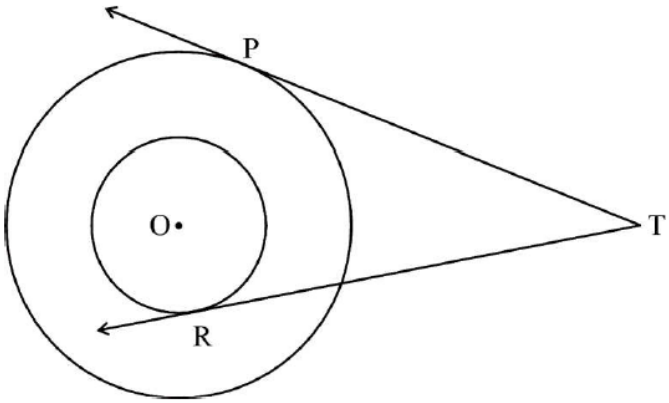
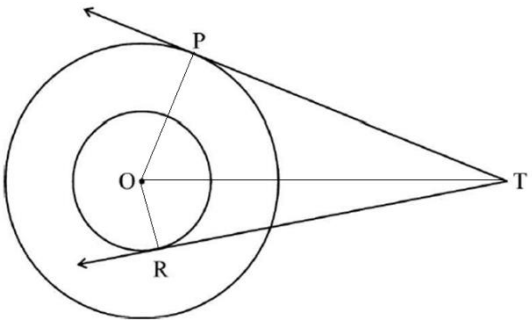
$= tan^2A$ **½**

$\therefore$ LHS = RHS

28(a)

If a hexagon PQRSTU circumscribes a circle, prove that,

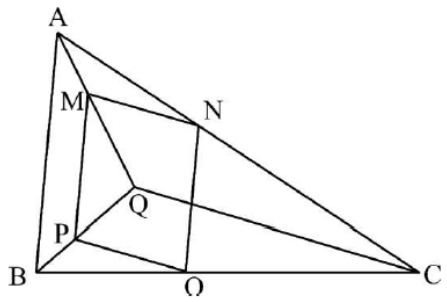
PQ + RS + TU = QR + ST + UP

Sol.	 Correct figure In the given figure, PA = PF … (1) AQ = BQ … (2) RC = RB … (3) CS = DS … (4) ET = TD … (5) UE = UF … (6) Adding (1), (2),(3), (4), (5) and (6), PA + AQ + RC + CS + ET + UE = PF + BQ + BR + DS + TD + UF $\Longrightarrow$ PQ+RS+TU = UP+ST+QR	**1** **1½** **½**
	OR	
28(b)	In the given figure, two concentric circles have radii 3 cm and 5 cm. Two tangents TR and TP are drawn to the circles from an external point T such that TR touches the inner circle at R and TP touches the outer circle at P. If $TR = 4\sqrt{10}$ cm, then find the length of TP. 	
Sol.	 Join OR, OP and OT In Δ ORT, $OT^2 = OR^2 + TR^2 = 3^2 + (4\sqrt{10})^2 = 169$ $\therefore OT = 13$ cm In Δ OPT,	**1** **1**

	$TP^2 = OT^2 - TP^2 = 13^2 - 5^2 = 144$ $\therefore TP = 12$ cm	**1**
29	Find a quadratic polynomial whose sum of the zeroes is 8 and difference of the zeroes is 2.	
Sol.	Let the zeroes be α and β $\therefore \alpha + \beta = 8$ and $\alpha - \beta = 2$ Solving above two equations, we get $\alpha = 5$ and $\beta = 3$ So, the quadratic polynomial is $x^2 - 8x + 15$	**1** **1** **1**
30(a)	The sum of the digits of a 2-digit number is 12. Seven times the number is equal to four times the number obtained by reversing the order of the digits. Find the number.	
Sol.	Let the unit's place digit be x and ten's place digit be y $\therefore$ Number = $10y + x$ According to question, $x + y = 12$ …(i) and $7(10y + x) = 4(10x + y)$ $x - 2y = 0$ …(ii) Solving (i) and (ii), we get $x = 8$ and $y = 4$ Hence, the required number is 48	½ ½ **1** ½ ½
	OR	
30(b)	Find the values of x and y from the following pair of linear equations : $62x + 43y = 167$ $43x + 62y = 148$	
Sol.	$62x + 43y = 167$ …(i) $43x + 62y = 148$ …(ii) Adding (i) and (ii) and simplifying, we get $x + y = 3$ …(iii) Subtracting (ii) from (i) and simplifying, we get $x - y = 1$ …(iv) Solving (iii) and (iv) to get $x = 2$ and $y = 1$	**1** **1** **1**
31	A school has invited 42 Mathematics teachers, 56 Physics teachers and 70 Chemistry teachers to attend a Science workshop. Find the minimum number of tables required, if the same number of teachers are to sit at a table and each table is occupied by teachers of the same subject.	
Sol.	HCF (42, 56, 70) = 14 Minimum number of tables required = $\frac{42}{14} + \frac{56}{14} + \frac{70}{14}$ $= 12$	**1½** **1** ½
	SECTION D **This section comprises of Long Answer (LA) type questions of 5 marks each.**	

32

In the given figure, MNOP is a parallelogram and AB ∥ MP. Prove that QC ∥ PO.



Sol.

$MP \parallel AB$

$\Rightarrow \Delta QMP \sim \Delta QAB$ ½

$\Rightarrow \frac{MP}{AB} = \frac{QP}{QB}$ … (i) **1**

Now, $NO \parallel MP \parallel AB$

$\Rightarrow \Delta CNO \sim \Delta CAB$ ½

$\Rightarrow \frac{NO}{AB} = \frac{CO}{CB}$ …(ii) **1**

As $MP = NO$ ½

From (i) and (ii), $\frac{CO}{CB} = \frac{QP}{QB}$ **1**

$\frac{CO}{CB} - 1 = \frac{QP}{QB} - 1$

or $\frac{BO}{OC} = \frac{BP}{PQ}$

$\therefore QC \parallel PO$ ½

33

An age-wise list of number of literate people in a block is prepared in the following table. There are total 100 people and their median age is 41.5 years. Information about two groups are missing, which are denoted by x and y. Find the value of x and y.

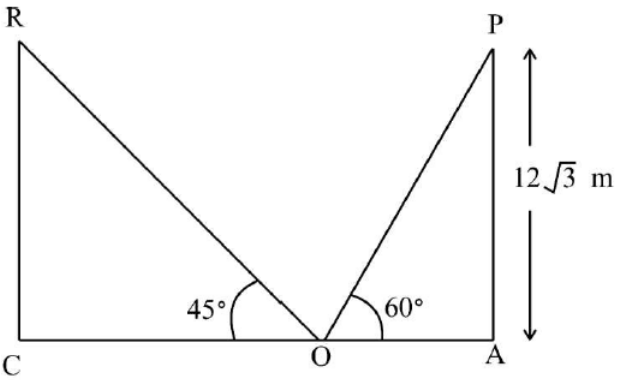
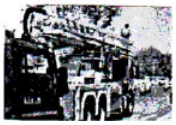
Age (in years)	Number of literate people
10 – 20	15
20 – 30	x
30 – 40	12
40 – 50	20
50 – 60	y
60 – 70	8
70 – 80	10

Sol.

Age (in years)	Number of literate people (f_i)	Cumulative frequency
$10 - 20$	15	15
$20 - 30$	x	$15 + x$
$30 - 40$	12	$27 + x$
$40 - 50$	20	$47 + x$
$50 - 60$	y	$47 + x + y$
$60 - 70$	8	$55 + x + y$
$70 - 80$	10	$65 + x + y$

1 mark for correct table

	$65 + x + y = 100$ $\Rightarrow x + y = 35$ …(i) Median $= 41.5 \therefore 40 - 50$ is the median class. $\Rightarrow\ 41.5 = 40 + \frac{50-27-x}{20} \times 10$ Solving, we get $x = 20$ From (i), $y = 15$	**1** **½** **1½** **½** **½**
34(a)	If Nidhi were 7 years younger than what she actually is, then the square of her age (in years) would be 1 more than 5 times her actual age. What is her present age ?	
Sol.	Let the present age of Nidhi be x years. According to question, $(x-7)^2 = 5x + 1$ $\Rightarrow\ x^2 - 19x + 48 = 0$ $\Rightarrow (x-16)(x-3) = 0$ $\Rightarrow x = 16, 3$ $x \neq 3$ $\therefore x = 16$ Hence, the present age of Nidhi $= 16$ years	**2** **1** **1** **1**
	OR	
34(b)	A shopkeeper buys a number of books for ₹ 1,800. If he had bought 15 more books for the same amount, then each book would have cost him ₹ 20 less. Find how many books he bought initially.	
Sol.	Let the number of books bought initially be x According to question, $\frac{1800}{x} - \frac{1800}{x+15} = 20$ $\Rightarrow\ x^2 + 15x - 1350 = 0$ $\Rightarrow (x+45)(x-30) = 0$ $x \neq -45$ $\therefore x = 30$ So, the number of books bought initially = 30	**2** **1** **1** **1**
35(a)	The largest possible hemisphere is drilled out from a wooden cubical block of side 21 cm such that the base of the hemisphere is on one of the faces of the cube. Find : (i) the volume of wood left in the block, (ii) the total surface area of the remaining solid.	
Sol.	Diameter of hemisphere = side of the cube = 21 cm $\therefore$ radius of hemisphere = $\frac{21}{2}$ cm (i) Volume of the wood left = volume of cube – volume of hemisphere $= 21^3 - \frac{2}{3} \times \frac{22}{7} \times \left(\frac{21}{2}\right)^3$	**½** **1**

	$= 6835.5 \text{ cm}^3$ (ii) Total surface area of remaining solid = TSA of cube − base area of hemisphere + CSA of hemisphere $= 6 \times 21^2 - \frac{22}{7} \times \left(\frac{21}{2}\right)^2 + 2 \times \frac{22}{7} \times \left(\frac{21}{2}\right)^2$ $= 2992.5 \text{ cm}^2$	**1** **1½** **1**
	OR	
35(b)	A solid toy is in the form of a hemisphere surmounted by a right circular cone. Ratio of the radius of the cone to its slant height is 3 : 5. If the volume of the toy is $240\pi \text{ cm}^3$, then find the total height of the toy.	
Sol.	Let the radius and the slant height of the cone be $3x$ cm and $5x$ cm respectively ∴ height of the cone $(h) = \sqrt{(5x)^2 - (3x)^2} = 4x$ cm According to question, volume of toy $= 240\pi$ $\Rightarrow \frac{2}{3}\pi(3x)^3 + \frac{1}{3}\pi(3x)^2(4x) = 240\pi$ Solving, we get $x = 2$ ∴ Total height of toy $= [4(2) + 3(2)]$ cm $= 14$ cm	**½** **1** **1½** **1** **1**
	SECTION E **This section comprises of 3 case study-based questions of 4 marks each.**	
36	Due to short circuit, a fire has broken out in New Home Complex. Two buildings, namely X and Y have mainly been affected. The fire engine has arrived and it has been stationed at a point which is in between the two buildings. A ladder at point O is fixed in front of the fire engine. The ladder inclined at an angle 60° to the horizontal is leaning against the wall of the terrace (top) of the building Y. The foot of the ladder is kept fixed and after some time it is made to lean against the terrace (top) of the opposite building X at an angle of 45° with the ground. Both the buildings along with the foot of the ladder, fixed at 'O' are in a straight line.  (Building X)  (Building Y)	

	Based on the above given information, answer the following questions : (i) Find the length of the ladder. *1* (ii) Find the distance of the building Y from point 'O', i.e. OA. *1* (iii) (a) Find the horizontal distance between the two buildings. *2* **OR** (b) Find the height of the building X. *2*	
Sol.	(i) In ΔOAP, $\frac{OP}{12\sqrt{3}} = coesc\ 60° = \frac{2}{\sqrt{3}}$ $\Rightarrow OP = 24$ m $\therefore$ Length of ladder is 24 m (ii) In ΔOAP, $\frac{OA}{12\sqrt{3}} = \cot 60° = \frac{1}{\sqrt{3}}$ $\Rightarrow OA = 12$ m $\therefore$ the distance of the building Y from point O ie.,OA is 12 m (iii) (a) $OP = OR = 24$ m $\therefore$ In ΔOCR, $\frac{OC}{24} = \cos 45° = \frac{1}{\sqrt{2}}$ $\Rightarrow OC = 12\sqrt{2}$ m $\therefore$ distance between two buildings $= OA + OC$ $= (12 + 12\sqrt{2})$ m or $12(1 + \sqrt{2})$ m **OR** (iii) (b) $OP = OR = 24$ m $\therefore$ In ΔOCR, $\frac{RC}{24} = \sin 45° = \frac{1}{\sqrt{2}}$ $\Rightarrow RC = 12\sqrt{2}$ m $\therefore$ height of building X is $12\sqrt{2}$ m	½ ½ ½ ½ ½ **1** ½ ½ **1** ½

37

A school has decided to plant some endangered trees on 51st World Environment Day in the nearest park. They have decided to plant those trees in few concentric circular rows such that each succeeding row has 20 more trees than the previous one. The first circular row has 50 trees.

Based on the above given information, answer the following questions :

(i) How many trees will be planted in the 10^{th} row ? *1*

(ii) How many more trees will be planted in the 8^{th} row than in the 5^{th} row ? *1*

(iii) (a) If 3200 trees are to be planted in the park, then how many rows are required ? *2*

OR

(b) If 3200 trees are to be planted in the park, then how many trees are still left to be planted after the 11^{th} row ? *2*

Sol.

Here $a = 50$ and $d = 20$

(i) Number of trees planted in 10^{th} row = $a_{10} = 50 + 9 \times 20$ ½

$= 230$ ½

(ii) $a_8 - a_5 = 3 \times 20 = 60$ **1**

(iii) (a) Let $S_n = 3200$

$\Rightarrow \frac{n}{2}[2 \times 50 + (n-1) \times 20] = 3200$ ½

$\Rightarrow n^2 + 4n - 320 = 0$ ½

$\Rightarrow (n+20)(n-16) = 0$ ½

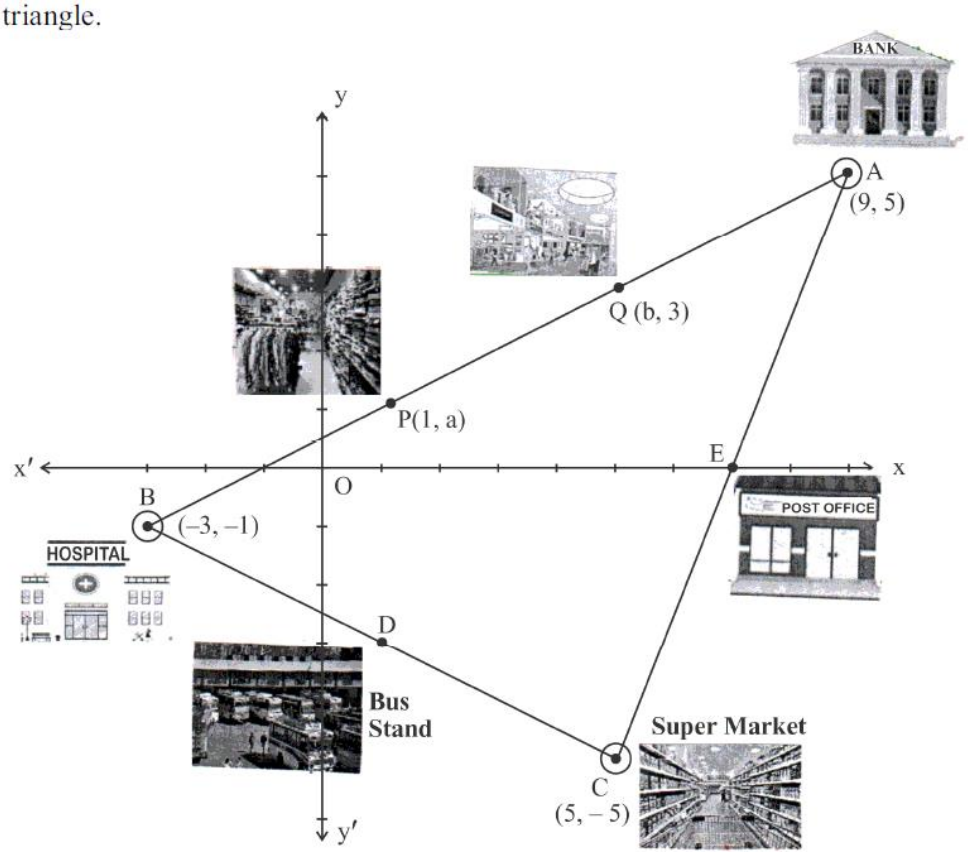
$n \neq -20$

$\therefore n = 16$ ½

Hence, required number of rows are 16

OR

(iii) (b) Required number of trees = $S_n - S_{11}$ ½

	$= 3200 - \frac{11}{2}[2 \times 50 + 10 \times 20]$ $= 1550$ Hence, number of trees left are 1550	**1** ½
38	Partha, a software engineer, lives in Jerusalem for his work. He lives in the most convenient area of the city from where bank, hospital, post office and supermarket can be easily accessed. In the graph, the bank is plotted as A(9, 5), hospital as B(– 3, – 1) and supermarket as C(5, – 5) such that A, B, C form a triangle.  Based on the above given information, answer the following questions : (i) Find the distance between the bank and the hospital. *1* (ii) In between the bank and the supermarket, there is a post office plotted at E which is their mid-point. Find the coordinates of E. *1* (iii) (a) In between the hospital and the supermarket, there is a bus stop plotted as D, which is their mid-point. If Partha wants to reach the bus stand from the bank, then how much distance does he need to cover ? *2* **OR** (b) P and Q are two different garment shops lying between the bank and the hospital, such that BP = PQ = QA. If the coordinates of P and Q are (1, a) and (b, 3) respectively, then find the values of 'a' and 'b'. *2*	
Sol.	(i) Distance between bank and hospital $= \sqrt{(-3-9)^2 + (-1-5)^2}$ $= \sqrt{180}$ units or $6\sqrt{5}$ units (ii) Coordinates of E are $\left(\frac{9+5}{2}, \frac{5+(-5)}{2}\right) = (7,0)$ (iii) (a) Coordinates of D are $\left(\frac{-3+5}{2}, \frac{-1+(-5)}{2}\right) = (1,-3)$ Distance Partha need to cover $= \sqrt{(9-1)^2 + (5-(-3))^2}$ $= \sqrt{128}$ units or $8\sqrt{2}$ units	½ ½ ½ +½ **1** ½ ½

	OR	
	(iii) (b) P is mid-point of BQ $\therefore a = \frac{-1+3}{2} = 1$ Q is mid-point of PA $\therefore b = \frac{1+9}{2} = 5$	**1** **1**

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

*This section has **20** Multiple Choice Questions (MCQs) carrying **1** mark each. 20×1=20*

1. If α and β are the zeroes of polynomial $3x^2 + 6x + k$ such that $\alpha + \beta + \alpha\beta = -\frac{2}{3}$, then the value of k is :

(A) -8

(B) 8

(C) -4

(D) 4

• • •

2. If x = 1 and y = 2 is a solution of the pair of linear equations $2x - 3y + a = 0$ and $2x + 3y - b = 0$, then :

(A) $a = 2b$

(B) $2a = b$

(C) $a + 2b = 0$

(D) $2a + b = 0$

3. The mid-point of the line segment joining the points P(– 4, 5) and Q(4, 6) lies on :

(A) x-axis

(B) y-axis

(C) origin

(D) neither x-axis nor y-axis

4. If θ is an acute angle and $7 + 4 \sin \theta = 9$, then the value of θ is :

(A) 90°

(B) 30°

(C) 45°

(D) 60°

5. The value of $\tan^2 \theta - \left(\frac{1}{\cos \theta} \times \sec \theta \right)$ is :

(A) 1

(B) 0

(C) – 1

(D) 2

6. If HCF(98, 28) = m and LCM(98, 28) = n, then the value of $n - 7m$ is :

(A) 0

(B) 28

(C) 98

(D) 198

• • •

7. The tangents drawn at the extremities of the diameter of a circle are always :

(A) parallel

(B) perpendicular

(C) equal

(D) intersecting

8. In triangles ABC and DEF, $\angle B = \angle E$, $\angle F = \angle C$ and AB = 3 DE. Then, the two triangles are :

(A) congruent but not similar

(B) congruent as well as similar

(C) neither congruent nor similar

(D) similar but not congruent

9. If $(-1)^n + (-1)^8 = 0$, then n is :

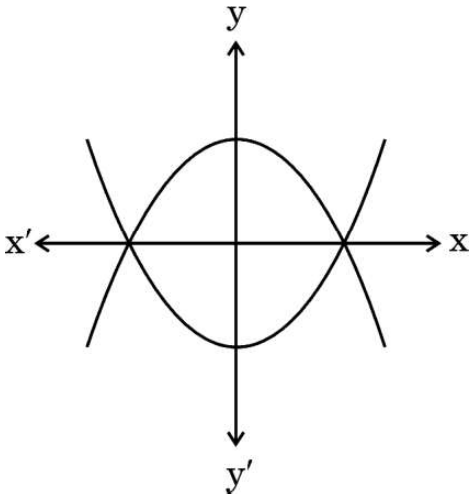
(A) any positive integer

(B) any negative integer

(C) any odd number

(D) any even number

10. Two polynomials are shown in the graph below. The number of distinct zeroes of both the polynomials is :



(A) 3 (B) 5

(C) 2 (D) 4

• • •

11. If the sum of first m terms of an AP is $2m^2 + 3m$, then its second term is :

(A) 10

(B) 9

(C) 12

(D) 4

12. Mode and Mean of a data are 15x and 18x, respectively. Then the median of the data is :

(A) x

(B) 11x

(C) 17x

(D) 34x

13. A card is selected at random from a deck of 52 playing cards. The probability of it being a red face card is :

(A) $\frac{3}{13}$

(B) $\frac{2}{13}$

(C) $\frac{1}{2}$

(D) $\frac{3}{26}$

14. Which of the following is a rational number between $\sqrt{3}$ and $\sqrt{5}$?

(A) 1·4142387954012 ....

(B) $2{\cdot}32\overline{6}$

(C) π

(D) 1·857142

• • •

15. If a sector of a circle has an area of 40π sq. units and a central angle of $72°$, the radius of the circle is :

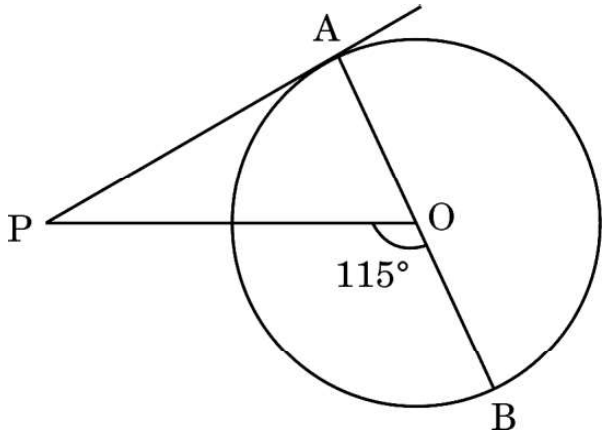
(A) 200 units

(B) 100 units

(C) 20 units

(D) $10\sqrt{2}$ units

16. In the given figure, PA is a tangent from an external point P to a circle with centre O. If $\angle POB = 115°$, then $\angle APO$ is equal to :



(A) $25°$

(B) $65°$

(C) $90°$

(D) $35°$

17. A kite is flying at a height of 150 m from the ground. It is attached to a string inclined at an angle of $30°$ to the horizontal. The length of the string is :

(A) $100\sqrt{3}$ m

(B) 300 m

(C) $150\sqrt{2}$ m

(D) $150\sqrt{3}$ m

• • •

18. A piece of wire 20 cm long is bent into the form of an arc of a circle of radius $\frac{60}{\pi}$ cm. The angle subtended by the arc at the centre of the circle is :

(A) 30°

(B) 60°

(C) 90°

(D) 50°

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* The probability of selecting a number at random from the numbers 1 to 20 is 1.

Reason (R): For any event E, if P(E) = 1, then E is called a sure event.

20. *Assertion (A) :* If we join two hemispheres of same radius along their bases, then we get a sphere.

Reason (R): Total Surface Area of a sphere of radius r is $3\pi r^2$.

• • •

SECTION B

*This section has **5** Very Short Answer (VSA) type questions carrying **2** marks each.* *5×2=10*

21. (a) If $x \cos 60° + y \cos 0° + \sin 30° - \cot 45° = 5$, then find the value of $x + 2y$.

OR

(b) Evaluate : $\dfrac{\tan^2 60°}{\sin^2 60° + \cos^2 30°}$

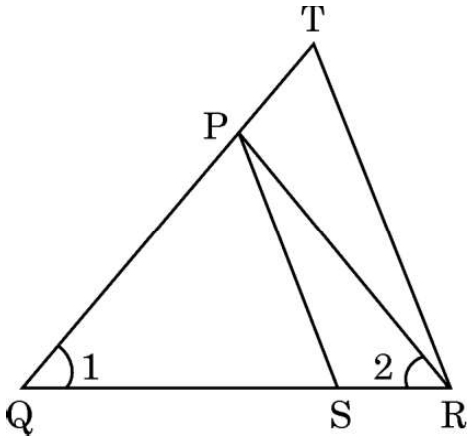
22. Find the zeroes of the polynomial $p(x) = x^2 + \dfrac{4}{3}x - \dfrac{4}{3}$.

23. The coordinates of the centre of a circle are (2a, a – 7). Find the value(s) of 'a' if the circle passes through the point (11, – 9) and has diameter $10\sqrt{2}$ units.

24. (a) If $\Delta ABC \sim \Delta PQR$ in which AB = 6 cm, BC = 4 cm, AC = 8 cm and PR = 6 cm, then find the length of (PQ + QR).

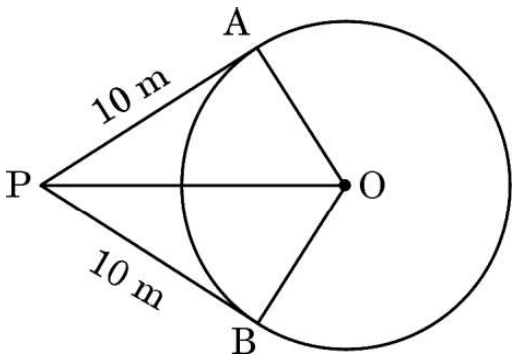
OR

(b) In the given figure, $\dfrac{QR}{QS} = \dfrac{QT}{PR}$ and $\angle 1 = \angle 2$, show that $\Delta PQS \sim \Delta TQR$.



• • •

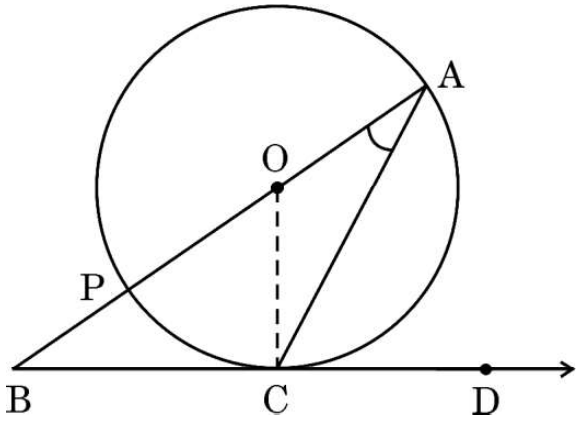
25. A person is standing at P outside a circular ground at a distance of 26 m from the centre of the ground. He found that his distances from the points A and B on the ground are 10 m (PA and PB are tangents to the circle). Find the radius of the circular ground.



SECTION C

*This section has **6** Short Answer (SA) type questions carrying **3** marks each.* $6 \times 3 = 18$

26. (a) In the given figure, O is the centre of the circle and BCD is tangent to it at C. Prove that $\angle BAC + \angle ACD = 90°$.



OR

(b) Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

• • •

27. (a) Prove that : $\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta \operatorname{cosec}\theta$

OR

(b) Prove that : $\frac{\sin A + \cos A}{\sin A - \cos A} + \frac{\sin A - \cos A}{\sin A + \cos A} = \frac{2}{2\sin^2 A - 1}$

28. Find the ratio in which the y-axis divides the line segment joining the points $(5, -6)$ and $(-1, -4)$. Also find the point of intersection.

29. Prove that $\frac{1}{\sqrt{5}}$ is an irrational number.

30. A room is in the form of a cylinder surmounted by a hemispherical dome. The base radius of the hemisphere is half of the height of the cylindrical part. If the room contains $\frac{1408}{21}\text{m}^3$ of air, find the height of the cylindrical part. (Use $\pi = \frac{22}{7}$).

31. Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2.

SECTION D

*This section has **4** Long Answer (LA) type questions carrying **5** marks each.* *4×5=20*

32. Vijay invested certain amounts of money in two schemes A and B, which offer interest at the rate of 8% per annum and 9% per annum, respectively. He received ₹ 1,860 as the total annual interest. However, had he interchanged the amounts of investments in the two schemes, he would have received ₹ 20 more as annual interest. How much money did he invest in each scheme ?

• • •

33. (a) The diagonal BD of a parallelogram ABCD intersects the line segment AE at the point F, where E is any point on the side BC. Prove that $DF \times EF = FB \times FA$.

OR

(b) In ΔABC, if $AD \perp BC$ and $AD^2 = BD \times DC$, then prove that $\angle BAC = 90°$.

34. (a) The perimeter of a right triangle is 60 cm and its hypotenuse is 25 cm. Find the lengths of other two sides of the triangle.

OR

(b) A train travels a distance of 480 km at a uniform speed. If the speed had been 8 km/h less, then it would have taken 3 hours more to cover the same distance. Find the speed of the train.

35. Find the missing frequency 'f' in the following table, if the mean of the given data is 18. Hence find the mode.

Daily Allowance	*Number of Children*
11 – 13	7
13 – 15	6
15 – 17	9
17 – 19	13
19 – 21	f
21 – 23	5
23 – 25	4

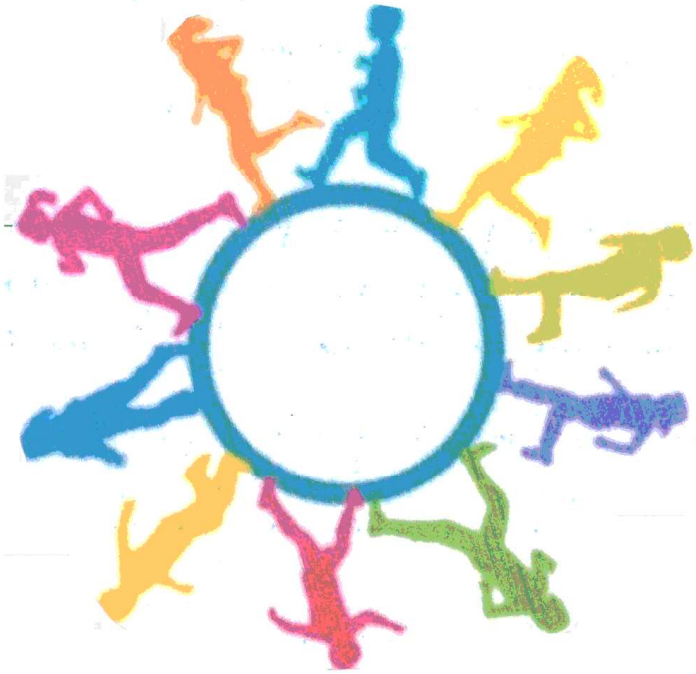
• • •

SECTION E

*This section has **3** case study based questions carrying **4** marks each.* *3×4=12*

Case Study – 1

36. A school is organizing a charity run to raise funds for a local hospital. The run is planned as a series of rounds around a track, with each round being 300 metres. To make the event more challenging and engaging, the organizers decide to increase the distance of each subsequent round by 50 metres. For example, the second round will be 350 metres, the third round will be 400 metres and so on. The total number of rounds planned is 10.



Based on the information given above, answer the following questions :

(i) Write the fourth, fifth and sixth term of the Arithmetic Progression so formed. *1*

(ii) Determine the distance of the 8^{th} round. *1*

(iii) (a) Find the total distance run after completing all 10 rounds. *2*

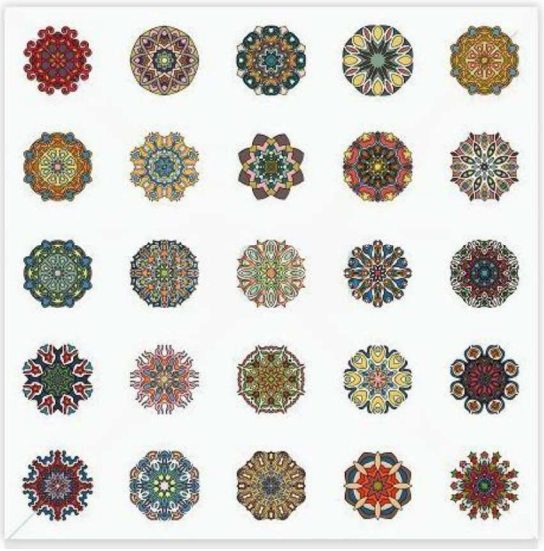
OR

(iii) (b) If a runner completes only the first 6 rounds, what is the total distance run by the runner ? *2*

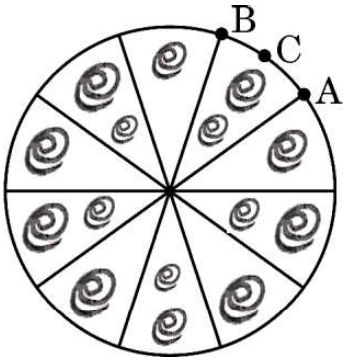
• • •

Case Study – 2

37. A brooch is a decorative piece often worn on clothing like jackets, blouses or dresses to add elegance. Made from precious metals and decorated with gemstones, brooches come in many shapes and designs.



One such brooch is made with silver wire in the form of a circle with diameter 35 mm. The wire is also used in making 5 diameters which divide the circle into 10 equal sectors as shown in the figure.



Based on the above given information, answer the following questions :

(i) Find the central angle of each sector. *1*

(ii) Find the length of the arc ACB. *1*

(iii) (a) Find the area of each sector of the brooch. *2*

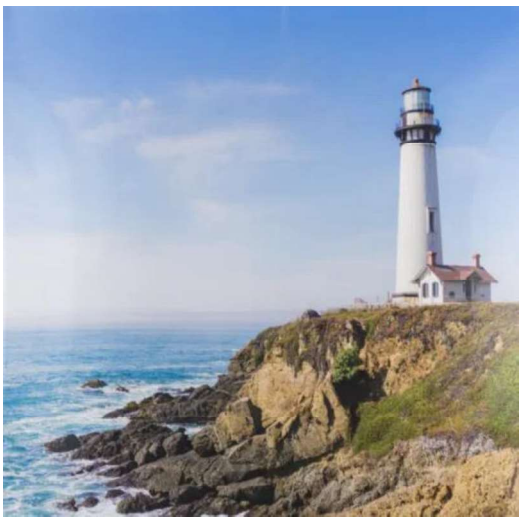
OR

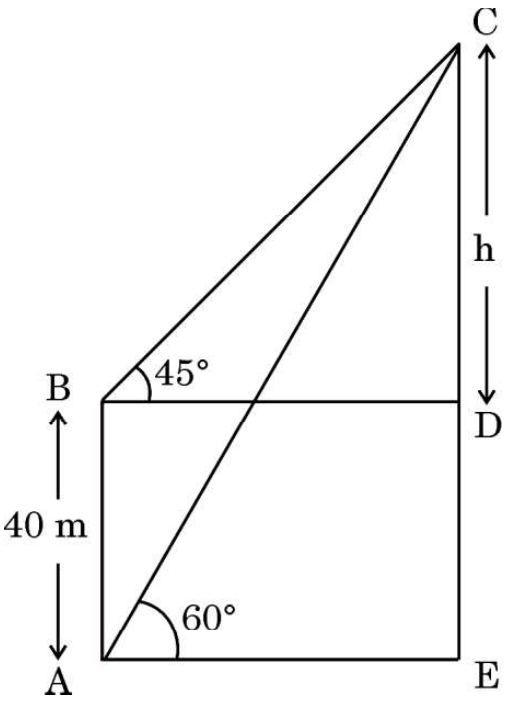
(iii) (b) Find the total length of the silver wire used. *2*

• • •

Case Study – 3

38. Amrita stood near the base of a lighthouse, gazing up at its towering height. She measured the angle of elevation to the top and found it to be 60°. Then, she climbed a nearby observation deck, 40 metres higher than her original position and noticed the angle of elevation to the top of lighthouse to be 45°.





Based on the above given information, answer the following questions :

(i) If CD is h metres, find the distance BD in terms of 'h'. *1*

(ii) Find distance BC in terms of 'h'. *1*

(iii) (a) Find the height CE of the lighthouse [Use $\sqrt{3}$ = 1·73] *2*

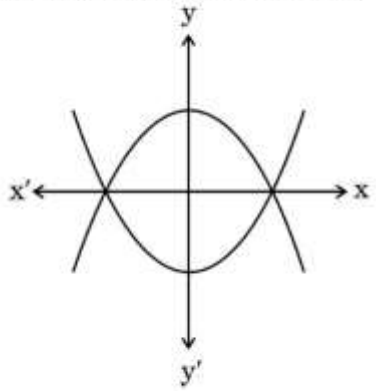
OR

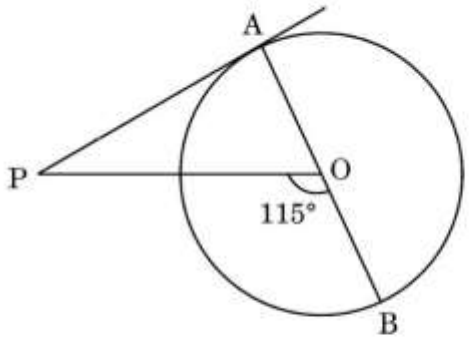
(iii) (b) Find distance AE, if AC = 100 m. *2*

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/1/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section has **20** Multiple Choice Questions (MCQs) carrying **1** mark each.	
1.	If α and β are the zeroes of polynomial $3x^2 + 6x + k$ such that $\alpha + \beta + \alpha\beta = -\frac{2}{3}$, then the value of k is : (A) -8 (B) 8 (C) -4 (D) 4	
Sol.	(D) 4	**1**
2.	If $x = 1$ and $y = 2$ is a solution of the pair of linear equations $2x - 3y + a = 0$ and $2x + 3y - b = 0$, then : (A) $a = 2b$ (B) $2a = b$ (C) $a + 2b = 0$ (D) $2a + b = 0$	
Sol.	(B) $2a = b$	**1**
3.	The mid-point of the line segment joining the points P(– 4, 5) and Q(4, 6) lies on : (A) x-axis (B) y-axis (C) origin (D) neither x-axis nor y-axis	
Sol.	(B) y – axis	**1**
4.	If θ is an acute angle and $7 + 4 \sin\theta = 9$, then the value of θ is : (A) $90°$ (B) $30°$ (C) $45°$ (D) $60°$	
Sol.	(B) 30^0	**1**

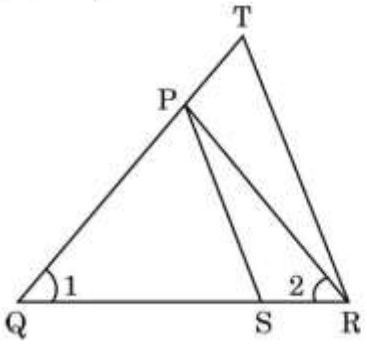
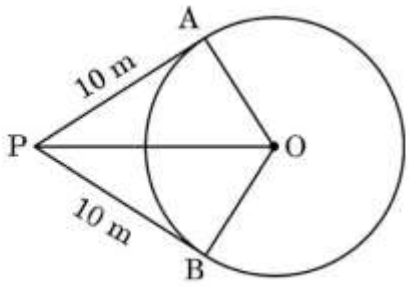
5.	The value of $\tan^2\theta - \left(\frac{1}{\cos\theta} \times \sec\theta\right)$ is : (A) 1 (B) 0 (C) -1 (D) 2	
Sol.	(C) -1	**1**
6.	If HCF(98, 28) = m and LCM(98, 28) = n, then the value of $n - 7m$ is : (A) 0 (B) 28 (C) 98 (D) 198	
Sol.	(C) 98	**1**
7.	The tangents drawn at the extremities of the diameter of a circle are always : (A) parallel (B) perpendicular (C) equal (D) intersecting	
Sol.	(A) parallel	**1**
8.	In triangles ABC and DEF, $\angle B = \angle E$, $\angle F = \angle C$ and AB = 3 DE. Then, the two triangles are : (A) congruent but not similar (B) congruent as well as similar (C) neither congruent nor similar (D) similar but not congruent	
Sol.	(D) similar but not congruent	**1**
9.	If $(-1)^n + (-1)^8 = 0$, then n is : (A) any positive integer (B) any negative integer (C) any odd number (D) any even number	
Sol.	(C) any odd number	**1**

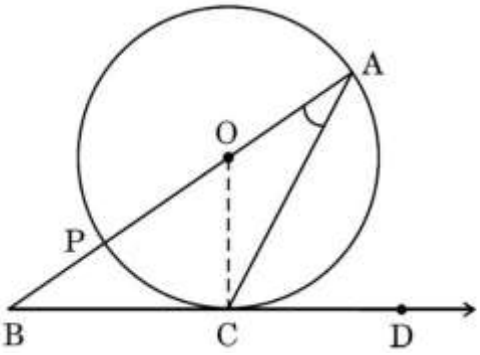
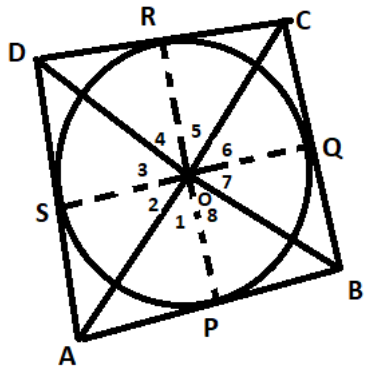
10.	Two polynomials are shown in the graph below. The number of distinct zeroes of both the polynomials is :  (A) 3 (B) 5 (C) 2 (D) 4	
Sol.	(C) 2	**1**
11.	If the sum of first m terms of an AP is $2m^2 + 3m$, then its second term is : (A) 10 (B) 9 (C) 12 (D) 4	
Sol.	(B) 9	**1**
12.	Mode and Mean of a data are 15x and 18x, respectively. Then the median of the data is : (A) x (B) 11x (C) 17x (D) 34x	
Sol.	(C) 17x	**1**
13.	A card is selected at random from a deck of 52 playing cards. The probability of it being a red face card is : (A) $\frac{3}{13}$ (B) $\frac{2}{13}$ (C) $\frac{1}{2}$ (D) $\frac{3}{26}$	
Sol.	(D) $\frac{3}{26}$	**1**

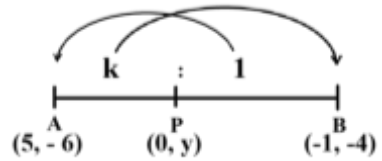
14.	Which of the following is a rational number between $\sqrt{3}$ and $\sqrt{5}$? (A) 1·4142387954012 .... (B) $2{\cdot}32\overline{6}$ (C) π (D) 1·857142	
Sol.	(D) 1.857142	**1**
15.	If a sector of a circle has an area of 40π sq. units and a central angle of 72°, the radius of the circle is : (A) 200 units (B) 100 units (C) 20 units (D) $10\sqrt{2}$ units	
Sol.	(D) $10\sqrt{2}$ units	**1**
16.	In the given figure, PA is a tangent from an external point P to a circle with centre O. If $\angle$ POB = 115°, then $\angle$ APO is equal to :  (A) 25° (B) 65° (C) 90° (D) 35°	
Sol.	(A) 25°	**1**
17.	A kite is flying at a height of 150 m from the ground. It is attached to a string inclined at an angle of 30° to the horizontal. The length of the string is : (A) $100\sqrt{3}$ m (B) 300 m (C) $150\sqrt{2}$ m (D) $150\sqrt{3}$ m	
Sol.	(B) 300 m	**1**

18.	A piece of wire 20 cm long is bent into the form of an arc of a circle of radius $\frac{60}{\pi}$ cm. The angle subtended by the arc at the centre of the circle is : (A) 30° (B) 60° (C) 90° (D) 50°	
Sol.	(B) 60°	**1**
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* The probability of selecting a number at random from the numbers 1 to 20 is 1. *Reason (R):* For any event E, if P(E) = 1, then E is called a sure event.	
Sol.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	**1**
20	*Assertion (A) :* If we join two hemispheres of same radius along their bases, then we get a sphere. *Reason (R):* Total Surface Area of a sphere of radius r is $3\pi r^2$.	
Sol.	(C) Assertion (A) is true, but Reason (R) is false.	**1**
	SECTION B This section has **5** Very Short Answer (VSA) type questions carrying **2** marks each.	
21.(a)	If $x \cos 60° + y \cos 0° + \sin 30° - \cot 45° = 5$, then find the value of $x + 2y$.	
Sol.	$x\left(\frac{1}{2}\right) + y\,(1) + \frac{1}{2} - 1 = 5$ $\Rightarrow \quad x + 2y = 11$	**1½** **½**
	OR	

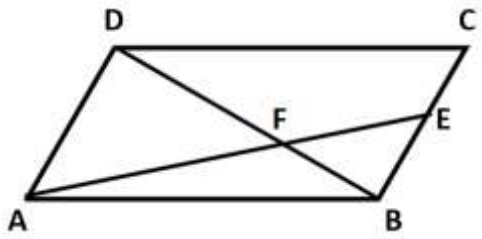
21. (b)	Evaluate : $\dfrac{\tan^2 60°}{\sin^2 60° + \cos^2 30°}$	
Sol.	$\dfrac{(\sqrt{3})^2}{\left(\frac{\sqrt{3}}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}$ $= 2$	**1½** ½
22.	Find the zeroes of the polynomial $p(x) = x^2 + \frac{4}{3}x - \frac{4}{3}$.	
Sol.	$\frac{1}{3}(3x^2 + 4x - 4)$ $= \frac{1}{3}(3x^2 + 6x - 2x - 4)$ $= \frac{1}{3}(3x - 2)(x + 2)$ Zeroes are $\frac{2}{3}, -2$	½ ½ ½ ½
23.	The coordinates of the centre of a circle are (2a, a – 7). Find the value(s) of 'a' if the circle passes through the point (11, – 9) and has diameter $10\sqrt{2}$ units.	
Sol.	radius $= 5\sqrt{2}$ units $(2a - 11)^2 + (a - 7 + 9)^2 = 50$ $\Rightarrow a^2 - 8a + 15 = 0$ $\Rightarrow (a - 5)(a - 3) = 0$ $\Rightarrow a = 5, 3$	½ ½ ½ ½
24.(a)	If $\Delta ABC \sim \Delta PQR$ in which AB = 6 cm, BC = 4 cm, AC = 8 cm and PR = 6 cm, then find the length of (PQ + QR).	
Sol.	$\frac{6}{PQ} = \frac{4}{QR} = \frac{8}{6}$ $\Rightarrow PQ = \frac{9}{2}$ cm or 4.5 cm and QR = 3 cm ∴ PQ + QR = 7.5cm	½ ½ ½ ½
	OR	

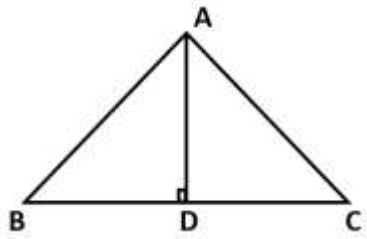
24.(b)	In the given figure, $\frac{QR}{QS} = \frac{QT}{PR}$ and $\angle 1 = \angle 2$, show that $\Delta PQS \sim \Delta TQR$.  	
Sol.	In ΔPQR, $\angle 1 = \angle 2 \therefore PR = PQ$ $\therefore \frac{QR}{QS} = \frac{QT}{PR} \Rightarrow \frac{QR}{QS} = \frac{QT}{PQ}$ Also, $\angle 1 = \angle 1$ $\therefore \Delta PQS \sim \Delta TQR$	½ ½ ½ ½
25.	A person is standing at P outside a circular ground at a distance of 26 m from the centre of the ground. He found that his distances from the points A and B on the ground are 10 m (PA and PB are tangents to the circle). Find the radius of the circular ground.  	
Sol.	$\angle OAP = 90°$ In right ΔOAP, $(26)^2 = OA^2 + (10)^2$ $\Rightarrow OA = \sqrt{576} = 24$ $\therefore$ radius = 24 m	½ **1** ½

	SECTION C This section has **6** Short Answer (SA) type questions carrying **3** marks each.	
26. (a)	In the given figure, O is the centre of the circle and BCD is tangent to it at C. Prove that $\angle BAC + \angle ACD = 90°$.  	
Sol.	In Δ OAC, OA = OC $\Rightarrow \angle OCA = \angle OAC$ Now, $\angle OCD = 90°$ $\Rightarrow \angle OCA + \angle ACD = 90°$ $\Rightarrow \angle OAC + \angle ACD = 90°$ or $\angle BAC + \angle ACD = 90°$	**1** **1** ½ ½
	OR	
26.(b)	Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.	
Sol.	 Correct Figure Δ OAP $\cong \Delta$ OAS $\therefore \angle 1 = \angle 2$ Similarly, $\angle 3 = \angle 4$, $\angle 5 = \angle 6$, $\angle 7 = \angle 8$ Also, $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$ $\Rightarrow 2(\angle 1 + \angle 4 + \angle 5 + \angle 8) = 360°$ $\Rightarrow \angle AOB + \angle COD = 180°$ Similarly, $\angle BOC + \angle AOD = 180°$	½ **1** ½ ½ ½

27. (a)	Prove that : $\frac{\tan\theta}{1-\cot\theta}+\frac{\cot\theta}{1-\tan\theta}=1+\sec\theta\,\text{cosec}\,\theta$	
Sol.	LHS $=\frac{\tan\theta}{1-\cot\theta}+\frac{\cot\theta}{1-\tan\theta}$ $=\frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\cos\theta}{\sin\theta}}+\frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\sin\theta}{\cos\theta}}$ $=\frac{\sin^2\theta}{\cos\theta(\sin\theta-\cos\theta)}-\frac{\cos^2\theta}{\sin\theta(\sin\theta-\cos\theta)}$ $=\frac{1}{(\sin\theta-\cos\theta)}\left[\frac{\sin^3\theta-\cos^3\theta}{\sin\theta\cos\theta}\right]$ $=\frac{(\sin\theta-\cos\theta)(\sin^2\theta+\sin\theta\cos\theta+\cos^2\theta)}{(\sin\theta-\cos\theta)\sin\theta\cos\theta}$ $=\frac{(1+\sin\theta\cos\theta)}{\sin\theta\cos\theta}$ $=1+\sec\theta\,\text{cosec}\,\theta$ = RHS	½ **1** ½ ½ ½
	OR	
27.(b)	Prove that : $\frac{\sin A+\cos A}{\sin A-\cos A}+\frac{\sin A-\cos A}{\sin A+\cos A}=\frac{2}{2\sin^2 A-1}$	
Sol.	LHS $=\frac{\sin A+\cos A}{\sin A-\cos A}+\frac{\sin A-\cos A}{\sin A+\cos A}$ $=\frac{(\sin A+\cos A)^2+(\sin A-\cos A)^2}{(\sin A-\cos A)(\sin A+\cos A)}$ $=\frac{\sin^2A+\cos^2A+2\sin A\cos A+\sin^2A+\cos^2A-2\sin A\cos A}{\sin^2A-\cos^2A}$ $=\frac{1+1}{\sin^2A-(1-\sin^2A)}$ $=\frac{2}{2\sin^2A-1}$ = RHS	**1** **1** ½ ½
28.	Find the ratio in which the y-axis divides the line segment joining the points (5, – 6) and (– 1, – 4). Also find the point of intersection.	
Sol.	 Let the ratio be k:1 and point on y- axis be P(0, y) $0=\frac{-k+5}{k+1}$ k = 5 Hence, ratio is 5:1 $y=\frac{-4(5)-6}{5+1}=\frac{-26}{6}=\frac{-13}{3}$ Coordinates of point of intersection are $P\left(0,-\frac{13}{3}\right)$	½ **1** ½ ½ ½

29.	Prove that $\frac{1}{\sqrt{5}}$ is an irrational number.	
Sol.	Let $\frac{1}{\sqrt{5}}$ be a rational number. $\therefore \frac{1}{\sqrt{5}} = \frac{p}{q}$, where $q \neq 0$ and let p & q be the co-primes. $5p^2 = q^2 \Longrightarrow q^2$ is divisible by 5. $\Longrightarrow$ q is divisible by 5. ----- (i) let $q = 5a$, where 'a' is some integer. $25a^2 = 5p^2 \Longrightarrow p^2 = 5a^2 \Longrightarrow p^2$ is divisible by 5. $\Longrightarrow$ p is divisible by 5 ----- (ii) (i) and (ii) leads to contradiction as p and q are coprimes. $\therefore \frac{1}{\sqrt{5}}$ is an irrational number	½ 1 1 ½
30.	A room is in the form of a cylinder surmounted by a hemispherical dome. The base radius of the hemisphere is half of the height of the cylindrical part. If the room contains $\frac{1408}{21}$ m^3 of air, find the height of the cylindrical part. (Use $\pi = \frac{22}{7}$).	
Sol.	Let r is the radius of hemisphere and cylinder and h is the height of cylinder $h = 2r$ Volume of air in room $= \frac{2}{3}\pi r^3 + \pi r^2 h$ $\frac{1408}{21} = \frac{2}{3}\pi r^3 + \pi r^2(2r)$ $\frac{1408}{21} = \frac{8}{3} \times \frac{22}{7} \times r^3$ $r^3 = 8$ $\therefore$ r = 2 m and h = 4 m	½ ½ **1** ½ ½
31.	Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2.	
Sol.	Total outcomes = 36 Number of Outcomes with difference of the numbers on the two dice is 2 = 8 (1,3) (3,1) (4,2) (2,4) (5,3) (3,5) (4,6) (6,4) P (difference of the numbers on the two dice is 2) = $\frac{8}{36}$ or $\frac{2}{9}$	**1** **1** **1**

	SECTION D This section has **4** Long Answer (LA) type questions carrying **5** marks each.	
32.	Vijay invested certain amounts of money in two schemes A and B, which offer interest at the rate of 8% per annum and 9% per annum, respectively. He received ₹ 1,860 as the total annual interest. However, had he interchanged the amounts of investments in the two schemes, he would have received ₹ 20 more as annual interest. How much money did he invest in each scheme ?	
Sol.	Let Vijay invested ₹ x at 8% rate of interest & ₹ y at 9% rate of interest ATQ, $\frac{8x}{100} + \frac{9y}{100} = 1860$ or $8x + 9y = 186000$ ……..(i) $\frac{9x}{100} + \frac{8y}{100} = 1880$ or $9x + 8y = 188000$ ……..(ii) On solving (i) and (ii), we get $x = 12000$ $y = 10000$ Hence, money invested in scheme A is ₹ 12000 and scheme B is ₹ 10000.	**1½** **1½** **1** **1**
33.(a)	The diagonal BD of a parallelogram ABCD intersects the line segment AE at the point F, where E is any point on the side BC. Prove that DF × EF = FB × FA.	
Sol.	 Correct figure In Δ ADF and Δ EBF, ∠ DFA = ∠ EFB ∠ ADF = ∠ FBE ∴ Δ ADF ~ Δ EBF $\therefore \frac{DF}{FB} = \frac{FA}{EF}$ ⇒ DF ×EF = FB ×FA	**1** **2** **1** **1**
	OR	

33.(b)	In ΔABC, if $AD \perp BC$ and $AD^2 = BD \times DC$, then prove that $\angle BAC = 90°$.	
Sol.	 Correct figure $AD^2 = BD \times DC$ $\frac{AD}{DC} = \frac{BD}{AD}$ Also, $\angle ADB = \angle ADC$ $\therefore \Delta DBA \sim \Delta DAC$ $\angle DBA = \angle DAC$ $\angle BAD = \angle DCA$ Adding both $\angle DBA + \angle DCA = \angle DAC + \angle BAD$ $\therefore \quad \angle BAC = 90°$	**1** **1** **1** **1** **1**
34.(a)	The perimeter of a right triangle is 60 cm and its hypotenuse is 25 cm. Find the lengths of other two sides of the triangle.	
Sol.	Let the other two sides be x cm and y cm ATQ $x + y + 25 = 60$ $y = 35 - x$ Now, $x^2 + y^2 = (25)^2$ $x^2 + (35 - x)^2 = 625$ $x^2 - 35x + 300 = 0$ $(x - 20)(x - 15) = 0$ $\Rightarrow x = 20, 15$ $x = 20 \Rightarrow y = 15$ $x = 15 \Rightarrow y = 20$ Hence sides are 15 cm and 20 cm.	**1** **½** **1** **1** **1** **½**
	OR	
34.(b)	A train travels a distance of 480 km at a uniform speed. If the speed had been 8 km/h less, then it would have taken 3 hours more to cover the same distance. Find the speed of the train.	
Sol.	Let the speed of train be x km/h Reduced speed of train = $(x - 8)$ km/h ATQ $\frac{480}{x-8} - \frac{480}{x} = 3$	**½** **1½**

	$x^2 - 8x - 1280 = 0$ $(x - 40)(x + 32) = 0$ $\Rightarrow x = 40$ $\therefore$ Speed of train = 40 km/h	**1½** **1** **½**
35.	**Find the missing frequency 'f' in the following table, if the mean of the given data is 18. Hence find the mode.** *Daily Allowance* | *Number of Children* 11 – 13 | 7 13 – 15 | 6 15 – 17 | 9 17 – 19 | 13 19 – 21 | f 21 – 23 | 5 23 – 25 | 4	
Sol.	Daily Allowance | x_i | f_i | $f_i x_i$ 11 – 13 | 12 | 7 | 84 13 – 15 | 14 | 6 | 84 15 – 17 | 16 | 9 | 144 17 – 19 | 18 | 13 | 234 19 – 21 | 20 | f | 20f 21 – 23 | 22 | 5 | 110 23 – 25 | 24 | 4 | 96 Total | | 44 + f | 752 + 20f Correct table Mean = $\frac{752+20f}{44+f}$ $\Rightarrow 18 = \frac{752+20f}{44+f}$ $\therefore$ f = 20 modal class is 19 – 21 mode = $19 + \frac{20-13}{40-13-5} \times 3$ = 19.95 approx.	**1½** **1** **½** **½** **1** **½**

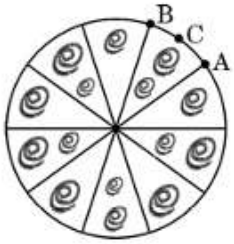
	SECTION E This section has **3** case study based carrying **4** marks each.	
36.	**Case Study – 1** A school is organizing a charity run to raise funds for a local hospital. The run is planned as a series of rounds around a track, with each round being 300 metres. To make the event more challenging and engaging, the organizers decide to increase the distance of each subsequent round by 50 metres. For example, the second round will be 350 metres, the third round will be 400 metres and so on. The total number of rounds planned is 10. Based on the information given above, answer the following questions : (i) Write the fourth, fifth and sixth term of the Arithmetic Progression so formed. (ii) Determine the distance of the 8^{th} round. (iii) (a) Find the total distance run after completing all 10 rounds. **OR** (iii) (b) If a runner completes only the first 6 rounds, what is the total distance run by the runner ?	
Sol.	A.P formed is 300, 350, 400…… (i) $a_4 = 450$ $a_5 = 500$ $a_6 = 550$ (ii) $a_8 = 300 + 7 \times 50$ $= 650$ m (iii) (a) $S_{10} = \frac{10}{2} \times (2 \times 300 + 9 \times 50)$ $= 5250$ m **OR** (iii) (b) $S_6 = \frac{6}{2} \times (2 \times 300 + 5 \times 50)$ $= 2250$ m	**1** ½ ½ **1** **1** **1** **1**

37.

Case Study – 2

A brooch is a decorative piece often worn on clothing like jackets, blouses or dresses to add elegance. Made from precious metals and decorated with gemstones, brooches come in many shapes and designs.

One such brooch is made with silver wire in the form of a circle with diameter 35 mm. The wire is also used in making 5 diameters which divide the circle into 10 equal sectors as shown in the figure.



Based on the above given information, answer the following questions :

(i) Find the central angle of each sector.

(ii) Find the length of the arc ACB.

(iii) (a) Find the area of each sector of the brooch.

OR

(iii) (b) Find the total length of the silver wire used.

Sol.

(i) central angle = $\frac{360^0}{10} = 36°$ **1**

(ii) length of arc ACB = $\frac{1}{10} \times 2 \times \frac{22}{7} \times \frac{35}{2} = 11\text{mm}$ **1**

(iii)(a) Area of each sector of the brooch = $\frac{1}{10} \times \frac{22}{7} \times \frac{35}{2} \times \frac{35}{2}$ **1**

$= \frac{385}{4}\ \text{mm}^2$ or $96.25\ \text{mm}^2$ **1**

OR

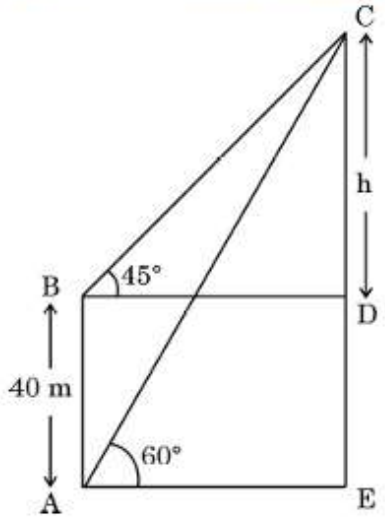
(iii) (b) length of silver wire used = $2 \times \frac{22}{7} \times \frac{35}{2} + 5 \times 35$ **1**

$= 285\ \text{mm}$ **1**

38.

Case Study – 3

Amrita stood near the base of a lighthouse, gazing up at its towering height. She measured the angle of elevation to the top and found it to be 60°. Then, she climbed a nearby observation deck, 40 metres higher than her original position and noticed the angle of elevation to the top of lighthouse to be 45°.



Based on the above given information, answer the following questions :

(i) **If CD is h metres, find the distance BD in terms of 'h'.**

(ii) **Find distance BC in terms of 'h'.**

(iii) (a) Find the height CE of the lighthouse [Use $\sqrt{3}$ = 1·73]

OR

(iii) (b) Find distance AE, if AC = 100 m.

Sol.

(i) $\frac{h}{BD} = \tan 45° = 1$ ½

$\Rightarrow$ BD = h m ½

(ii) $\frac{h}{BC} = \sin 45° = \frac{1}{\sqrt{2}}$ ½

$\Rightarrow$ BC = $\sqrt{2}$h m ½

(iii)(a) $\tan 60° = \frac{EC}{AE}$

$\Rightarrow \sqrt{3} = \frac{h+40}{h}$ **1**

$\Rightarrow$ h = 20 ($\sqrt{3}$ + 1) = 20 × 2.73 = 54.6 m ½

$\therefore$ CE = 54.6 + 40 = 94.6 m ½

OR

	(iii)(b) $\cos 60° = \frac{AE}{AC}$ $\Rightarrow \quad \frac{1}{2} = \frac{AE}{100}$ $\therefore \quad AE = 50$ m	**1** **1**

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

*This section has **20** Multiple Choice Questions (MCQs) carrying **1** mark each.* *20×1=20*

1. If $7 \cos^2 \theta + 3 \sin^2 \theta = 4$, then the value of θ is :

(A) $30°$

(B) $45°$

(C) $60°$

(D) $90°$

• • •

2. The probability of drawing an even prime number out of numbers from 1 to 30 is :

(A) $\frac{1}{30}$

(B) $\frac{4}{15}$

(C) $\frac{7}{30}$

(D) 0

3. The quadratic equation whose roots are 7 and $\frac{1}{7}$ is :

(A) $7x^2 - 50x + 7 = 0$

(B) $7x^2 - 50x + 1 = 0$

(C) $7x^2 + 50x - 7 = 0$

(D) $7x^2 + 50x - 1 = 0$

4. The least number which is a perfect square and is divisible by each of 16, 20 and 50, is :

(A) 1200

(B) 100

(C) 3600

(D) 2400

5. The coordinates of the end points of a diameter of a circle are $(5, -2)$ and $(5, 2)$. The length of the radius of the circle is :

(A) ± 2 (B) ± 4

(C) 4 (D) 2

6. The points $(-5, 0)$, $(5, 0)$ and $(0, 4)$ are the vertices of a triangle which is a/an :

(A) right-angled triangle

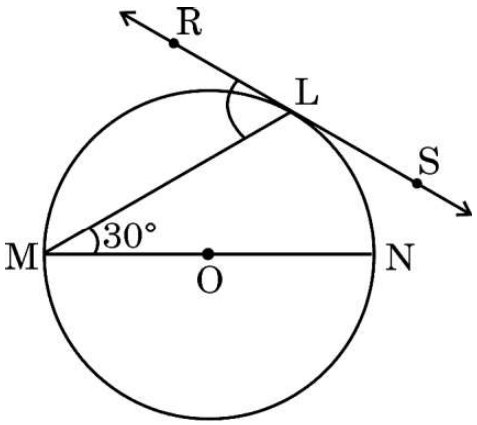
(B) isosceles triangle

(C) equilateral triangle

(D) scalene triangle

• • •

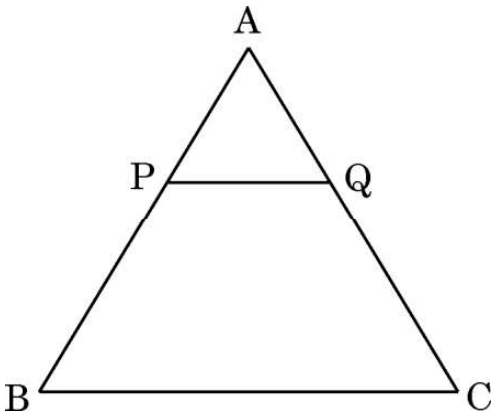
7. In the given figure, RS is the tangent to the circle at the point L and MN is the diameter. If $\angle$ NML = 30°, then $\angle$ RLM is :



(A) 30° (B) 60°

(C) 90° (D) 120°

8. In the given figure, PQ || BC. If $\frac{AP}{PB} = \frac{4}{13}$ and AC = 20·4 cm, then the length of AQ is :



(A) 2·8 cm (B) 5·8 cm

(C) 3·8 cm (D) 4·8 cm

9. Which of the following statements is ***incorrect*** ?

(A) Two congruent figures are always similar.

(B) A square and a rhombus of the same area are always similar.

(C) Two equilateral triangles are always similar.

(D) Two similar triangles need not be congruent.

• • •

10. The sum of the exponents of prime factors in the prime factorisation of 4004 is :

(A) 5

(B) 4

(C) 3

(D) 2

11. In a cricket match, a batsman hits the boundary 7 times out of the 42 balls he plays. The probability of his ***not*** hitting a boundary is :

(A) $\frac{1}{7}$

(B) $\frac{2}{7}$

(C) $\frac{5}{6}$

(D) $\frac{1}{6}$

12. If a large circular pizza is divided into 5 equal sectors, then the central angle of each sector will be :

(A) 60°

(B) 90°

(C) 45°

(D) 72°

13. If $\sin 30° \tan 45° = \frac{\sec 60°}{k}$, then the value of k is :

(A) 4

(B) 3

(C) 2

(D) 1

• • •

14. The line represented by the equation $x - y = 0$ is :

(A) parallel to x-axis

(B) parallel to y-axis

(C) passing through the origin

(D) passing through the point (3, 2)

15. The 10^{th} term of the AP

$5, \frac{19}{4}, \frac{9}{2}, \frac{17}{4}, \ldots$ is :

(A) $\frac{11}{4}$

(B) $\frac{4}{11}$

(C) $\frac{13}{4}$

(D) $\frac{4}{13}$

16. If -4 is a zero of the polynomial $p(x) = x^2 - x - (2 + 2k)$, then the value of k is :

(A) 3 (B) 9

(C) 6 (D) -9

17. The equation of a line parallel to the x-axis and at a distance of 3 units below x-axis is :

(A) $x = 3$

(B) $x = -3$

(C) $y = -3$

(D) $y = 3$

18. The HCF of 40, 110 and 360 is :

(A) 40 (B) 110

(C) 360 (D) 10

• • •

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* Common difference of the AP : 5, 1, – 3, – 7, … is 4.

Reason (R): Common difference of the AP : $a_1, a_2, a_3, \ldots, a_n$ is obtained by $d = a_n - a_{n-1}$.

20. *Assertion (A) :* The pair of linear equations $px + 3y + 59 = 0$ and $2x + 6y + 118 = 0$ will have infinitely many solutions if $p = 1$.

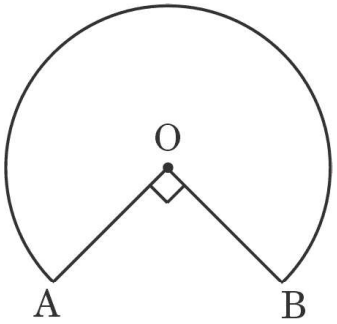
Reason (R): If the pair of linear equations $px + 3y + 19 = 0$ and $2x + 6y + 157 = 0$ has a unique solution, then $p \neq 1$.

SECTION B

*This section has **5** Very Short Answer (VSA) type questions carrying **2** marks each.* *5×2=10*

21. If p and q are zeroes of the polynomial $p(y) = 21y^2 - y - 2$, then find the value of $(1 - p) \cdot (1 - q)$.

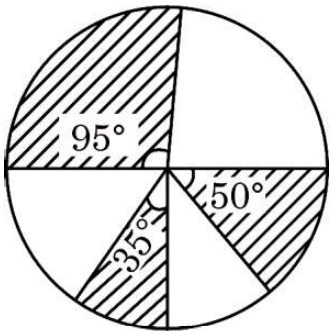
22. (a) In the given figure, the shape of the top of a table is that of a sector of a circle with centre O and $\angle AOB = 90°$. If AO = OB = 42 cm, then find the perimeter of the top of the table.



OR

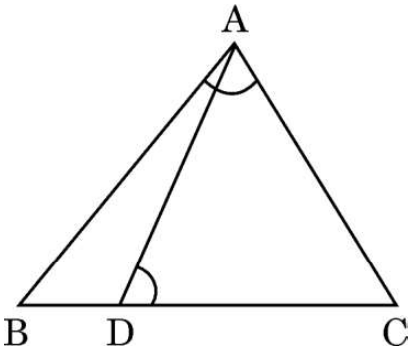
• • •

(b) In the given figure, three sectors of a circle of radius 5 cm, making angles 35°, 50° and 95° at the centre are shaded. Find the area of the shaded region. [Use $\pi = \frac{22}{7}$]



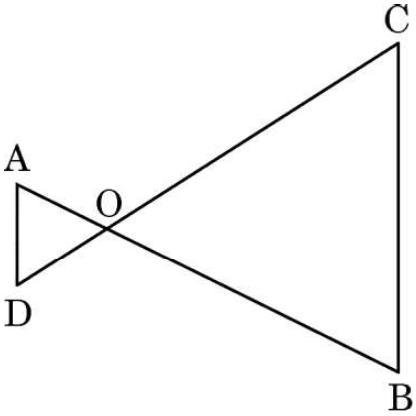
23. If $\tan A = \sqrt{3}$; where A is an acute angle, then find the value of $\frac{\sin^2 A}{1 + \cos^2 A}$.

24. (a) In the given figure, D is a point on the side BC of Δ ABC such that $\angle ADC = \angle BAC$. Show that $CA^2 = CD \cdot CB$.



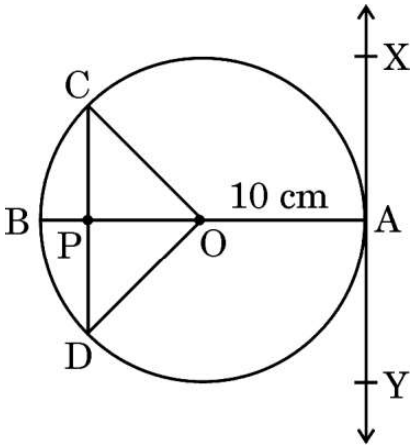
OR

(b) In the given figure, $OA \cdot OB = OC \cdot OD$. Show that $\angle A = \angle C$ and $\angle B = \angle D$.



• • •

25. At point A on the diameter AB of a circle of radius 10 cm, tangent XAY is drawn to the circle. Find the length of the chord CD parallel to XY at a distance of 16 cm from A.



SECTION C

*This section has **6** Short Answer (SA) type questions carrying **3** marks each.* *6×3=18*

26. (a) Prove that the parallelogram circumscribing a circle is a rhombus.

OR

(b) Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line-segment joining the points of contact at the centre.

27. (a) Prove that : $\left(1+\frac{1}{\tan^2\theta}\right)\left(1+\frac{1}{\cot^2\theta}\right)=\frac{1}{\sin^2\theta-\sin^4\theta}$

OR

(b) Prove that : $\sqrt{\frac{\text{cosec}\,\theta-1}{\text{cosec}\,\theta+1}}+\sqrt{\frac{\text{cosec}\,\theta+1}{\text{cosec}\,\theta-1}}=2\sec\theta$

• • •

28. If the mid-point of the line segment joining the points A(3, 4) and B(k, 6) is P(x, y) and $x + y - 10 = 0$, then find the value of k.

29. The length of the hour hand of a clock is 10 cm. Find the area of the minor sector swept by the hour hand of the clock between 5 a.m. to 8 a.m. Also, find the area of the major sector.

30. Prove that $\sqrt{3}$ is an irrational number.

31. A sum of ₹ 2,000 is invested at 7% per annum simple interest. Calculate the interests at the end of 1^{st}, 2^{nd} and 3^{rd} year. Do these interests form an AP ? If so, find the interest at the end of the 27^{th} year.

SECTION D

*This section has **4** Long Answer (LA) type questions carrying **5** marks each.* *4×5=20*

32. (a) Two ships are sailing in the sea on either side of a lighthouse. The angles of depression to the two ships as observed from the top of the lighthouse are 60° and 45°, respectively. If the distance between the ships is $100\left(\frac{1+\sqrt{3}}{\sqrt{3}}\right)$ m, then find the height of the lighthouse.

OR

(b) The angles of depression of the top and the bottom of an 8 m tall building from the top of another multistoried building are 30° and 45°, respectively. Find the height of the multistoried building and the distance between the two buildings.

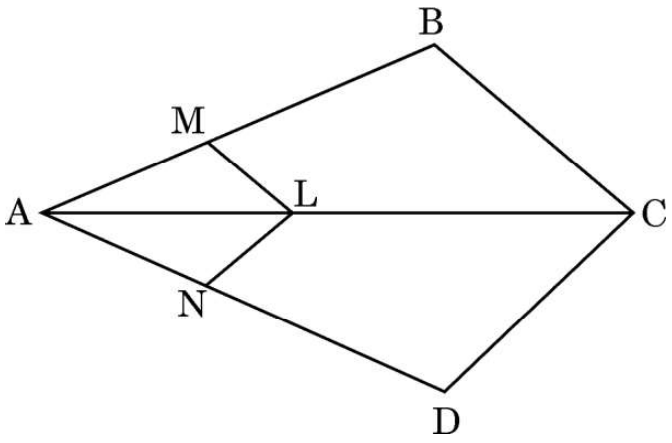
33. (a) The sum of the areas of two squares is 52 cm^2 and difference of their perimeters is 8 cm. Find the lengths of the sides of the two squares.

OR

• • •

(b) The time taken by a person to travel an upward distance of 150 km was $2\frac{1}{2}$ hours more than the time taken in the downward return journey. If he returned at a speed of 10 km/h more than the speed while going up, find the speeds in each direction.

34. Prove that a line drawn parallel to one side of a triangle to intersect the other two sides in distinct points divides the other two sides in the same ratio. Hence, in the figure given below, prove that $\frac{AM}{MB} = \frac{AN}{ND}$ where LM || CB and LN || CD.



35. Find the Mean and Mode of the following frequency distribution :

Class	*Frequency*
0 – 10	8
10 – 20	7
20 – 30	15
30 – 40	20
40 – 50	12
50 – 60	8
60 – 70	10

• • •

SECTION E

*This section has **3** case study based questions carrying **4** marks each.* *3×4=12*

Case Study – 1

36. A school is organizing a grand cultural event to show the talent of its students. To accommodate the guests, the school plans to rent chairs and tables from a local supplier. It finds that rent for each chair is ₹ 50 and for each table is ₹ 200. The school spends ₹ 30,000 for renting the chairs and tables. Also, the total number of items (chairs and tables) rented are 300.

If the school rents 'x' chairs and 'y' tables, answer the following questions :

(i) Write down the pair of linear equations representing the given information. *1*

(ii) (a) Find the number of chairs and number of tables rented by the school. *2*

OR

(b) If the school wants to spend a maximum of ₹ 27,000 on 300 items (tables and chairs), then find the number of chairs and tables it can rent. *2*

(iii) What is maximum number of tables that can be rented in ₹ 30,000 if no chairs are rented ? *1*

• • •

Case Study – 2

37. Rahul is a lucky charm for his cricket team. He has a jar of cards with numbers from 10 to 74. Before each match, he draws a card from the jar. If the card bears an even number, the team wins. If the number is even and divisible by 5, they win by a big margin. If the number is an odd number less than 30, they win by a small margin. And if the number is a prime number between 50 and 74, they lose.

Answer the following questions if Rahul draws a card today :

(i) What is the probability that Rahul draws a card with an even number ? *1*

(ii) What is the probability that Rahul draws a card with an odd number less than 30 ? *1*

(iii) (a) What is the probability that Rahul draws a card with a prime number between 50 and 74 ? *2*

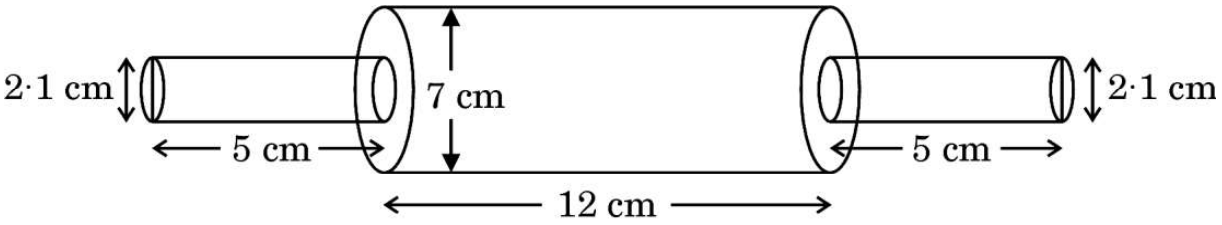
OR

(b) What is the probability that Rahul draws a card with an even number divisible by 5 ? *2*

• • •

Case Study – 3

38. A skilled carpenter decided to craft a special rolling pin for the local baker. He carefully joined three cylindrical pieces of wood – two small ones on the ends and one larger in the centre to create a perfect tool. The baker loved the rolling pin, as it rolled out the smoothest dough for breads and pastries.



The length of the bigger cylindrical part is 12 cm and diameter is 7 cm and the length of each smaller cylindrical part is 5 cm and diameter is 2·1 cm.

Based on the above information, answer the following questions :

(i) Find the volume of the bigger cylindrical part. *1*

(ii) Find the curved surface area of the bigger cylindrical part. *1*

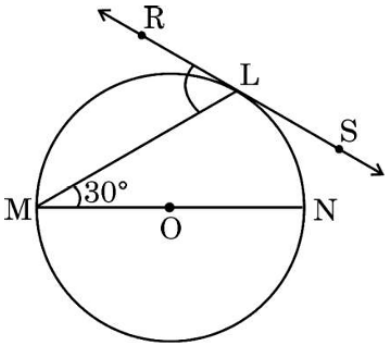
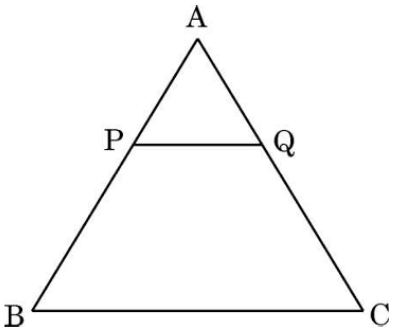
(iii) (a) Find the ratio of the volume of the bigger cylindrical part to the total volume of the two smaller (identical) cylindrical parts. *2*

OR

(b) Find the sum of the curved surface areas of the two identical smaller cylindrical parts. *2*

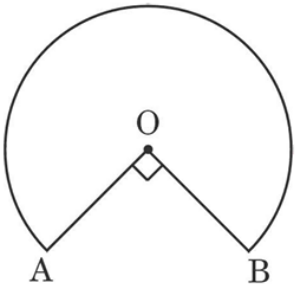
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/2/1)

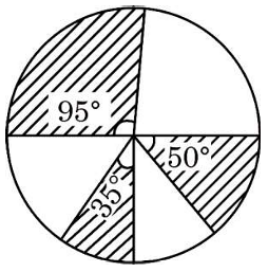
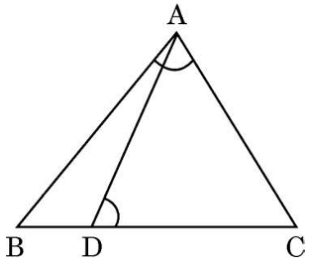
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section has **20** Multiple Choice Questions (MCQs) carrying 1 mark each.	
1.	If $7\cos^2\theta + 3\sin^2\theta = 4$, then the value of θ is : (A) 30° (B) 45° (C) 60° (D) 90°	
Sol.	(C) 60°	**1**
2.	The probability of drawing an even prime number out of numbers from 1 to 30 is : (A) $\frac{1}{30}$ (B) $\frac{4}{15}$ (C) $\frac{7}{30}$ (D) 0	
Sol.	(A) $\frac{1}{30}$	**1**
3.	The quadratic equation whose roots are 7 and $\frac{1}{7}$ is : (A) $7x^2 - 50x + 7 = 0$ (B) $7x^2 - 50x + 1 = 0$ (C) $7x^2 + 50x - 7 = 0$ (D) $7x^2 + 50x - 1 = 0$	
Sol.	(A) $7x^2 - 50x + 7 = 0$	**1**
4.	The least number which is a perfect square and is divisible by each of 16, 20 and 50, is : (A) 1200 (B) 100 (C) 3600 (D) 2400	
Sol.	The correct option is not available in the given options. Full marks may be awarded to every attempt.	**1**

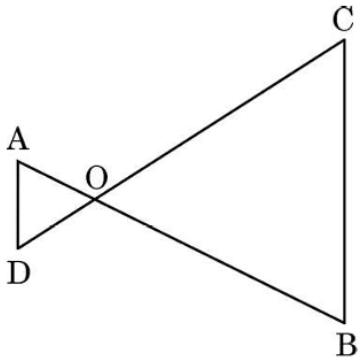
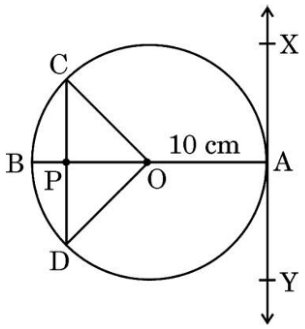
5.	The coordinates of the end points of a diameter of a circle are $(5, -2)$ and $(5, 2)$. The length of the radius of the circle is : (A) ± 2 (B) ± 4 (C) 4 (D) 2	
Sol.	(D) 2	**1**
6.	The points $(-5, 0)$, $(5, 0)$ and $(0, 4)$ are the vertices of a triangle which is a/an : (A) right-angled triangle (B) isosceles triangle (C) equilateral triangle (D) scalene triangle	
Sol.	(B) isosceles triangle	**1**
7.	In the given figure, RS is the tangent to the circle at the point L and MN is the diameter. If $\angle NML = 30°$, then $\angle RLM$ is :  (A) 30° (B) 60° (C) 90° (D) 120°	
Sol.	(B) 60°	**1**
8.	In the given figure, PQ $\|\|$ BC. If $\frac{AP}{PB} = \frac{4}{13}$ and AC = 20·4 cm, then the length of AQ is :  (A) 2·8 cm (B) 5·8 cm (C) 3·8 cm (D) 4·8 cm	
Sol.	(D) 4.8 cm	**1**

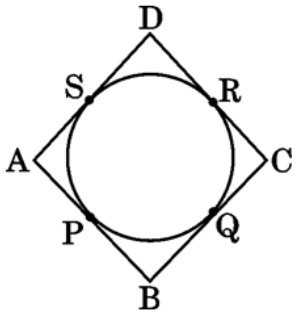
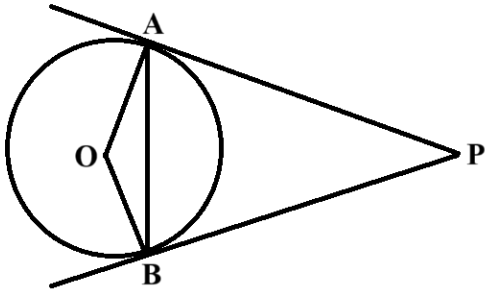
9.	Which of the following statements is ***incorrect*** ? (A) Two congruent figures are always similar. (B) A square and a rhombus of the same area are always similar. (C) Two equilateral triangles are always similar. (D) Two similar triangles need not be congruent.	
Sol.	(B) A square and a rhombus of the same area are always similar.	**1**
10.	The sum of the exponents of prime factors in the prime factorisation of 4004 is : (A) 5 (B) 4 (C) 3 (D) 2	
Sol.	(A) 5	**1**
11.	In a cricket match, a batsman hits the boundary 7 times out of the 42 balls he plays. The probability of his ***not*** hitting a boundary is : (A) $\frac{1}{7}$ (B) $\frac{2}{7}$ (C) $\frac{5}{6}$ (D) $\frac{1}{6}$	
Sol.	(C) $\frac{5}{6}$	**1**
12.	If a large circular pizza is divided into 5 equal sectors, then the central angle of each sector will be : (A) 60° (B) 90° (C) 45° (D) 72°	
Sol.	(D) 72°	**1**
13.	If $\sin 30° \tan 45° = \frac{\sec 60°}{k}$, then the value of k is : (A) 4 (B) 3 (C) 2 (D) 1	
Sol.	(A) 4	**1**

14.	The line represented by the equation $x - y = 0$ is : (A) parallel to x-axis (B) parallel to y-axis (C) passing through the origin (D) passing through the point (3, 2)	
Sol.	(C) passing through the origin.	**1**
15.	The 10^{th} term of the AP $5, \frac{19}{4}, \frac{9}{2}, \frac{17}{4}, \ldots$ is : (A) $\frac{11}{4}$ (B) $\frac{4}{11}$ (C) $\frac{13}{4}$ (D) $\frac{4}{13}$	
Sol.	(A) $\frac{11}{4}$	**1**
16.	If -4 is a zero of the polynomial $p(x) = x^2 - x - (2 + 2k)$, then the value of k is : (A) 3 (B) 9 (C) 6 (D) -9	
Sol.	(B) 9	**1**
17.	The equation of a line parallel to the x-axis and at a distance of 3 units below x-axis is : (A) $x = 3$ (B) $x = -3$ (C) $y = -3$ (D) $y = 3$	
Sol.	(C) $y = -3$	**1**
18.	The HCF of 40, 110 and 360 is : (A) 40 (B) 110 (C) 360 (D) 10	
Sol.	(D) 10	**1**

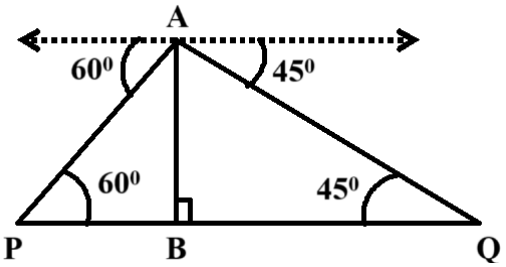
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* Common difference of the AP : 5, 1, – 3, – 7, … is 4. *Reason (R):* Common difference of the AP : $a_1, a_2, a_3, \ldots, a_n$ is obtained by $d = a_n - a_{n-1}$.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
20.	*Assertion (A) :* The pair of linear equations $px + 3y + 59 = 0$ and $2x + 6y + 118 = 0$ will have infinitely many solutions if $p = 1$. *Reason (R):* If the pair of linear equations $px + 3y + 19 = 0$ and $2x + 6y + 157 = 0$ has a unique solution, then $p \neq 1$.	
Sol.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).	**1**
	SECTION B This section has **5** Very Short Answer (VSA) type questions carrying 2 marks each.	
21.	If p and q are zeroes of the polynomial $p(y) = 21y^2 - y - 2$, then find the value of $(1 - p) \cdot (1 - q)$.	
Sol.	$p + q = \frac{1}{21}$ $p.q = \frac{-2}{21}$ $(1 - p)(1 - q) = 1 - (p + q) + pq$ $= 1 - \frac{1}{21} - \frac{2}{21}$ $= \frac{18}{21}$ or $\frac{6}{7}$	½ ½ ½ ½
22 (a)	In the given figure, the shape of the top of a table is that of a sector of a circle with centre O and $\angle AOB = 90°$. If AO = OB = 42 cm, then find the perimeter of the top of the table.  	
Sol.	Reflex $\angle AOB = 360° - 90° = 270°$	½

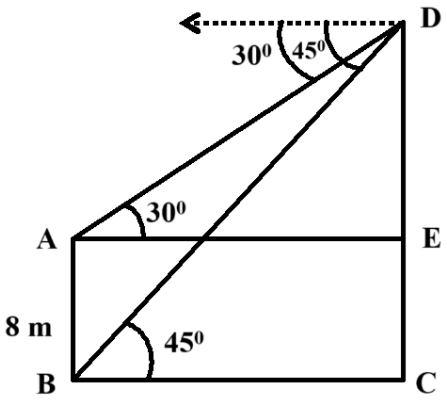
	Perimeter of the top of table = length of major arc + 2 × radius $= \frac{270}{360} \times 2 \times \frac{22}{7} \times 42 + 2 \times 42$ = 282 cm	**1** ½
	OR	
22 (b)	In the given figure, three sectors of a circle of radius 5 cm, making angles 35°, 50° and 95° at the centre are shaded. Find the area of the shaded region. [Use $\pi = \frac{22}{7}$]  	
Sol.	Area of shaded region $= \frac{95}{360} \times \frac{22}{7} \times (5)^2 + \frac{50}{360} \times \frac{22}{7} \times (5)^2 + \frac{35}{360} \times \frac{22}{7} \times (5)^2$ $= \frac{(95+50+35)}{360} \times \frac{22}{7} \times (5)^2$ $= \frac{180}{360} \times \frac{22}{7} \times (5)^2$ $= \frac{275}{7}$ cm^2 or 39.29 cm^2 approx.	**1** ½ ½
23.	If $\tan A = \sqrt{3}$; where A is an acute angle, then find the value of $\frac{\sin^2 A}{1+\cos^2 A}$.	
Sol.	$\tan A = \sqrt{3} = \tan 60°$ $\Longrightarrow A = 60°$ $\frac{\sin^2 A}{1+\cos^2 A} = \frac{\sin^2 60°}{1+\cos^2 60°}$ $= \frac{\left(\frac{\sqrt{3}}{2}\right)^2}{1+\left(\frac{1}{2}\right)^2}$ $= \frac{3}{5}$	½ **1** ½
24 (a)	In the given figure, D is a point on the side BC of Δ ABC such that ∠ ADC = ∠ BAC. Show that $CA^2 = CD \cdot CB$.  	
Sol.	In Δ ACD and Δ BCA ∠ ADC = ∠ BAC ∠ ACD = ∠ BCA	

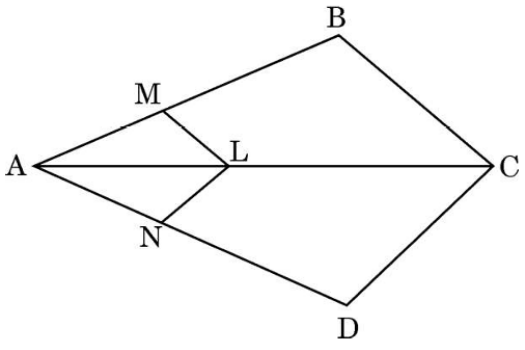
	∴ Δ ACD ~ Δ BCA So, $\frac{CA}{CB} = \frac{CD}{CA}$ $\Rightarrow CA^2 = CD.CB$	**1** ½ ½
	OR	
24 (b)	In the given figure, OA . OB = OC . OD. Show that ∠ A = ∠ C and ∠ B = ∠ D.  	
Sol.	Given OA.OB = OC.OD $\Rightarrow \frac{OA}{OC} = \frac{OD}{OB}$ & ∠ AOD = ∠ COB ∴ Δ AOD ~ Δ COB So, ∠ D = ∠ B and ∠ A = ∠ C	 ½ ½ ½ ½
25.	At point A on the diameter AB of a circle of radius 10 cm, tangent XAY is drawn to the circle. Find the length of the chord CD parallel to XY at a distance of 16 cm from A.  	
Sol.	AP = 16 cm ∴ OP = 16 – 10 = 6 cm XY ‖ CD ∴ ∠ CPO = 90° In right Δ OPC, CP = $\sqrt{(10)^2 - (6)^2}$ = 8 cm CD = 2 × CP = 2 × 8 = 16 cm	 ½ **1** ½

	SECTION C This section has **6** Short Answer (SA) type questions carrying 3 marks each.	
26 (a)	Prove that the parallelogram circumscribing a circle is a rhombus.	
Sol.	Correct figure  We know that lengths of tangents drawn from an external point to a circle are equal ∴ AP = AS --- ① BP = BQ --- ② CR = CQ --- ③ DR = DS --- ④ Adding ①, ②, ③ and ④, we have (AP + BP) + (CR + DR) = AS + (BQ + CQ) + DS $\Rightarrow$ AB + CD = BC + AD ∵ AB = CD and BC = AD ∴ AB = BC = CD = AD Therefore, ABCD is a rhombus.	½ **1** ½ ½ ½
	OR	
26 (b)	Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line-segment joining the points of contact at the centre.	
Sol.	PA and PB are tangents from the external point P to the circle with centre O. Correct figure  ∠ OAP = ∠ OBP = 90° In quadrilateral OAPB, ∠ APB + ∠ OAP + ∠ OBP + ∠ AOB = 360° $\Rightarrow$ ∠ APB + 90° + 90° + ∠ AOB = 360° $\Rightarrow$ ∠ APB + ∠ AOB = 180° ∴ ∠ APB and ∠ AOB are supplementary.	**1** **1** ½ ½

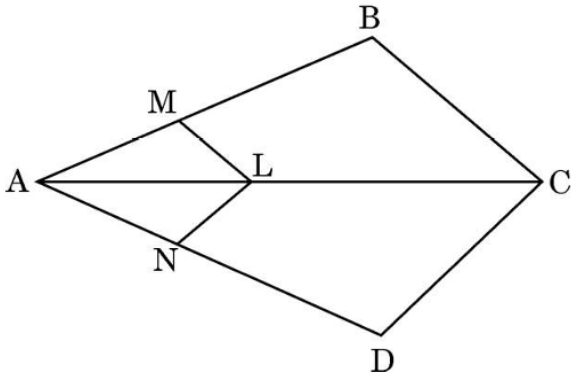
27 (a)	Prove that : $\left(1+\frac{1}{\tan^2\theta}\right)\left(1+\frac{1}{\cot^2\theta}\right)=\frac{1}{\sin^2\theta-\sin^4\theta}$	
Sol.	LHS = $(1+\cot^2\theta)(1+\tan^2\theta)$ $=\operatorname{cosec}^2\theta.\sec^2\theta$ $=\frac{1}{\sin^2\theta}\cdot\frac{1}{\cos^2\theta}$ $=\frac{1}{\sin^2\theta(1-\sin^2\theta)}$ $=\frac{1}{\sin^2\theta-\sin^4\theta}$ = RHS	**1** ½ ½ ½ ½
	OR	
27 (b)	Prove that : $\sqrt{\frac{\operatorname{cosec}\theta-1}{\operatorname{cosec}\theta+1}}+\sqrt{\frac{\operatorname{cosec}\theta+1}{\operatorname{cosec}\theta-1}}=2\sec\theta$	
Sol.	LHS = $\frac{\operatorname{cosec}\theta-1+\operatorname{cosec}\theta+1}{\sqrt{(\operatorname{cosec}\theta+1)(\operatorname{cosec}\theta-1)}}$ $=\frac{2\operatorname{cosec}\theta}{\sqrt{(\operatorname{cosec}^2\theta-1)}}$ $=\frac{2\operatorname{cosec}\theta}{\cot\theta}$ $=2\sec\theta$ = RHS	**1** **1** ½ ½
28.	If the mid-point of the line segment joining the points A(3, 4) and B(k, 6) is P(x, y) and $x + y - 10 = 0$, then find the value of k.	
Sol.	$x=\frac{3+k}{2}$ and $y=\frac{4+6}{2}=5$ $\therefore\left(\frac{3+k}{2}\right)+5-10=0$ $\Longrightarrow k=7$	½ ½ **1** **1**
29.	The length of the hour hand of a clock is 10 cm. Find the area of the minor sector swept by the hour hand of the clock between 5 a.m. to 8 a.m. Also, find the area of the major sector.	
Sol.	Central angle subtended by hour hand between 5 am to 8 am = $\frac{360^\circ}{12}\times 3=90^\circ$ Area of minor segment = $\frac{90}{360}\times\frac{22}{7}\times(10)^2$ $=\frac{550}{7}$ or 78.57 cm^2 approx. Area of circle = $\frac{22}{7}\times(10)^2=\frac{2200}{7}$ cm^2 Area of major segment = $\frac{2200}{7}-\frac{550}{7}$ $=\frac{1650}{7}$ or 235.71 cm^2 approx.	½ **1** ½ ½ ½
30.	Prove that $\sqrt{3}$ is an irrational number.	
Sol.	Let $\sqrt{3}$ be a rational number. $\therefore\sqrt{3}=\frac{p}{q}$, where $q\neq 0$ and let p & q be coprimes. $\Longrightarrow 3q^2=p^2$	½

	$\Rightarrow p^2$ is divisible by 3. $\Rightarrow$ p is divisible by 3. ----- ① Let p = 3a, where 'a' is some integer $\therefore 9a^2 = 3q^2$ $\Rightarrow q^2 = 3a^2$ $\Rightarrow q^2$ is divisible by 3 $\Rightarrow$ q is divisible by 3 ----- ② $\therefore$ 3 divides both p & q. ① and ② leads to contradiction as p and q are coprimes. Hence, $\sqrt{3}$ is an irrational number.	**1** **1** ½
31.	A sum of ₹ 2,000 is invested at 7% per annum simple interest. Calculate the interests at the end of 1st, 2nd and 3rd year. Do these interests form an AP ? If so, find the interest at the end of the 27th year.	
Sol.	Interest at the end of 1st year = $\frac{2000 \times 7 \times 1}{100}$ = ₹ 140 Interest at the end of 2nd year = $\frac{2000 \times 7 \times 2}{100}$ = ₹ 280 Interest at the end of 3rd year = $\frac{2000 \times 7 \times 3}{100}$ = ₹ 420 140, 280, 420, … Yes, Interests form an AP with first term = 140 and common difference = 140 Interest at the end of 27th year = 140 + 26 × 140 = ₹ 3780	½ ½ ½ ½ ½ ½
	SECTION D This section has **4** Long Answer (LA) type questions carrying 5 marks each.	
32 (a)	Two ships are sailing in the sea on either side of a lighthouse. The angles of depression to the two ships as observed from the top of the lighthouse are 60° and 45°, respectively. If the distance between the ships is $100\left(\frac{1+\sqrt{3}}{\sqrt{3}}\right)$ m, then find the height of the lighthouse.	
Sol.	Correct figure  Here, AB represents the height of the lighthouse. In right Δ ABP $\frac{AB}{PB} = \tan 60° = \sqrt{3}$ $\Rightarrow PB = \frac{AB}{\sqrt{3}}$ --- ①	**1** **1** ½

	In right Δ ABQ $\frac{AB}{BQ} = \tan 45° = 1$ $\Longrightarrow$ BQ = AB --- ② Adding ① and ②, we have PB + BQ = $\frac{AB}{\sqrt{3}}$ + AB $\Longrightarrow$ PQ = AB $\left(\frac{1+\sqrt{3}}{\sqrt{3}}\right)$ $\Longrightarrow$ 100 $\left(\frac{1+\sqrt{3}}{\sqrt{3}}\right)$ = AB $\left(\frac{1+\sqrt{3}}{\sqrt{3}}\right)$ $\Longrightarrow$ AB = 100 m	½ ½ ½ ½ ½
	OR	
32 (b)	The angles of depression of the top and the bottom of an 8 m tall building from the top of another multistoried building are 30° and 45°, respectively. Find the height of the multistoried building and the distance between the two buildings.	
Sol.	Correct figure  Here, CD represents the multistoried building. In right Δ DEA $\frac{DE}{AE} = \tan 30° = \frac{1}{\sqrt{3}}$ $\Longrightarrow$ AE = $\sqrt{3}$ DE --- ① In right Δ DCB $\frac{DC}{BC} = \tan 45° = 1$ $\Longrightarrow$ BC = DC --- ② From figure, AE = BC $\therefore \sqrt{3}$ DE = DC $\Longrightarrow \sqrt{3}$ (DC – 8) = DC $\Longrightarrow$ DC = $\frac{8\sqrt{3}}{\sqrt{3}-1}$ = $\frac{8\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$ = (12 + 4$\sqrt{3}$) m From ②, BC = (12 + 4$\sqrt{3}$) m	**1** **1** ½ ½ ½ ½ ½ ½

33 (a)	The sum of the areas of two squares is 52 cm^2 and difference of their perimeters is 8 cm. Find the lengths of the sides of the two squares.	
Sol.	Let the lengths of the sides of two squares be 'x' cm and 'y' cm such that x > y. ATQ $x^2 + y^2 = 52$ --- ① $4x - 4y = 8$ or $x - y = 2$ --- ② From ① and ②, we have $y^2 + 2y - 24 = 0$ $\Longrightarrow (y + 6)(y - 4) = 0$ $\therefore y = 4$ So, $x = 2 + 4 = 6$ ∴ Lengths of the sides of two squares are 6 cm and 4 cm respectively.	**1** **1** **1** **1** ½ ½
	OR	
33 (b)	The time taken by a person to travel an upward distance of 150 km was $2\frac{1}{2}$ hours more than the time taken in the downward return journey. If he returned at a speed of 10 km/h more than the speed while going up, find the speeds in each direction.	
Sol.	Let the speed in upward direction be 'x' km/h and the speed in downward direction = (x + 10) km/h ATQ $\frac{150}{x} - \frac{150}{x+10} = \frac{5}{2}$ $\Longrightarrow x^2 + 10x - 600 = 0$ $\Longrightarrow (x + 30)(x - 20) = 0$ ∴ x = 20 and x + 10 = 20 + 10 = 30 Therefore, speeds in upward and downward direction are 20 km/h and 30 km/h respectively.	½ **2** **1** ½ ½ ½
34.	Prove that a line drawn parallel to one side of a triangle to intersect the other two sides in distinct points divides the other two sides in the same ratio. Hence, in the figure given below, prove that $\frac{AM}{MB} = \frac{AN}{ND}$ where LM || CB and LN || CD.  	
Sol.	Correct figure, given, to prove and construction	**1½**

Correct proof **1½**



In Δ ABC, LM ‖ CB

$\frac{AM}{MB} = \frac{AL}{LC}$ --- ① **1**

In Δ ADC, LN ‖ CD

$\frac{AN}{ND} = \frac{AL}{LC}$ --- ② **½**

from ① and ②, we have

$\frac{AM}{MB} = \frac{AN}{ND}$ **½**

35. Find the Mean and Mode of the following frequency distribution :

Class	*Frequency*
0 – 10	8
10 – 20	7
20 – 30	15
30 – 40	20
40 – 50	12
50 – 60	8
60 – 70	10

Sol.

Class	frequency (f_i)	x_i	$u_i = \frac{x_i - 35}{10}$	$f_i u_i$
0 – 10	8	5	– 3	– 24
10 – 20	7	15	– 2	– 14
20 – 30	15	25	– 1	– 15
30 – 40	20	35 = a	0	0
40 – 50	12	45	1	12
50 – 60	8	55	2	16
60 – 70	10	65	3	30
Total	80			5

Correct table **1½**

Mean = $35 + \frac{5}{80} \times 10$ **1**

= 35.625 **½**

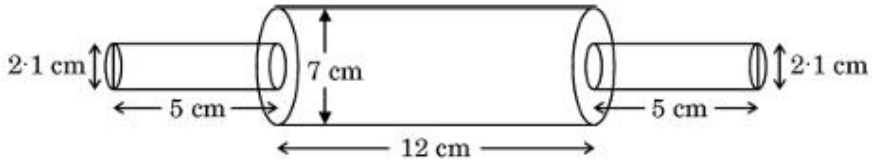
	Modal Class is 30 – 40 Mode = $30 + \left(\frac{20-15}{2\times20-15-12}\right) \times 10$ $= \frac{440}{13}$ or 33.85 approx.	½ **1** ½
	SECTION E This section has **3** case study based questions carrying 4 marks each.	
36.	**Case Study – 1** A school is organizing a grand cultural event to show the talent of its students. To accommodate the guests, the school plans to rent chairs and tables from a local supplier. It finds that rent for each chair is ₹ 50 and for each table is ₹ 200. The school spends ₹ 30,000 for renting the chairs and tables. Also, the total number of items (chairs and tables) rented are 300. **If the school rents 'x' chairs and 'y' tables, answer the following questions :** (i) Write down the pair of linear equations representing the given information. (ii) (a) Find the number of chairs and number of tables rented by the school. **OR** (b) If the school wants to spend a maximum of ₹ 27,000 on 300 items (tables and chairs), then find the number of chairs and tables it can rent. (iii) What is maximum number of tables that can be rented in ₹ 30,000 if no chairs are rented ?	
Sol.	(i) $x + y = 300$ and $50x + 200y = 30000$ or $x + 4y = 600$ (ii) (a) $x + y = 300$ and $x + 4y = 600$ Solving the equations, we get $x = 200$ and $y = 100$ ∴ Number of chairs and tables rented by the school are 200 and 100 respectively. **OR** (b) $x + y = 300$ and $50x + 200y = 27000$ or $x + 4y = 540$ Solving the equations, we get $x = 220$ and $y = 80$ ∴ Number of chairs and tables rented by the school are 220 and 80 respectively. (iii) Number of tables $= \frac{30000}{200} = 150$ ∴ Maximum number of tables that can be rented is 150 if no chairs are rented.	½ ½ **1 + 1** **1** **½ + ½** **1**

37.	**Case Study – 2** Rahul is a lucky charm for his cricket team. He has a jar of cards with numbers from 10 to 74. Before each match, he draws a card from the jar. If the card bears an even number, the team wins. If the number is even and divisible by 5, they win by a big margin. If the number is an odd number less than 30, they win by a small margin. And if the number is a prime number between 50 and 74, they lose. Answer the following questions if Rahul draws a card today : (i) What is the probability that Rahul draws a card with an even number ? (ii) What is the probability that Rahul draws a card with an odd number less than 30 ? (iii) (a) What is the probability that Rahul draws a card with a prime number between 50 and 74 ? **OR** (b) What is the probability that Rahul draws a card with an even number divisible by 5 ?	
Sol.	(i) Total possible outcomes = 74 – 10 + 1 = 65 P (even number) = $\frac{33}{65}$ (ii) P (odd number less than 30) = $\frac{10}{65}$ or $\frac{2}{13}$ (iii) (a) Favourable outcomes are 53, 59, 61, 67, 71, 73 Number of favourable outcomes = 6 P (prime number between 50 and 74) = $\frac{6}{65}$ **OR** (b) Favourable outcomes are 10, 20, 30, 40, 50, 60, 70 Number of favourble outcomes = 7 P (even number divisble by 5) = $\frac{7}{65}$	½ ½ **1** **1** **1** **1** **1**

38.

Case Study – 3

A skilled carpenter decided to craft a special rolling pin for the local baker. He carefully joined three cylindrical pieces of wood – two small ones on the ends and one larger in the centre to create a perfect tool. The baker loved the rolling pin, as it rolled out the smoothest dough for breads and pastries.



The length of the bigger cylindrical part is 12 cm and diameter is 7 cm and the length of each smaller cylindrical part is 5 cm and diameter is 2·1 cm.

Based on the above information, answer the following questions :

(i) Find the volume of the bigger cylindrical part.

(ii) Find the curved surface area of the bigger cylindrical part.

(iii) (a) Find the ratio of the volume of the bigger cylindrical part to the total volume of the two smaller (identical) cylindrical parts.

OR

(b) Find the sum of the curved surface areas of the two identical smaller cylindrical parts.

Sol.

(i) Volume of the bigger cylindrical part $= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 12$ ½

$= 462 \text{ cm}^3$ ½

(ii) The Curved Surface Area of bigger cylindrical part $= 2 \times \frac{22}{7} \times \frac{7}{2} \times 12$ ½

$= 264 \text{ cm}^2$ ½

(iii) (a) Total volume of the two smaller cylindrical parts $= 2 \times \frac{22}{7} \times \frac{2.1}{2} \times \frac{2.1}{2} \times 5$ ½

$= 34.65 \text{ cm}^3$ ½

Required ratio $= \frac{462}{34.65} = \frac{3080}{231}$ **1**

∴ Required ratio is 3080 : 231

OR

(b) The Sum of Curved Surface Area of two smaller cylindrical parts $= 2 \times 2 \times \frac{22}{7} \times \frac{2.1}{2} \times 5$ **1**

$= 66 \text{ cm}^2$ **1**

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A**, **B**, **C**, **D** and **E**.*

(iii) *In **Section A**, Questions no. **1** to **18** are Multiple Choice Questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B**, Questions no. **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C**, Questions no. **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D**, Questions no. **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E**, Questions no. **36** to **38** are Case Study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

*This section has **20** Multiple Choice Questions (MCQs) carrying **1** mark each.* *20×1=20*

1. If $\tan 3\theta = \sqrt{3}$, then $\frac{\theta}{2}$ equals :

(A) 60° (B) 30°

(C) 20° (D) 10°

2. If x is the LCM of 4, 6, 8 and y is the LCM of 3, 5, 7 and p is the LCM of x and y, then which of the following is true ?

(A) p = 35x (B) p = 4y

(C) p = 8x (D) p = 16y

• • •

3. The value of 'k' for which the system of linear equations $6x + y = 3k$ and $36x + 6y = 3$ have infinitely many solutions is :

(A) 6 (B) $\frac{1}{6}$

(C) $\frac{1}{2}$ (D) $\frac{1}{3}$

4. If α and β are the zeroes of the polynomial $p(x) = x^2 - ax - b$, then the value of $(\alpha + \beta + \alpha\beta)$ is equal to :

(A) $a + b$

(B) $-a - b$

(C) $a - b$

(D) $-a + b$

5. If $\frac{x}{12} - \frac{3}{x} = 0$, then the values of x are :

(A) ± 6 (B) ± 4

(C) ± 12 (D) ± 3

6. The line represented by $\frac{x}{4} + \frac{y}{6} = 1$, intersects x-axis and y-axis respectively at P and Q. The coordinates of the mid-point of line segment PQ are :

(A) (2, 3) (B) (3, 2)

(C) (2, 0) (D) (0, 3)

7. Two of the vertices of Δ PQR are P(–1, 5) and Q(5, 2). The coordinates of a point which divides PQ in the ratio 2 : 1 are :

(A) (3, – 3)

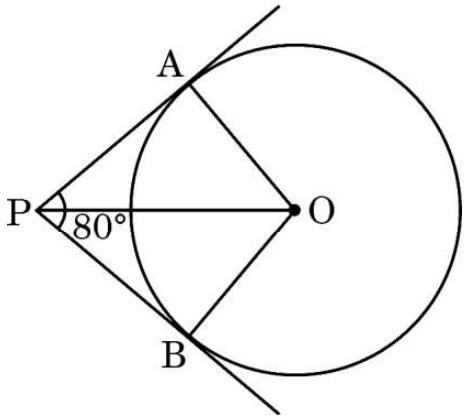
(B) (5, 5)

(C) (3, 3)

(D) (5, 1)

• • •

8. If tangents PA and PB drawn from an external point P to the circle with centre O are inclined to each other at an angle of 80° as shown in the given figure, then the measure of ∠ POA is :



(A) 40° (B) 50°

(C) 60° (D) 80°

9. (cot θ + tan θ) equals :

(A) cosec θ sec θ (B) sin θ sec θ

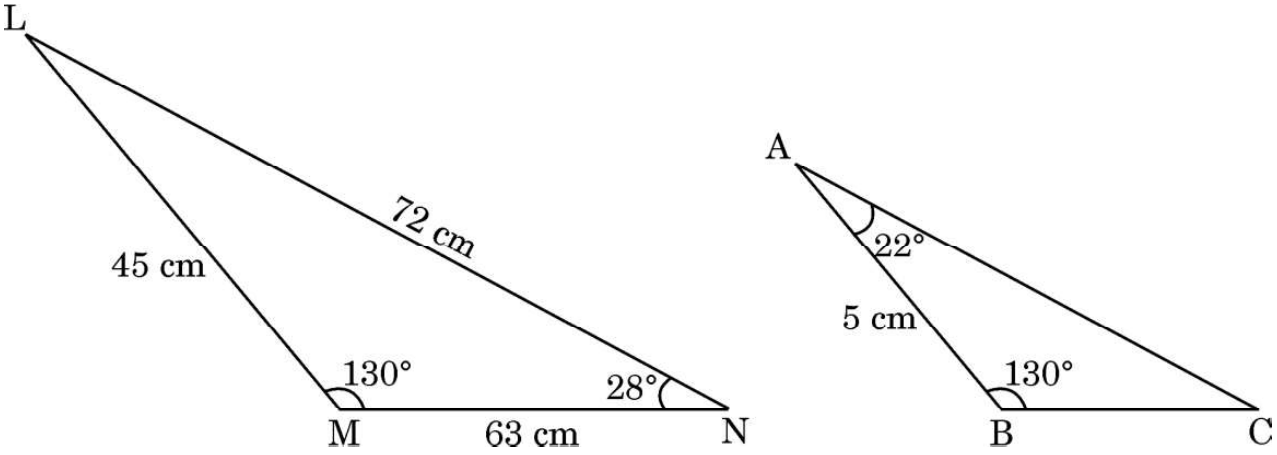
(C) cos θ tan θ (D) sin θ cos θ

10. If in two triangles Δ DEF and Δ PQR, ∠ D = ∠ Q and ∠ R = ∠ E, then which of the following is ***not*** true ?

(A) $\frac{DE}{QR} = \frac{DF}{PQ}$ (B) $\frac{EF}{PR} = \frac{DF}{PQ}$

(C) $\frac{EF}{RP} = \frac{DE}{QR}$ (D) $\frac{DE}{PQ} = \frac{EF}{RP}$

11. The measurements of Δ LMN and Δ ABC are shown in the figure given below. The length of side AC is :



(A) 16 cm (B) 7 cm

(C) 8 cm (D) 4 cm

• • •

12. If the volumes of two cubes are in the ratio 8 : 125, then the ratio of their surface areas is :

(A) 8 : 125

(B) 4 : 25

(C) 2 : 5

(D) 16 : 25

13. If the area of a sector of circle of radius 36 cm is 54π cm^2, then the length of the corresponding arc of the sector is :

(A) 8π cm (B) 6π cm

(C) 4π cm (D) 3π cm

14. A die is thrown once. The probability of getting a number which is ***not*** a factor of 36, is :

(A) $\frac{1}{2}$ (B) $\frac{2}{3}$

(C) $\frac{1}{6}$ (D) $\frac{5}{6}$

15. If the mean of 2, 9, x+6, 2x+3, 5, 10, 5 is 7, then the value of x is :

(A) 9 (B) 6

(C) 5 (D) 3

16. AOBC is a rectangle whose three vertices are A(0, 2), O(0, 0) and B(4, 0). The square of the length of its diagonal is equal to :

(A) 36 (B) 20

(C) 16 (D) 4

17. Zeroes of the polynomial $p(x) = x^2 - 3\sqrt{2}\,x + 4$ are :

(A) $2, \sqrt{2}$

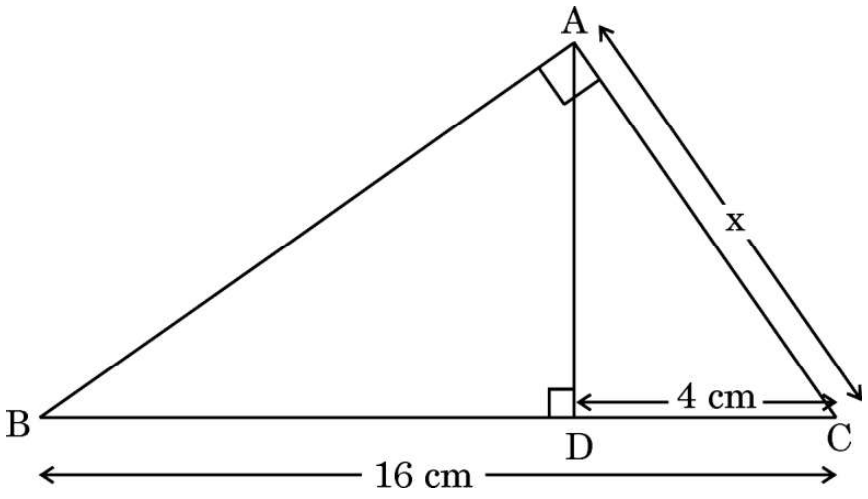
(B) $2\sqrt{2}, \sqrt{2}$

(C) $4\sqrt{2}, -\sqrt{2}$

(D) $\sqrt{2}, 2$

• • •

18. In the given figure, in Δ ABC, AD $\perp$ BC and $\angle$ BAC = 90°. If BC = 16 cm and DC = 4 cm, then the value of x is :



(A) 4 cm (B) 5 cm

(C) 8 cm (D) 3 cm

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* A ladder leaning against a wall, stands at a horizontal distance of 6 m from the wall. If the height of the wall up to which the ladder reaches is 8 m, then the length of the ladder is 10 m.

Reason (R): The ladder makes an angle of 60° with the ground.

20. *Assertion (A) :* If two tangents are drawn to a circle from an external point, then they subtend equal angles at the centre of the circle.

Reason (R): A parallelogram circumscribing a circle is a rhombus.

• • •

SECTION B

*This section has **5** Very Short Answer (VSA) type questions carrying **2** marks each.* *5×2=10*

21. If $4k = \tan^2 60° - 2\,\text{cosec}^2 30° - 2\tan^2 30°$, then find the value of k.

22. The probability of guessing the correct answer of a certain test question is $\frac{x}{12}$. If the probability of not guessing the correct answer is $\frac{5}{6}$, then find the value of x.

23. (a) Find the smallest number which is divisible by both 644 and 462.

OR

(b) Two numbers are in the ratio 4 : 5 and their HCF is 11. Find the LCM of these numbers.

24. (a) Find the value(s) of 'k' so that the quadratic equation $4x^2 + kx + 1 = 0$ has real and equal roots.

OR

(b) If 'α' and 'β' are the zeroes of the polynomial $p(y) = y^2 - 5y + 3$, then find the value of $\alpha^4\beta^3 + \alpha^3\beta^4$.

25. Prove that the tangents drawn at the ends of a diameter of a circle are parallel.

SECTION C

*This section has **6** Short Answer (SA) type questions carrying **3** marks each.* *6×3=18*

26. (a) If the mid-point of the line segment joining the points A(3, 4) and B(k, 6) is P(x, y) and $x + y - 10 = 0$, find the value of k.

OR

(b) Find the coordinates of the points which divide the line segment joining A(– 2, 2) and B(2, 8) into four equal parts.

• • •

27. Prove that $\left(5\sqrt{3}+\frac{2}{3}\right)$ is an irrational number given that $\sqrt{3}$ is an irrational number.

28. (a) Prove that : $\sqrt{\frac{\sec A-1}{\sec A+1}}+\sqrt{\frac{\sec A+1}{\sec A-1}}=2\ \text{cosec}\ A$

OR

(b) Prove that : $\left(\frac{1}{\cos A}-\cos A\right)\left(\frac{1}{\sin A}-\sin A\right)=\frac{1}{\tan A+\cot A}$

29. A chord of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding minor segment. [Use $\pi = 3{\cdot}14$]

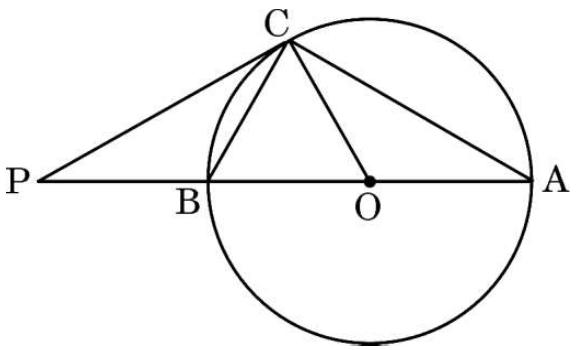
30. Three unbiased coins are tossed simultaneously. Find the probability of getting :

(a) exactly two tails

(b) at least one head

(c) at most two heads

31. In the given figure, PC is a tangent to the circle at C. AOB is the diameter which when extended meets the tangent at P. Find $\angle$ CBA and $\angle$ BCO, if $\angle$ PCA = 110°.



• • •

SECTION D

*This section has **4** Long Answer (LA) type questions carrying **5** marks each.* $4\times5=20$

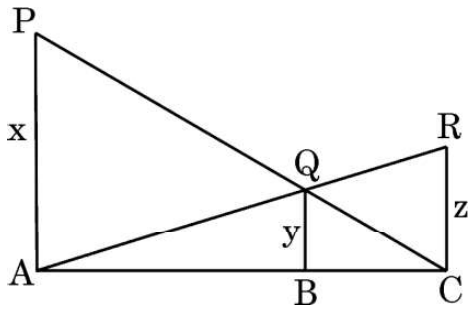
32. The perimeter of an isosceles triangle is 32 cm. If each equal side is $\frac{5}{6}^{\text{th}}$ of the base, find the area of the triangle.

33. (a) The sum of the third term and the seventh term of an AP is 6 and their product is 8. Find the sum of the first sixteen terms of the AP.

OR

(b) The minimum age of children eligible to participate in a painting competition is 8 years. It is observed that the age of the youngest boy was 8 years and the ages of the participants, when seated in order of age, have a common difference of 4 months. If the sum of the ages of all the participants is 168 years, find the age of the eldest participant in the painting competition.

34. (a) In the given figure, PA, QB and RC are perpendicular to AC. If PA = x units, QB = y units and RC = z units, prove that $\frac{1}{x}+\frac{1}{z}=\frac{1}{y}$.



OR

(b) Sides AB and BC and median AD of triangle ABC are respectively proportional to sides PQ and QR and median PM of Δ PQR. Show that Δ ABC ~ Δ PQR.

35. A vessel is in the form of an inverted cone. Its height is 8 cm and the radius of its top, which is open, is 5 cm. It is filled with water up to the brim. When lead shots, each of which is a sphere of radius 0·5 cm, are dropped into the vessel, one-fourth of the water flows out. Find the number of lead shots dropped in the vessel.

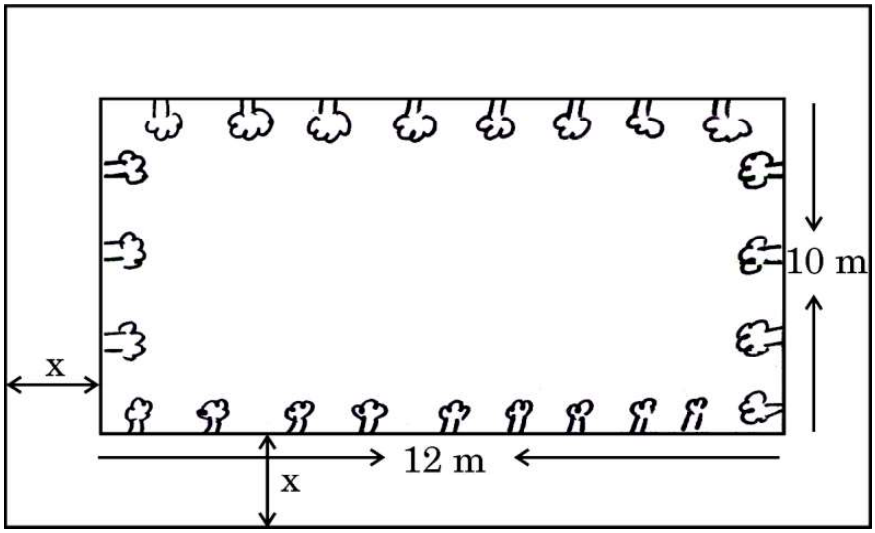
• • •

SECTION E

*This section has **3** Case Study based questions carrying **4** marks each.* *3×4=12*

Case Study – 1

36. A garden designer is planning a rectangular lawn that is to be surrounded by a uniform walkway.



The total area of the lawn and the walkway is 360 square metres. The width of the walkway is same on all sides. The dimensions of the lawn itself are 12 metres by 10 metres.

Based on the information given above, answer the following questions :

(i) Formulate the quadratic equation representing the total area of the lawn and the walkway, taking width of walkway = x m. *1*

(ii) (a) Solve the quadratic equation to find the width of the walkway 'x'. *2*

OR

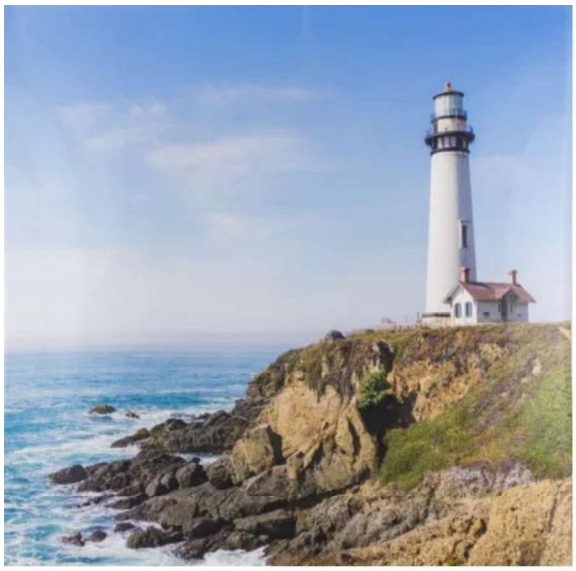
(b) If the cost of paving the walkway at the rate of ₹ 50 per square metre is ₹ 12,000, calculate the area of the walkway. *2*

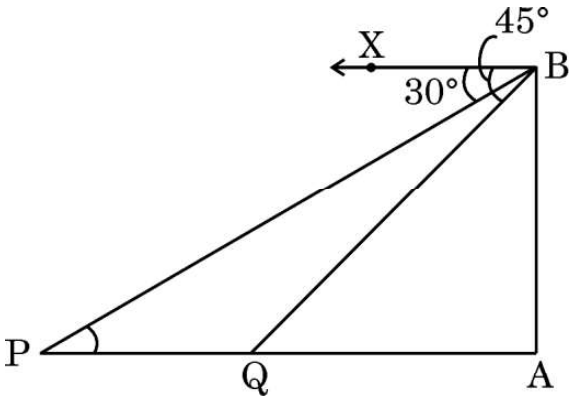
(iii) Find the perimeter of the lawn. *1*

• • •

Case Study – 2

37. A lighthouse stands tall on a cliff by the sea, watching over ships that pass by. One day a ship is seen approaching the shore and from the top of the lighthouse, the angles of depression of the ship are observed to be 30° and 45° as it moves from point P to point Q. The height of the lighthouse is 50 metres.





Based on the information given above, answer the following questions :

(i) Find the distance of the ship from the base of the lighthouse when it is at point Q, where the angle of depression is 45°. *1*

(ii) Find the measures of ∠ PBA and ∠ QBA. *1*

(iii) (a) Find the distance travelled by the ship between points P and Q. *2*

OR

(b) If the ship continues moving towards the shore and takes 10 minutes to travel from Q to A, calculate the speed of the ship in km/h, from Q to A. *2*

• • •

Case Study – 3

38. The India Meteorological Department observes seasonal and annual rainfall every year in different sub-divisions of our country. It helps them to compare and analyse the results.

The table below shows sub-divisions wise seasonal (monsoon) rainfall (in mm) in 2023.

Rainfall (mm)	*No. of Sub-divisions*
200 – 400	3
400 – 600	4
600 – 800	7
800 – 1000	4
1000 – 1200	3
1200 – 1400	3

Based on the information given above, answer the following questions :

(i) Write the modal class. *1*

(ii) (a) Find the median of the given data. *2*

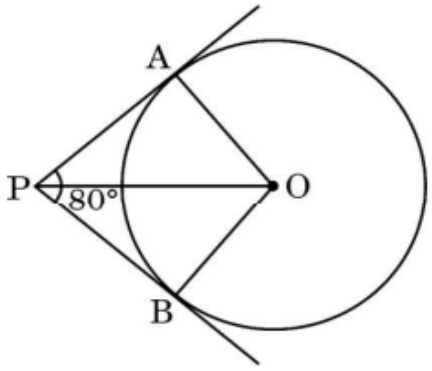
OR

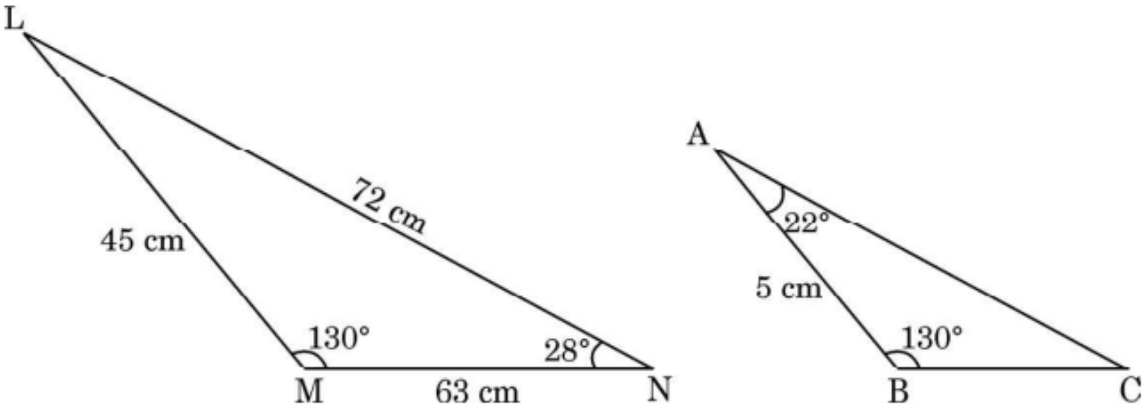
(b) Find the mean rainfall in the season. *2*

(iii) If a sub-division having at least 800 mm rainfall during monsoon season is considered a good rainfall sub-division, then how many sub-divisions had good rainfall ? *1*

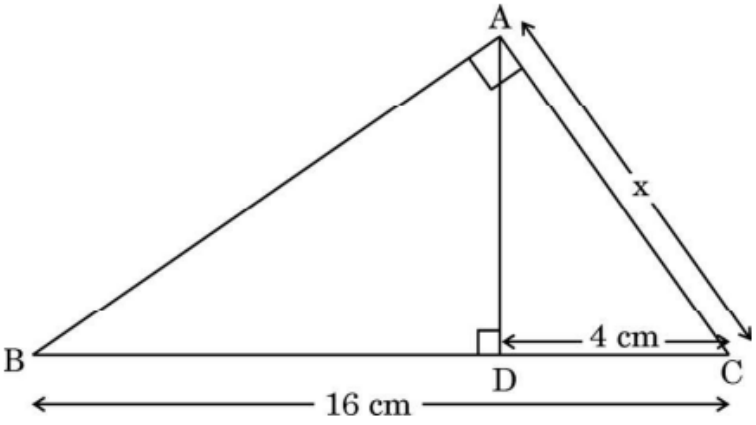
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/3/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **This section has 20 Multiple Choice Questions (MCQs) carrying 1 mark each.**	
1.	If $\tan 3\theta = \sqrt{3}$, then $\frac{\theta}{2}$ equals : (A) $60°$ (B) $30°$ (C) $20°$ (D) $10°$	
Sol.	(D) $10°$	**1**
2.	If x is the LCM of 4, 6, 8 and y is the LCM of 3, 5, 7 and p is the LCM of x and y, then which of the following is true ? (A) $p = 35x$ (B) $p = 4y$ (C) $p = 8x$ (D) $p = 16y$	
Sol.	(A) $p = 35x$	**1**
3.	The value of 'k' for which the system of linear equations $6x + y = 3k$ and $36x + 6y = 3$ have infinitely many solutions is : (A) 6 (B) $\frac{1}{6}$ (C) $\frac{1}{2}$ (D) $\frac{1}{3}$	
Sol.	(B) $\frac{1}{6}$	**1**
4.	If α and β are the zeroes of the polynomial $p(x) = x^2 - ax - b$, then the value of $(\alpha + \beta + \alpha\beta)$ is equal to : (A) $a + b$ (B) $-a - b$ (C) $a - b$ (D) $-a + b$	
Sol.	(C) $a - b$	**1**

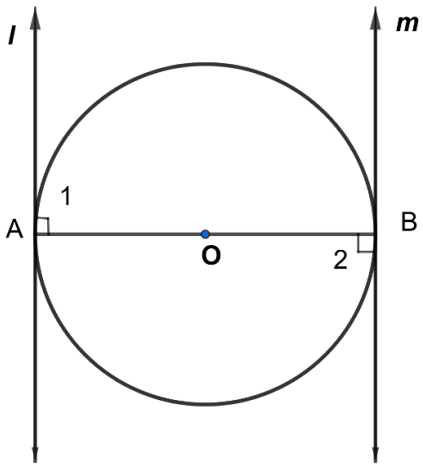
5.	If $\frac{x}{12} - \frac{3}{x} = 0$, then the values of x are : (A) ± 6 (B) ± 4 (C) ± 12 (D) ± 3	
Sol.	(A) ± 6	**1**
6.	The line represented by $\frac{x}{4} + \frac{y}{6} = 1$, intersects x-axis and y-axis respectively at P and Q. The coordinates of the mid-point of line segment PQ are : (A) (2, 3) (B) (3, 2) (C) (2, 0) (D) (0, 3)	
Sol.	(A) (2, 3)	**1**
7.	Two of the vertices of Δ PQR are P(–1, 5) and Q(5, 2). The coordinates of a point which divides PQ in the ratio 2 : 1 are : (A) (3, – 3) (B) (5, 5) (C) (3, 3) (D) (5, 1)	
Sol.	(C) (3, 3)	**1**
8.	If tangents PA and PB drawn from an external point P to the circle with centre O are inclined to each other at an angle of 80° as shown in the given figure, then the measure of $\angle$ POA is :  (A) 40° (B) 50° (C) 60° (D) 80°	
Sol.	(B) 50°	**1**

9.	$(\cot\theta + \tan\theta)$ equals : (A) $\operatorname{cosec}\theta \sec\theta$ (B) $\sin\theta \sec\theta$ (C) $\cos\theta \tan\theta$ (D) $\sin\theta \cos\theta$	
Sol.	(A) $\operatorname{cosec}\theta \sec\theta$	**1**
10.	If in two triangles Δ DEF and Δ PQR, $\angle D = \angle Q$ and $\angle R = \angle E$, then which of the following is ***not*** true ? (A) $\frac{DE}{QR} = \frac{DF}{PQ}$ (B) $\frac{EF}{PR} = \frac{DF}{PQ}$ (C) $\frac{EF}{RP} = \frac{DE}{QR}$ (D) $\frac{DE}{PQ} = \frac{EF}{RP}$	
Sol.	(D) $\frac{DE}{PQ} = \frac{EF}{RP}$	**1**
11.	The measurements of Δ LMN and Δ ABC are shown in the figure given below. The length of side AC is :  (A) 16 cm (B) 7 cm (C) 8 cm (D) 4 cm	
Sol.	(C) 8 cm	**1**
12.	If the volumes of two cubes are in the ratio 8 : 125, then the ratio of their surface areas is : (A) 8 : 125 (B) 4 : 25 (C) 2 : 5 (D) 16 : 25	
Sol.	(B) 4:25	**1**

13.	If the area of a sector of circle of radius 36 cm is 54π cm^2, then the length of the corresponding arc of the sector is : (A) 8π cm (B) 6π cm (C) 4π cm (D) 3π cm	
Sol.	(D) 3π cm	**1**
14.	A die is thrown once. The probability of getting a number which is ***not*** a factor of 36, is : (A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{1}{6}$ (D) $\frac{5}{6}$	
Sol.	(C) $\frac{1}{6}$	**1**
15.	If the mean of 2, 9, x+6, 2x+3, 5, 10, 5 is 7, then the value of x is : (A) 9 (B) 6 (C) 5 (D) 3	
Sol.	(D) 3	**1**
16.	AOBC is a rectangle whose three vertices are A(0, 2), O(0, 0) and B(4, 0). The square of the length of its diagonal is equal to : (A) 36 (B) 20 (C) 16 (D) 4	
Sol.	(B) 20	**1**
17.	Zeroes of the polynomial $p(x) = x^2 - 3\sqrt{2}x + 4$ are : (A) $2, \sqrt{2}$ (B) $2\sqrt{2}, \sqrt{2}$ (C) $4\sqrt{2}, -\sqrt{2}$ (D) $\sqrt{2}, 2$	
Sol.	(B) $2\sqrt{2}, \sqrt{2}$	**1**

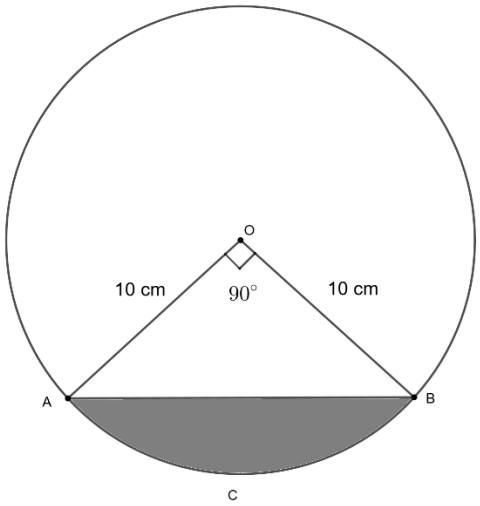
18.	In the given figure, in Δ ABC, AD $\perp$ BC and $\angle$ BAC = 90°. If BC = 16 cm and DC = 4 cm, then the value of x is :  (A) 4 cm (B) 5 cm (C) 8 cm (D) 3 cm	
Sol.	(C) 8 cm	**1**
	*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* A ladder leaning against a wall, stands at a horizontal distance of 6 m from the wall. If the height of the wall up to which the ladder reaches is 8 m, then the length of the ladder is 10 m. *Reason (R):* The ladder makes an angle of 60° with the ground.	
Sol.	(C) Assertion (A) is true, but Reason (R) is false.	**1**
20.	*Assertion (A) :* If two tangents are drawn to a circle from an external point, then they subtend equal angles at the centre of the circle. *Reason (R):* A parallelogram circumscribing a circle is a rhombus.	
Sol.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).	**1**

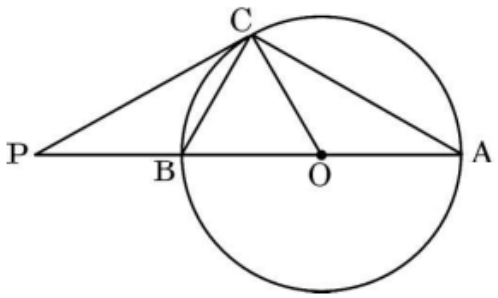
	SECTION B **This section has 5 Very Short Answer (VSA) type questions carrying 2 marks each.**	
21.	If $4k = \tan^2 60° - 2\,\text{cosec}^2 30° - 2\tan^2 30°$, then find the value of k.	
Sol.	$4k = \left(\sqrt{3}\right)^2 - 2(2)^2 - 2\left(\frac{1}{\sqrt{3}}\right)^2$ $= -\frac{17}{3}$ $k = -\frac{17}{12}$	**1 ½** **½**
22.	The probability of guessing the correct answer of a certain test question is $\frac{x}{12}$. If the probability of not guessing the correct answer is $\frac{5}{6}$, then find the value of x.	
Sol.	$\frac{x}{12} + \frac{5}{6} = 1$ $x = 2$	**1** **1**
23. (a)	Find the smallest number which is divisible by both 644 and 462.	
Sol.	$462 = 2 \times 3 \times 7 \times 11$ $644 = 2^2 \times 7 \times 23$ $\text{LCM}(462, 644) = 2^2 \times 3 \times 7 \times 11 \times 23 = 21252$ ∴ Smallest number which is divisible by both 462 and 644 is 21252	**½** **½** **1**
	OR	
23. (b)	Two numbers are in the ratio 4 : 5 and their HCF is 11. Find the LCM of these numbers.	
Sol.	Let the two numbers be 4x and 5x where x is common factor Now HCF = 11 ∴ $x = 11$ Numbers are 44 and 55 $\text{LCM}(44, 55) = \frac{44 \times 55}{11} = 220$	 **½** **1** **½**

24. (a)	Find the value(s) of 'k' so that the quadratic equation $4x^2 + kx + 1 = 0$ has real and equal roots.	
Sol.	For real and equal roots, $D = 0$ $k^2 - 16 = 0$ $k = \pm 4$	½ **1** ½
	OR	
24. (b)	If 'α' and 'β' are the zeroes of the polynomial $p(y) = y^2 - 5y + 3$, then find the value of $\alpha^4\beta^3 + \alpha^3\beta^4$.	
Sol.	$\alpha + \beta = 5$ $\alpha\beta = 3$ $\alpha^4\beta^3 + \alpha^3\beta^4 = (\alpha\beta)^3(\alpha + \beta)$ $= 27 \times 5 = 135$	½ ½ ½ ½
25.	Prove that the tangents drawn at the ends of a diameter of a circle are parallel.	
Sol.	 Tangents l and m are drawn at the end points A and B of the diameter AB of the circle $\angle 1 = 90°, \angle 2 = 90°$ $\therefore\ \angle 1 = \angle 2$ But these are alternate interior angles. $\therefore\ l \parallel m$	**Correct figure ½ Mark** ½ ½ ½

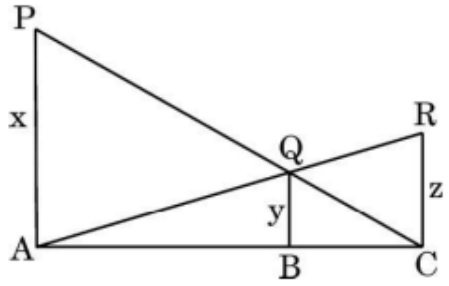
	SECTION C **This section has 6 Short Answer (SA) type questions carrying 3 marks each.**	
26. (a)	If the mid-point of the line segment joining the points A(3, 4) and B(k, 6) is P(x, y) and $x + y - 10 = 0$, find the value of k.	
Sol.	$P(x, y)$ is the mid $-$ point $\therefore (x, y) = (\frac{3+k}{2}, \frac{4+6}{2})$ $x = \frac{3+k}{2}, y = 5$ $x + y - 10 = 0$ $\frac{3+k}{2} + 5 - 10 = 0$ $k = 7$	**1** **1** **1**
	OR	
26. (b)	Find the coordinates of the points which divide the line segment joining A(– 2, 2) and B(2, 8) into four equal parts.	
Sol.	**1 : 1 : 1 : 1** A (–2, 2) P Q R B (2, 8) Coordinates of mid – point Q of AB $= (0, 5)$ Coordinates of mid – point P of AQ $= \left(-1, \frac{7}{2}\right)$ Coordinates of mid – point R of BQ $= \left(1, \frac{13}{2}\right)$	**1** **1** **1**
27.	Prove that $\left(5\sqrt{3} + \frac{2}{3}\right)$ is an irrational number given that $\sqrt{3}$ is an irrational number.	
Sol.	Let $5\sqrt{3} + \frac{2}{3}$ be a rational number. $\therefore 5\sqrt{3} + \frac{2}{3} = \frac{a}{b}$ where a and b are integers and $b \neq 0$.	**1**

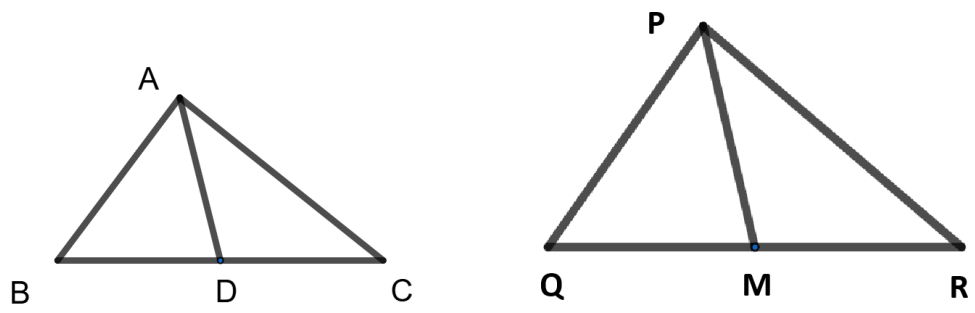
	$5\sqrt{3} = \frac{a}{b} - \frac{2}{3}$ $\sqrt{3} = \frac{3a - 2b}{15b}$ $3a - 2b$ and $15b$ are integers. $\therefore$ RHS is rational. But LHS $= \sqrt{3}$ is an irrational number which is contradiction to our supposition. Hence $5\sqrt{3} + \frac{2}{3}$ is an irrational number.	**1** ½ ½
28. (a)	Prove that : $\sqrt{\frac{\sec A - 1}{\sec A + 1}} + \sqrt{\frac{\sec A + 1}{\sec A - 1}} = 2 \operatorname{cosec} A$	
Sol.	$\text{LHS} = \frac{\sec A - 1 + \sec A + 1}{\sqrt{\sec^2 A - 1}}$ $= \frac{2\sec A}{\tan A}$ $= 2\operatorname{cosec} A = \text{RHS}$	**1** **1** **1**
	OR	
28. (b)	Prove that : $\left(\frac{1}{\cos A} - \cos A\right)\left(\frac{1}{\sin A} - \sin A\right) = \frac{1}{\tan A + \cot A}$	
Sol.	$\text{LHS} = \left(\frac{1 - \cos^2 A}{\cos A}\right)\left(\frac{1 - \sin^2 A}{\sin A}\right)$ $= \frac{\sin^2 A}{\cos A} \cdot \frac{\cos^2 A}{\sin A}$ $= \sin A . \cos A$ $\text{RHS} = \frac{\sin A . \cos A}{\sin^2 A + \cos^2 A}$ $= \sin A . \cos A$ $\therefore$ LHS $=$ RHS	**1** ½ ½ ½ ½

29.	A chord of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding minor segment. [Use $\pi = 3{\cdot}14$]	
Sol.	 Area of minor segment ACB = Area of sector OACB − Area of right ΔOAB Area of sector OACB $= \frac{90}{360} \times 3.14 \times 10 \times 10$ $= 78.5\ \text{cm}^2$ Area of right $\Delta OAB = \frac{1}{2} \times 10 \times 10$ $= 50\ \text{cm}^2$ Area of minor segment ACB $= (78.5 - 50)$ $= 28.5\ \text{cm}^2$	½ ½ ½ ½ ½ ½
30.	Three unbiased coins are tossed simultaneously. Find the probability of getting : (a) exactly two tails (b) at least one head (c) at most two heads	
Sol.	Possible outcomes are HHH, HHT, HTH, HTT, THH, THT, TTH, TTT	

	(a) P(exactly two tails) $= \frac{3}{8}$ (b) P(atleast one head) $= \frac{7}{8}$ (c) P(atmost two heads) $= \frac{7}{8}$	1 1 1
31.	In the given figure, PC is a tangent to the circle at C. AOB is the diameter which when extended meets the tangent at P. Find $\angle$ CBA and $\angle$ BCO, if $\angle$ PCA = 110°.  	
Sol.	$\angle ACB = \angle OCB + \angle OCA = 90°$ $\angle PCB + \angle OCB + \angle OCA = 110°$ $\angle PCB = 110° - 90° = 20°$ $\angle PCB + \angle OCB = 90°$ $\angle OCB = 90° - 20° = 70°$ As $OB = OC \Rightarrow \angle OBC = \angle OCB$ $\angle OBC = \angle OCB = 70°$	½ 1 1 ½
	SECTION D **This section has 4 Long Answer (LA) type questions carrying 5 marks each.**	
32.	The perimeter of an isosceles triangle is 32 cm. If each equal side is $\frac{5}{6}$th of the base, find the area of the triangle.	
Sol.	Let each equal side of triangle be x and base be y ATQ, $x + x + y = 32$ $2x + y = 32$ Also, $x = \frac{5}{6}y$	1 1

	On solving these equations, we get $x = 10$ and $y = 12$	½ + ½
	$\therefore$ sides of the traingle are 10 cm, 10 cm, 12 cm	
	Semi $-$ perimeter of the triangle $= 16$ cm	½
	Area of the triangle $= \sqrt{16 \times 6 \times 6 \times 4}$	**1**
	$= 48\ \text{cm}^2$	½
33. (a)	The sum of the third term and the seventh term of an AP is 6 and their product is 8. Find the sum of the first sixteen terms of the AP.	
Sol.	Let first term $= a$ and common difference $= d$	
	ATQ, $\quad (a + 2d) + (a + 6d) = 6$	
	$a + 4d = 3$	½
	$a = 3 - 4d$	
	Also, $\quad (a + 2d)(a + 6d) = 8$	½
	$(3 - 4d + 2d)(3 - 4d + 6d) = 8$	
	$9 - 4d^2 = 8$	
	$d = \pm\frac{1}{2}$	**1**
	When $d = \frac{1}{2} \Longrightarrow a = 1$	½
	$S_{16} = \frac{16}{2}\left[2 \times 1 + 15 \times \frac{1}{2}\right]$	½
	$= 76$	½
	When $d = -\frac{1}{2} \Longrightarrow a = 5$	½
	$S_{16} = \frac{16}{2}\left[2 \times 5 + 15 \times (-\frac{1}{2})\right]$	½
	$= 20$	½
	OR	

33. (b)	The minimum age of children eligible to participate in a painting competition is 8 years. It is observed that the age of the youngest boy was 8 years and the ages of the participants, when seated in order of age, have a common difference of 4 months. If the sum of the ages of all the participants is 168 years, find the age of the eldest participant in the painting competition.	
Sol.	The ages of the participants form the following AP $8, 8\frac{1}{3}, 8\frac{2}{3}, 9, \cdots$ where first term $= 8$ and common difference $= \frac{1}{3}$ Let the number of participants be n $S_n = \frac{n}{2}\left[2 \times 8 + (n-1)\frac{1}{3}\right] = 168$ $n^2 + 47n - 1008 = 0$ $\Longrightarrow n = 16$ $\therefore$ the age of the eldest participant $= 8 + 15 \times \frac{1}{3} = 13$ years	**1** **1** **1** **1** **1**
34. (a)	In the given figure, PA, QB and RC are perpendicular to AC. If PA = x units, QB = y units and RC = z units, prove that $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$.  	
Sol.	$\Delta ABQ \sim \Delta ACR$ $\frac{AB}{AC} = \frac{QB}{RC} = \frac{y}{z}$ ... ... (i) Similarly, $\Delta CBQ \sim \Delta CAP$ $\frac{BC}{AC} = \frac{QB}{PA} = \frac{y}{x}$ ... ... (ii) On adding (i) & (ii), we get	**1** ½ ½ ½

	$\frac{AB}{AC}+\frac{BC}{AC}=\frac{y}{z}+\frac{y}{x}$ $\frac{AB+BC}{AC}=y\left(\frac{1}{z}+\frac{1}{x}\right)$ $\frac{AC}{AC}=y\left(\frac{1}{z}+\frac{1}{x}\right)$ $\therefore \frac{1}{x}+\frac{1}{z}=\frac{1}{y}$	1 1 ½
	OR	
34. (b)	Sides AB and BC and median AD of triangle ABC are respectively proportional to sides PQ and QR and median PM of Δ PQR. Show that Δ ABC ~ Δ PQR.	
Sol.	 In ΔABD and ΔPQM $\frac{AB}{PQ}=\frac{BC}{QR}=\frac{AD}{PM}$ (given) $\frac{AB}{PQ}=\frac{2BD}{2QM}=\frac{AD}{PM}$ $\frac{AB}{PQ}=\frac{BD}{QM}=\frac{AD}{PM}$ $\therefore \Delta ABD \sim \Delta PQM$ $\therefore \angle B=\angle Q$ In ΔABC and ΔPQR $\frac{AB}{PQ}=\frac{BC}{QR}$ and $\angle B=\angle Q$ $\Delta ABC \sim \Delta PQR$	Correct figure 1 mark 1 1 ½ 1 ½

35.	A vessel is in the form of an inverted cone. Its height is 8 cm and the radius of its top, which is open, is 5 cm. It is filled with water up to the brim. When lead shots, each of which is a sphere of radius 0·5 cm, are dropped into the vessel, one-fourth of the water flows out. Find the number of lead shots dropped in the vessel.	
Sol.	Radius of cone $= 5$ cm, height of cone $= 8$ cm	
	Volume of water in the cone $= \frac{1}{3}\pi \times (5)^2 \times 8$	**1**
	$= \frac{200\pi}{3}$ cm^3	½
	Volume of water flows out $= \frac{1}{4}$(Volume of water in the cone)	
	$= \frac{1}{4} \times \frac{200\pi}{3} = \frac{50\pi}{3}$ cm^3	**1**
	Radius of sphere (lead shot) $= 0.5 = \frac{1}{2}$ cm	
	Volume of one lead shot $= \frac{4}{3}\pi \times \left(\frac{1}{2}\right)^3$	**1**
	$= \frac{\pi}{6}$ cm^3	½
	Number of lead shots $= \frac{\frac{50\pi}{3}}{\frac{\pi}{6}} = 100$	**1**

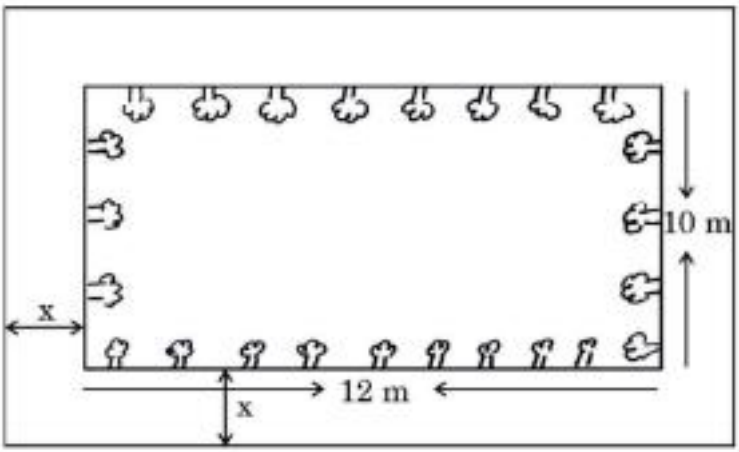
SECTION E

This section has 3 Case Study based questions carrying 4 marks each.

36.

Case Study – 1

A garden designer is planning a rectangular lawn that is to be surrounded by a uniform walkway.



The total area of the lawn and the walkway is 360 square metres. The width of the walkway is same on all sides. The dimensions of the lawn itself are 12 metres by 10 metres.

Based on the information given above, answer the following questions :

(i) Formulate the quadratic equation representing the total area of the lawn and the walkway, taking width of walkway = x m.

(ii) (a) Solve the quadratic equation to find the width of the walkway 'x'.

OR

(b) If the cost of paving the walkway at the rate of ₹ 50 per square metre is ₹ 12,000, calculate the area of the walkway.

(iii) Find the perimeter of the lawn.

Sol.

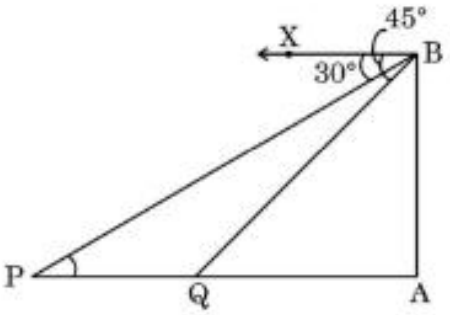
$(i)\ (12 + 2x)(10 + 2x) = 360$ ½

$4x^2 + 44x - 240 = 0$ *or* $x^2 + 11x - 60 = 0$ ½

$(ii)(a)\ (x + 15)(x - 4) = 0$ **1**

$x = 4$

$\therefore$ width of the walkway $= 4$ m **1**

	OR (ii)(b) Area of the walkway $= \frac{12000}{50}$ $= 240\ m^2$ (iii) Perimeter of the lawn $= 2(12 + 10) = 44$ m	**1** **1** **1**
37.	**Case Study – 2** A lighthouse stands tall on a cliff by the sea, watching over ships that pass by. One day a ship is seen approaching the shore and from the top of the lighthouse, the angles of depression of the ship are observed to be 30° and 45° as it moves from point P to point Q. The height of the lighthouse is 50 metres.  Based on the information given above, answer the following questions : (i) Find the distance of the ship from the base of the lighthouse when it is at point Q, where the angle of depression is 45°. (ii) Find the measures of ∠ PBA and ∠ QBA. (iii) (a) Find the distance travelled by the ship between points P and Q. **OR** (b) If the ship continues moving towards the shore and takes 10 minutes to travel from Q to A, calculate the speed of the ship in km/h, from Q to A.	
Sol.	(i) $\angle AQB = \angle QBX = 45°$ and $\angle APB = \angle PBX = 30°$ In $\Delta AQB, \tan 45° = \frac{50}{AQ}$	½

	$AQ = 50$ m	½
	(ii) $\angle PBA = 60°$	½
	$\angle QBA = 45°$	½
	$(iii)(a)$ In $\Delta APB, \tan 30° = \frac{50}{AP}$	½
	$AP = 50\sqrt{3}$ m	½
	Distance travelled by the ship $= PQ = 50\sqrt{3} - 50 = 50(\sqrt{3} - 1)$ m	**1**
	or 36.5 m	
	OR	
	(iii)(b) Speed of the ship $= \frac{50 \text{ metres}}{10 \text{ minutes}}$	**1**
	$= 0.3$ km/h	**1**
38.	**Case Study – 3** The India Meteorological Department observes seasonal and annual rainfall every year in different sub-divisions of our country. It helps them to compare and analyse the results.	

The table below shows sub-divisions wise seasonal (monsoon) rainfall (in mm) in 2023.

Rainfall (mm)	*No. of Sub-divisions*
200 – 400	3
400 – 600	4
600 – 800	7
800 – 1000	4
1000 – 1200	3
1200 – 1400	3

Based on the information given above, answer the following questions :

(i) Write the modal class.

(ii) (a) Find the median of the given data.

OR

(b) Find the mean rainfall in the season.

(iii) If a sub-division having at least 800 mm rainfall during monsoon season is considered a good rainfall sub-division, then how many sub-divisions had good rainfall ?

Sol.

(i) Modal Class $= 600 - 800$ — **1**

(ii)(a)

Rainfall (mm)	No. of Sub-divisions (f_i)	cf
200–400	3	3
400–600	4	7
600–800	7	14
800–1000	4	18
1000–1200	3	21
1200–1400	3	24

Correct table ½ mark

$N = 24$

Median Class $= 600 - 800$ — ½

$$\text{Median} = 600 + \frac{12 - 7}{7} \times 200$$ — ½

$$= \frac{5200}{7} \text{ or } 742.8 \text{ mm } (approx.)$$ — ½

OR

(ii)(b)

Rainfall (mm)	No. of Sub-divisions (f_i)	x_i	$f_i x_i$
200−400	3	300	900
400−600	4	500	2000
600−800	7	700	4900
800−1000	4	900	3600
1000−1200	3	1100	3300
1200−1400	3	1300	3900
	$\sum f_i = 24$		$\sum f_i x_i = 18600$

Correct table 1 Mark

Mean $= \frac{18600}{24} = 775$ **1**

$\therefore$ Mean rainfall $= 775$ mm

(iii) Required number of sub − divisions $= 4 + 3 + 3 = 10$ **1**

• • •

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A** – Question numbers **1** to **18** are multiple choice questions (MCQs) and question numbers **19** and **20** are Assertion – Reason based questions of **1** mark each.*

(iv) *In **Section B** – Question numbers **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C** – Question numbers **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D** – Question numbers **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E** – Question numbers **36** to **38** are **case-study based integrated** questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section **B**, 2 questions in Section **C**, 2 questions in Section **D** and 3 questions of **2** marks in Section **E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **NOT allowed.***

SECTION – A

20×1 = 20

This section consists of 20 questions of 1 mark each.

1. If $x = ab^3$ and $y = a^3b$, where a and b are prime numbers, then [HCF (x, y) – LCM (x, y)] is equal to : **1**

(a) $1 - a^3b^3$ (b) $ab\,(1 - ab)$

(c) $ab - a^4b^4$ (d) $ab\,(1 - ab)\,(1 + ab)$

2. $\left(1+\sqrt{3}\right)^2 - \left(1-\sqrt{3}\right)^2$ is : **1**

(a) a positive rational number. (b) a negative integer.

(c) a positive irrational number. (d) a negative irrational number.

3. The value of 'a' for which $ax^2 + x + a = 0$ has equal and positive roots is : **1**

(a) 2 (b) -2 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$

4. The distance of a point A from x-axis is 3 units. Which of the following cannot be coordinates of the point A ? **1**

(a) (1, 3) (b) (– 3, – 3) (c) (– 3, 3) (d) (3, 1)

5. The number of red balls in a bag is 10 more than the number of black balls. If the probability of drawing a red ball at random from this bag is $\frac{3}{5}$, then the total number of balls in the bag is : **1**

(a) 50 (b) 60 (c) 80 (d) 40

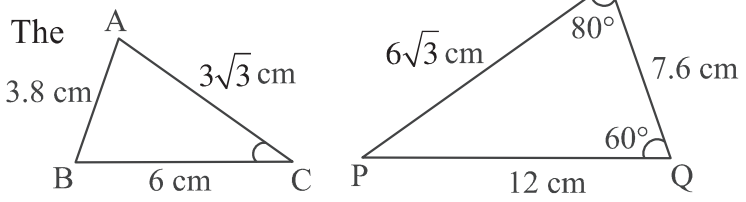
• • •

6. The value of 'p' for which the equations $px + 3y = p - 3$, $12x + py = p$ has infinitely many solutions is : **1**

(a) -6 only (b) 6 only

(c) ± 6 (d) Any real number except ± 6

7. ΔABC and ΔPQR are shown in the adjoining figures. The measure of $\angle C$ is : **1**



(a) 140°

(b) 80°

(c) 60°

(d) 40°

8. $\tan 2A = 3 \tan A$ is true, when the measure of $\angle A$ is : **1**

(a) 90° (b) 60° (c) 45° (d) 30°

9. Which of the following statements is true ? **1**

(a) $\sin 20° > \sin 70°$ (b) $\sin 20° > \cos 20°$

(c) $\cos 20° > \cos 70°$ (d) $\tan 20° > \tan 70°$

10. A 30 m long rope is tightly stretched and tied from the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is : **1**

(a) $10\sqrt{3}$ m (b) $30\sqrt{3}$ m (c) 15 m (d) $15\sqrt{3}$ m

11. On the top face of the wooden cube of side 7 cm, hemispherical depressions of radius 0.35 cm are to be formed by taking out the wood. The maximum number of depressions that can be formed is : **1**

(a) 400 (b) 100 (c) 20 (d) 10

12. The cumulative frequency for calculating median is obtained by adding the frequencies of all the : **1**

(a) classes up to the median class

(b) classes following the median class

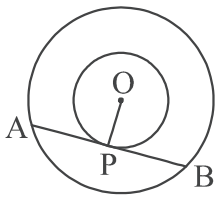
(c) classes preceding the median class

(d) all classes

13. If mean and median of given set of observations are 10 and 11 respectively, then the value of mode is : **1**

(a) 10.5 (b) 8 (c) 13 (d) 21

14. In the adjoining figure, AB is the chord of the larger circle touching the smaller circle. The centre of both the circles is O. If AB = 2 r and OP = r, then the radius of larger circle is : **1**



(a) 2 r (b) 3 r

(c) $2\sqrt{2}\ r$ (d) $\sqrt{2}\, r$

• • •

15. A parallelogram having one of its sides 5 cm circumscribes a circle. The perimeter of parallelogram is : **1**

(a) 20 cm (b) less than 20 cm

(c) more than 20 cm but less than 40 cm (d) 40 cm

16. E and F are points on the sides AB and AC respectively of a ΔABC such that $\frac{AE}{EB} = \frac{AF}{FC} = \frac{1}{2}$. Which of the following relation is true ? **1**

(a) EF = 2BC (b) BC = 2EF (c) EF = 3BC (d) BC = 3 EF

17. Which of the following statements is true for a polynomial $p(x)$ of degree 3? **1**

(a) $p(x)$ has at most two distinct zeroes.

(b) $p(x)$ has at least two distinct zeroes.

(c) $p(x)$ has exactly three distinct zeroes.

(d) $p(x)$ has at most three distinct zeroes.

18. A pair of dice is thrown. The probability that sum of numbers appearing on top faces is at most 10 is : **1**

(a) $\frac{1}{11}$ (b) $\frac{10}{11}$ (c) $\frac{5}{6}$ (d) $\frac{11}{12}$

Directions :

In question number 19 and 20, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option :

(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A) :** 4^n ends with digit 0 for some natural number n.

Reason (R) : For a number 'x' having 2 and 5 as its prime factors, x^n always ends with digit 0 for every natural number n. **1**

20. **Assertion (A) :** Tangents drawn at the end points of a diameter of a circle are always parallel to each other.

Reason (R) : The lengths of tangents drawn to a circle from a point outside the circle are always equal. **1**

SECTION – B

This section consists of 5 questions of 2 marks each.

21. Solve the following system of equations algebraically : **2**

$30x + 44y = 10;\ 40x + 55y = 13$

• • •

22. **(A)** A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/sec. Find the length of his shadow after 3 seconds. **2**

OR

(B) In parallelogram ABCD, side AD is produced to a point E and BE intersects CD at F. Prove that $\Delta ABE \sim \Delta CFB$ **2**

23. Find the coordinates of the point C which lies on the line AB produced such that AC = 2BC, where coordinates of points A and B are (– 1, 7) and (4, – 3) respectively. **2**

24. **(A)** Find the value of x for which
$(\sin A + \text{cosec } A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$ **2**

OR

(B) Evaluate the following : **2**

$$\frac{3\sin 30° - 4\sin^3 30°}{2\sin^2 50° + 2\cos^2 50°}$$

25. Two friends Anil and Ashraf were born in the December month in the year 2010. Find the probability that : **2**

(i) they share same date of birth.

(ii) they have different dates of birth.

SECTION – C

This section consists of 6 questions of 3 marks each.

26. **(A)** Prove that $\sqrt{2}$ is an irrational number. **3**

OR

(B) Let x and y be two distinct prime numbers and $p = x^2 y^3$, $q = xy^4$, $r = x^5 y^2$. Find the HCF and LCM of p, q and r. Further check if HCF $(p, q, r) \times$ LCM $(p, q, r) = p \times q \times r$ or not. **3**

27. The monthly incomes of two persons are in the ratio 9 : 7 and their monthly expenditures are in the ratio 4 : 3. If each saved ₹ 5,000, express the given situation algebraically as a system of linear equations in two variables. Hence, find their respective monthly incomes. **3**

28. P (x, y), Q (– 2, – 3) and R (2, 3) are the vertices of a right triangle PQR right angled at P. Find the relationship between x and y. Hence, find all possible values of x for which $y = 2$. **3**

29. **(A)** Prove that $\dfrac{\cos A + \sin A - 1}{\cos A - \sin A + 1} = \text{cosec } A - \cot A$ **3**

OR

(B) If $\cot\theta + \cos\theta = p$ and $\cot\theta - \cos\theta = q$,
prove that $p^2 - q^2 = 4\sqrt{pq}$ **3**

• • •

30. α and β are zeroes of a quadratic polynomial $px^2 + qx + 1$. Form a quadratic polynomial whose zeroes are $\frac{2}{\alpha}$ and $\frac{2}{\beta}$. **3**

31. Rectangle ABCD circumscribes the circle of radius 10 cm. Prove that ABCD is a square. Hence, find the perimeter of ABCD. **3**

SECTION – D

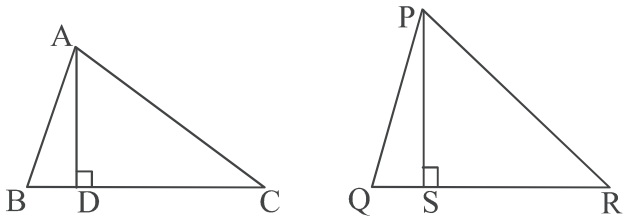
This section consists of 4 questions of 5 marks each.

32. **(A)** The sides of a right triangle are such that the longest side is 4 m more than the shortest side and the third side is 2 m less than the longest side. Find the length of each side of the triangle. Also, find the difference between the numerical values of the area and the perimeter of the given triangle. **5**

OR

(B) Express the equation $\frac{x-2}{x-3} + \frac{x-4}{x-5} = \frac{10}{3}$; $(x \neq 3, 5)$ as a quadratic equation in standard form. Hence, find the roots of the equation so formed. **5**

33. **(A)** The corresponding sides of ΔABC and ΔPQR are in the ratio 3 : 5. AD⊥BC and PS⊥QR as shown in the following figures : **5**



(i) Prove that ΔADC ~ ΔPSR

(ii) If AD = 4 cm, find the length of PS.

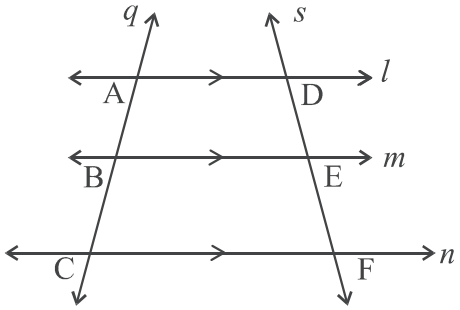
(iii) Using (ii) find ar (ΔABC) : ar (ΔPQR)

OR

(B) State basic proportionality theorem. Use it to prove the following :

If three parallel lines *l*, *m*, *n* are intersected by transversals *q* and *s* as shown in the adjoining figure,

then $\frac{AB}{BC} = \frac{DE}{EF}$.



5

• • •

34. A wooden cubical die is formed by forming hemispherical depressions on each face of the cube such that face 1 has one depression, face 2 has two depressions and so on. The sum of number of hemispherical depressions on opposite faces is always 7. If the edge of the cubical die measures 5 cm and each hemispherical depression is of diameter 1.4 cm, find the total surface area of the die so formed. **5**

35. The following table shows the number of patients of different age group who were discharged from the hospital in a particular month :

Age (in years)	Number of Patients Discharged
5-15	6
15-25	11
25-35	21
35-45	23
45-55	14
55-65	5
Total	**80**

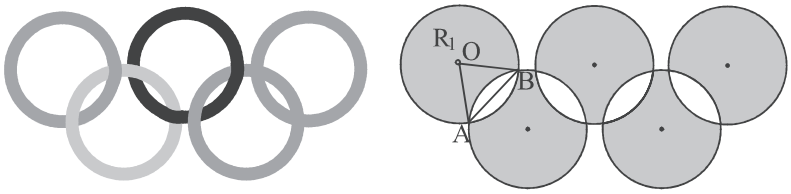
Find the 'mean' and the 'mode' of the above data. **5**

SECTION – E

This section consists of 3 Case-study based questions of 4 marks each.

36. The Olympic symbol comprising five interlocking rings represents the union of the five continents of the world and the meeting of athletes from all over the world at the Olympic games. In order to spread awareness about Olympic games, students of Class-X took part in various activities organised by the school. One such group of students made 5 circular rings in the school lawn with the help of ropes. Each circular ring required 44 m of rope.

Also, in the shaded regions as shown in the figure, students made rangoli showcasing various sports and games. It is given that ΔOAB is an equilateral triangle and all unshaded regions are congruent.



Based on above information, answer the following questions :

(i) Find the radius of each circular ring. **1**

(ii) What is the measure of $\angle AOB$? **1**

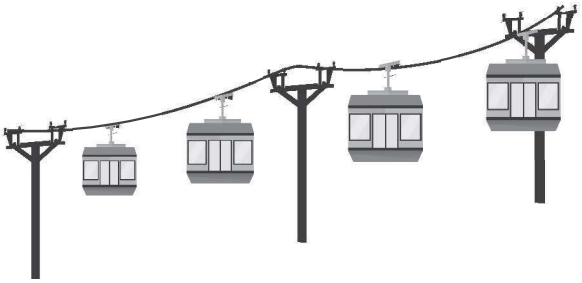
(iii) (a) Find the area of shaded region R_1. **2**

OR

(iii) (b) Find the length of rope around the unshaded regions. **2**

• • •

37. Cable cars at hill stations are one of the major tourist attractions. On a hill station, the length of cable car ride from base point to top most point on the hill is 5000 m. Poles are installed at equal intervals on the way to provide support to the cables on which car moves.



The distance of first pole from base point is 200 m and subsequent poles are installed at equal interval of 150 m. Further, the distance of last pole from the top is 300 m.

Based on above information, answer the following questions using Arithmetic Progression :

(i) Find the distance of 10^{th} pole from the base. **1**

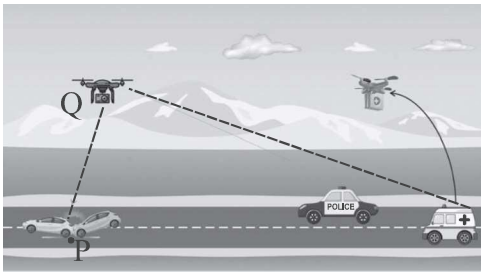
(ii) Find the distance between 15^{th} pole and 25^{th} pole. **1**

(iii) (a) Find the time taken by cable car to reach 15^{th} pole from the top if it is moving at the speed of 5m/sec and coming from top. **2**

OR

(iii) (b) Find the total number of poles installed along the entire journey. **2**

38. A drone was used to facilitate movement of an ambulance on the straight highway to a point P on the ground where there was an accident.



The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point Q, 100 m vertically above the point P. The angle of depression of the ambulance was found to be 30° at a particular instant.

Based on above information, answer the following questions :

(i) Represent the above situation with the help of a diagram. **1**

(ii) Find the distance between the ambulance and the site of accident (P) at the particular instant. (Use $\sqrt{3} = 1.73$) **1**

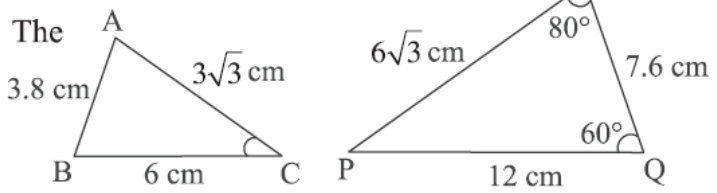
(iii) (a) Find the time (in seconds) in which the angle of depression changes from 30° to 45°. **2**

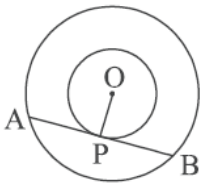
OR

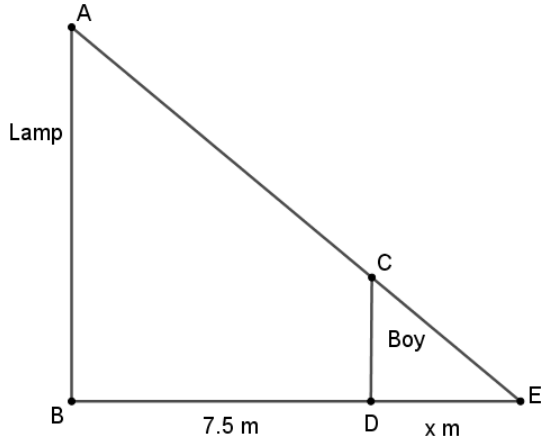
(iii) (b) How long (in seconds) will the ambulance take to reach point P from a point T on the highway such that angle of depression of the ambulance at T is 60° from the drone ? **2**

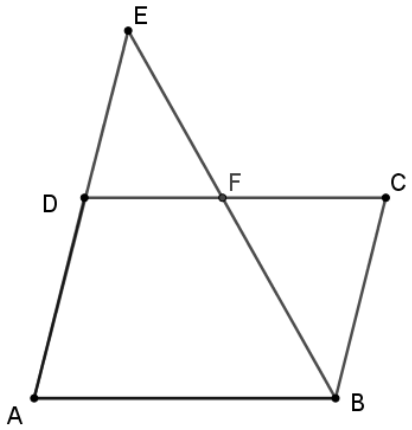
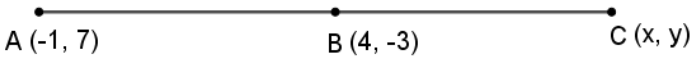
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/4/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION - A **This section consists of 20 questions of 1 mark each.**	
1.	If $x = ab^3$ and $y = a^3b$, where a and b are prime numbers, then [HCF (x, y) – LCM (x, y)] is equal to : (a) $1 - a^3b^3$ (b) $ab\,(1 - ab)$ (c) $ab - a^4b^4$ (d) $ab\,(1 - ab)\,(1 + ab)$	
Sol.	(d) $ab(1 - ab)(1 + ab)$	**1**
2.	$\left(1+\sqrt{3}\right)^2 - \left(1-\sqrt{3}\right)^2$ is : (a) a positive rational number. (b) a negative integer. (c) a positive irrational number. (d) a negative irrational number.	
Sol.	(c) a positive irrational number	**1**
3.	The value of 'a' for which $ax^2 + x + a = 0$ has equal and positive roots is : (a) 2 (b) -2 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$	
Sol.	(d) $-\frac{1}{2}$	**1**
4.	The distance of a point A from x-axis is 3 units. Which of the following cannot be coordinates of the point A ? (a) (1, 3) (b) (– 3, – 3) (c) (– 3, 3) (d) (3, 1)	
Sol.	(d) (3, 1)	**1**
5.	The number of red balls in a bag is 10 more than the number of black balls. If the probability of drawing a red ball at random from this bag is $\frac{3}{5}$, then the total number of balls in the bag is : (a) 50 (b) 60 (c) 80 (d) 40	
Sol.	(a) 50	**1**
6.	The value of 'p' for which the equations $px + 3y = p - 3$, $12x + py = p$ has infinitely many solutions is : (a) – 6 only (b) 6 only (c) ± 6 (d) Any real number except ± 6	
Sol.	(b) 6 only	**1**

7.	ΔABC and ΔPQR are shown in the adjoining figures. The measure of $\angle C$ is : (a) 140° (b) 80° (c) 60° (d) 40° 	
Sol.	(d) 40°	**1**
8.	tan 2A = 3 tan A is true, when the measure of $\angle$ A is : (a) 90° (b) 60° (c) 45° (d) 30°	
Sol.	(d) 30°	**1**
9.	Which of the following statements is true ? (a) sin 20° > sin 70° (b) sin 20° > cos 20° (c) cos 20° > cos 70° (d) tan 20° > tan 70°	
Sol.	(c) $\cos 20° > \cos 70°$	**1**
10.	A 30 m long rope is tightly stretched and tied from the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is : (a) $10\sqrt{3}$ m (b) $30\sqrt{3}$ m (c) 15 m (d) $15\sqrt{3}$ m	
Sol.	(d) $15\sqrt{3}$ m	**1**
11.	On the top face of the wooden cube of side 7 cm, hemispherical depressions of radius 0.35 cm are to be formed by taking out the wood. The maximum number of depressions that can be formed is : (a) 400 (b) 100 (c) 20 (d) 10	
Sol.	(b) 100	**1**
12.	The cumulative frequency for calculating median is obtained by adding the frequencies of all the : (a) classes up to the median class (b) classes following the median class (c) classes preceding the median class (d) all classes	
Sol.	(c) classes preceding the median class	**1**
13.	If mean and median of given set of observations are 10 and 11 respectively, then the value of mode is : (a) 10.5 (b) 8 (c) 13 (d) 21	
Sol.	(c) 13	**1**

14.	In the adjoining figure, AB is the chord of the larger circle touching the smaller circle. The centre of both the circles is O. If AB = 2 r and OP = r, then the radius of larger circle is : (a) 2 r (b) 3 r (c) $2\sqrt{2}\ r$ (d) $\sqrt{2}\,r$ 	
Sol.	(d) $\sqrt{2}\,r$	**1**
15.	A parallelogram having one of its sides 5 cm circumscribes a circle. The perimeter of parallelogram is : (a) 20 cm (b) less than 20 cm (c) more than 20 cm but less than 40 cm (d) 40 cm	
Sol.	(a) 20 cm	**1**
16.	E and F are points on the sides AB and AC respectively of a ΔABC such that $\frac{AE}{EB} = \frac{AF}{FC} = \frac{1}{2}$. Which of the following relation is true ? (a) EF = 2BC (b) BC = 2EF (c) EF = 3BC (d) BC = 3 EF	
Sol.	(d) BC = 3 EF	**1**
17.	Which of the following statements is true for a polynomial $p(x)$ of degree 3? (a) $p(x)$ has at most two distinct zeroes. (b) $p(x)$ has at least two distinct zeroes. (c) $p(x)$ has exactly three distinct zeroes. (d) $p(x)$ has at most three distinct zeroes.	
Sol.	(d) $p(x)$ has at most three distinct zeroes.	**1**
18.	A pair of dice is thrown. The probability that sum of numbers appearing on top faces is at most 10 is : (a) $\frac{1}{11}$ (b) $\frac{10}{11}$ (c) $\frac{5}{6}$ (d) $\frac{11}{12}$	
Sol.	(d) $\frac{11}{12}$	**1**
	Directions : **In question number 19 and 20, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option :** (a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A). (b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true but Reason (R) is false. (d) Assertion (A) is false but Reason (R) is true.	
19.	**Assertion (A) :** 4^n ends with digit 0 for some natural number n. **Reason (R) :** For a number 'x' having 2 and 5 as its prime factors, x^n always ends with digit 0 for every natural number n.	
Sol.	(d) Assertion (A) is false but Reason (R) is true	**1**

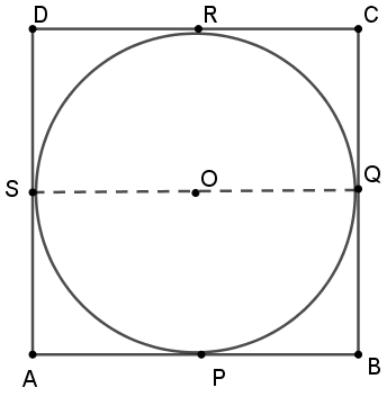
20	**Assertion (A) :** Tangents drawn at the end points of a diameter of a circle are always parallel to each other. **Reason (R) :** The lengths of tangents drawn to a circle from a point outside the circle are always equal.	
Sol.	(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).	**1**
	SECTION - B **This section consists of 5 questions of 2 marks each.**	
21.	Solve the following system of equations algebraically : $30x + 44y = 10;\ 40x + 55y = 13$	
Sol.	Given equations can be rewritten as $120\,x + 176\,y = 40$ …(i) $120\,x + 165\,y = 39$ …(ii) Subtracting to get $y = \frac{1}{11}$ Substituting to get $x = \frac{1}{5}$	**1** ½ ½
22 (A).	A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/sec. Find the length of his shadow after 3 seconds.	
Sol.	Let AB be the lamp post and CD be the boy 1.5 m tall.  For correct figure Let the length of shadow be x m Speed of boy = 2.5 m/sec ∴ Distance covered in 3 seconds = 7.5 m Now, Δ ABE~Δ CDE $\Rightarrow \frac{CD}{AB} = \frac{DE}{BE}$	½ ½ ½

	$\Rightarrow \frac{1.5}{12} = \frac{x}{7.5+x}$ Solving, we get $x = \frac{15}{14}$ or 1.07 approx. Hence length of shadow is 1.07 m	½
	OR	
22 (B).	In parallelogram ABCD, side AD is produced to a point E and BE intersects CD at F. Prove that $\Delta ABE \sim \Delta CFB$	
Sol.	 For correct figure In Δ ABE and Δ CFB, $\angle AEB = \angle CBF$ $\angle A = \angle C$ $\therefore \Delta ABE \sim \Delta CFB$	½ **1** ½
23.	Find the coordinates of the point C which lies on the line AB produced such that AC = 2BC, where coordinates of points A and B are $(-1, 7)$ and $(4, -3)$ respectively.	
Sol.	 Let coordinates of point C be (x, y) $AC = 2\,BC$ $\Rightarrow$ B is mid-point of AC $\Rightarrow \frac{-1+x}{2} = 4 \Rightarrow x = 9$ $\frac{7+y}{2} = -3 \Rightarrow y = -13$ $\therefore$ Coordinates of C are $(9, -13)$	½ ½ ½ ½

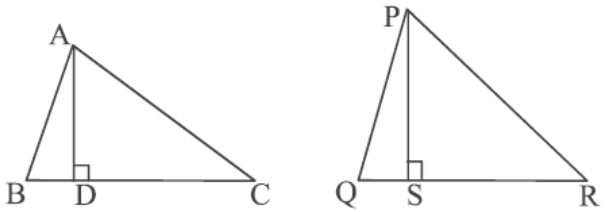
24 (A).	Find the value of x for which $(\sin A + \text{cosec } A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$	
Sol.	$(\sin A + \text{cosec } A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$ $\Rightarrow \sin^2 A + \text{cosec}^2 A + 2 + \cos^2 A + \sec^2 A + 2 = x + \tan^2 A + \cot^2 A$ $\Rightarrow 1 + 2 + 2 + 1 + \cot^2 A + 1 + \tan^2 A = x + \tan^2 A + \cot^2 A$ $\therefore x = 7$	½ **1** ½
	OR	
24 (B).	Evaluate the following : $\frac{3 \sin 30° - 4 \sin^3 30°}{2 \sin^2 50° + 2 \cos^2 50°}$	
Sol.	$\frac{3 \sin 30° - 4 \sin^3 30°}{2 \sin^2 50° + 2 \cos^2 50°}$ $= \frac{3 \times \frac{1}{2} - 4 \times \frac{1}{8}}{2 (\sin^2 50° + \cos^2 50°)}$ $= \frac{\frac{3}{2} - \frac{1}{2}}{2 \times 1}$ $= \frac{1}{2}$	**1** ½ ½
25.	Two friends Anil and Ashraf were born in the December month in the year 2010. Find the probability that : (i) they share same date of birth. (ii) they have different dates of birth.	
Sol.	Number of days in December 2010 = 31 (i) P (same date of birth) = $\frac{1}{31}$ (ii) P (different dates of birth) = $\frac{30}{31}$	**1** **1**
	SECTION - C **This section consists of 6 questions of 3 marks each.**	
26 (A).	Prove that $\sqrt{2}$ is an irrational number.	
Sol.	Let $\sqrt{2}$ be a rational number. $\therefore \sqrt{2} = \frac{p}{q}$, where $q \neq 0$ and let p & q be co-primes. $2q^2 = p^2 \Rightarrow p^2$ is divisible by $2 \Rightarrow p$ is divisible by 2 ----- (i)	½ **1**

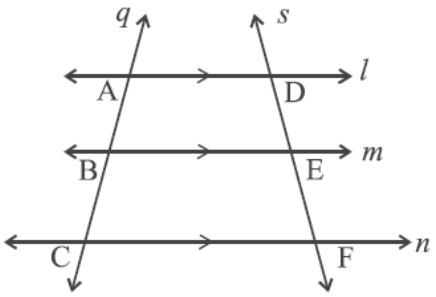
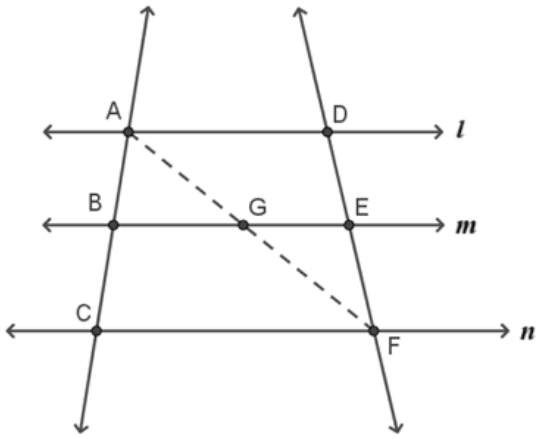
	$\Rightarrow p = 2a$, where 'a' is some integer $4a^2 = 2q^2 \Rightarrow q^2 = 2a^2 \Rightarrow q^2$ is divisible by $2 \Rightarrow q$ is divisible by 2 ----- (ii) (i) and (ii) leads to contradiction as 'p' and 'q' are co-primes. $\therefore \sqrt{2}$ is an irrational number.	**1** ½
	OR	
26 (B).	Let x and y be two distinct prime numbers and $p = x^2y^3$, $q = xy^4$, $r = x^5y^2$. Find the HCF and LCM of p, q and r. Further check if HCF $(p, q, r) \times$ LCM $(p, q, r) = p \times q \times r$ or not.	
Sol.	$p = x^2y^3, q = xy^4, r = x^5y^2$ HCF $(p, q, r) = xy^2$ LCM $(p, q, r) = x^5y^4$ HCF $\times$ LCM $= x^6y^6$ $p \times q \times r = x^8y^9$ $\Rightarrow$ HCF $(p, q, r) \times$ LCM $(p, q, r) \neq p \times q \times r$	**1** **1** **1**
27.	The monthly incomes of two persons are in the ratio 9 : 7 and their monthly expenditures are in the ratio 4 : 3. If each saved ₹ 5,000, express the given situation algebraically as a system of linear equations in two variables. Hence, find their respective monthly incomes.	
Sol.	Let us assume that income of two persons be ₹ $9x$ and ₹ $7x$ and their expenitures be ₹ $4y$ and ₹ $3y$ ATQ $9x - 4y = 5000$ and $7x - 3y = 5000$ Solving the two equations, we get $x = 5000$ $\therefore$ Monthly incomes of two persons are ₹ 45000 and ₹ 35000 respectively.	**1** **1** ½ ½
28.	P (x, y), Q $(-2, -3)$ and R $(2, 3)$ are the vertices of a right triangle PQR right angled at P. Find the relationship between x and y. Hence, find all possible values of x for which $y = 2$.	
Sol.	In Δ PQR, $\angle P = 90°$ $PQ^2 + PR^2 = QR^2$ $\Rightarrow (x+2)^2 + (y+3)^2 + (x-2)^2 + (y-3)^2 = 4^2 + 6^2$ $\Rightarrow x^2 + 4x + 4 + y^2 + 6y + 9 + x^2 - 4x + 4 + y^2 - 6y + 9 = 52$	**1**

	gives, $x^2 + y^2 = 13$ Now for $y = 2, x = \pm 3$	**1** **1**
29 (A).	Prove that $\frac{\cos A + \sin A - 1}{\cos A - \sin A + 1} = \text{cosec } A - \cot A$	
Sol.	LHS $= \frac{\cos A + \sin A - 1}{\cos A - \sin A + 1}$ $= \frac{\cot A + 1 - \text{cosec } A}{\cot A - 1 + \text{cosec } A}$ $= \frac{\cot A - \text{cosec } A + \text{cosec}^2 A - \cot^2 A}{\cot A - 1 + \text{cosec } A}$ $= \frac{(\text{cosec } A - \cot A)(-1 + \text{cosec } A + \cot A)}{\cot A - 1 + \text{cosec } A}$ $= \text{cosec } A - \cot A = \text{RHS}$	 **1** **1** ½ ½
	OR	
29 (B).	If $\cot\theta + \cos\theta = p$ and $\cot\theta - \cos\theta = q$, prove that $p^2 - q^2 = 4\sqrt{pq}$	
Sol.	LHS $= p^2 - q^2$ $= (\cot\theta + \cos\theta)^2 - (\cot\theta - \cos\theta)^2$ $= [(\cot\theta + \cos\theta) + (\cot\theta - \cos\theta)][(\cot\theta + \cos\theta) - (\cot\theta - \cos\theta)]$ $= 2\cot\theta \times 2\cos\theta = 4\cot\theta\cos\theta$ RHS $= 4\sqrt{pq}$ $= 4\sqrt{(\cot\theta + \cos\theta)(\cot\theta - \cos\theta)}$ $= 4\sqrt{cot^2\theta - cos^2\theta}$ $= 4\sqrt{cos^2\theta(cosec^2\theta - 1)}$ $= 4\sqrt{cos^2\theta \times cot^2\theta}$ $= 4\cot\theta\cos\theta$ $\therefore$ LHS = RHS	 **1** ½ ½ ½ ½
30.	α and β are zeroes of a quadratic polynomial $px^2 + qx + 1$. Form a quadratic polynomial whose zeroes are $\frac{2}{\alpha}$ and $\frac{2}{\beta}$.	
Sol.	$\alpha + \beta = -\frac{q}{p}, \alpha\beta = \frac{1}{p}$	½

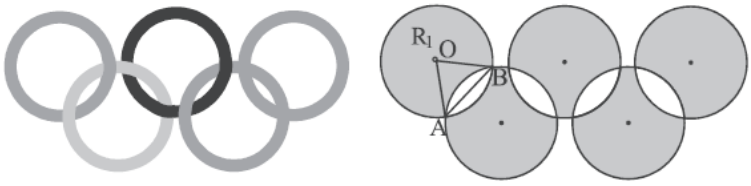
	Sum of zeroes of the required polynomial $= \frac{2}{\alpha} + \frac{2}{\beta} = 2\frac{(\beta+\alpha)}{\alpha\beta} = -2q$	**1**
	Product of zeroes of the required polynomial $= \frac{2}{\alpha} \times \frac{2}{\beta} = \frac{4}{\alpha\beta} = 4p$	**1**
	$\therefore$ required polynomial is $x^2 + 2qx + 4p$	½
31.	Rectangle ABCD circumscribes the circle of radius 10 cm. Prove that ABCD is a square. Hence, find the perimeter of ABCD.	
Sol.	 For correct figure	½
	AP = AS BP = BQ CR = CQ DR = DS	**1**
	Adding the above four equations,	
	AP + BP + CR + DR = AS + BQ + CQ + DS	
	$\Longrightarrow$ AB + CD = AD + CB --- (i)	½
	Since ABCD is a rectangle	
	$\therefore$ AB = CD and BC = AD	
	$\Longrightarrow$ from (i), 2 AB = 2 AD or AB = AD	½
	Hence ABCD is a square	
	Clearly side of square = diameter of circle = 20 cm	
	$\therefore$ Perimeter of square $= 4 \times 20$ cm $= 80$ cm	½

	SECTION - D **This section consists of 4 questions of 5 marks each.**	
32 (A).	The sides of a right triangle are such that the longest side is 4 m more than the shortest side and the third side is 2 m less than the longest side. Find the length of each side of the triangle. Also, find the difference between the numerical values of the area and the perimeter of the given triangle.	
Sol.	Let the length of shortest side be x m $\therefore$ length of longest side $= (x + 4)$ m and length of third side $= (x + 2)$ m Now, $(x + 4)^2 = x^2 + (x + 2)^2$ $\Rightarrow\ x^2 - 4x - 12 = 0$ $\Rightarrow (x - 6)(x + 2) = 0$ $\Rightarrow x = 6$ $\therefore$ sides are 6 m, 8 m and 10 m Area $= \frac{1}{2} \times 6 \times 8 = 24$ m^2 Perimeter $= 6 + 8 + 10 = 24$ m Difference $= 0$	**1** **1** **1** ½ ½ ½ ½
	OR	
32 (B).	Express the equation $\frac{x-2}{x-3}+\frac{x-4}{x-5}=\frac{10}{3}$; $(x \neq 3, 5)$ as a quadratic equation in standard form. Hence, find the roots of the equation so formed.	
Sol.	$\frac{x-2}{x-3}+\frac{x-4}{x-5}=\frac{10}{3}$ $\Rightarrow \frac{(x-2)(x-5)+(x-4)(x-3)}{(x-3)(x-5)}=\frac{10}{3}$ Simplifying, we get $2x^2 - 19x + 42 = 0$ $\Rightarrow (x - 6)(2x - 7) = 0$ $\Rightarrow x = 6$ or $x = \frac{7}{2}$	 **1½** **1½** **1** **1**

33 (A).	The corresponding sides of ΔABC and ΔPQR are in the ratio 3 : 5. $AD \perp BC$ and $PS \perp QR$ as shown in the following figures :  (i) Prove that $\Delta ADC \sim \Delta PSR$ (ii) If AD = 4 cm, find the length of PS. (iii) Using (ii) find ar (ΔABC) : ar (ΔPQR)	
Sol.	As, $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} = \frac{3}{5}$ $\Rightarrow \Delta ABC \sim \Delta PQR$ $\Rightarrow \angle C = \angle R$ (i) In ΔADC and ΔPSR, $\angle ADC = \angle PSR$ and $\angle C = \angle R$ $\therefore \Delta ADC \sim \Delta PSR$ (ii) $\frac{AD}{PS} = \frac{AC}{PR} = \frac{3}{5}$ $\Rightarrow \frac{4}{PS} = \frac{3}{5}$ $\Rightarrow PS = \frac{20}{3}$ cm (iii) $\frac{\text{ar}(\Delta ABC)}{\text{ar}(\Delta PQR)} = \frac{\frac{1}{2} \times BC \times AD}{\frac{1}{2} \times QR \times PS}$ $= \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$ $\therefore$ ar (ΔABC): ar (ΔPQR) = 9 : 25	½ **1** ½ ½ ½ ½ **1** ½
	OR	

33 (B).	State basic proportionality theorem. Use it to prove the following : If three parallel lines l, m, n are intersected by transversals q and s as shown in the adjoining figure, then $\frac{AB}{BC} = \frac{DE}{EF}$.  	
Sol.	Correct statement  Join AF intersecting line m at G In Δ ACF, BG $\parallel$ CF $\Rightarrow \frac{AB}{BC} = \frac{AG}{GF}$ … (i) In Δ FDA, GE $\parallel$ AD $\Rightarrow \frac{EF}{DE} = \frac{GF}{AG}$ or $\frac{DE}{EF} = \frac{AG}{GF}$ … (ii) From, (i) and (ii), we get $\frac{AB}{BC} = \frac{DE}{EF}$	**1** **1** **1** **1** **1**
34.	A wooden cubical die is formed by forming hemispherical depressions on each face of the cube such that face 1 has one depression, face 2 has two depressions and so on. The sum of number of hemispherical depressions on opposite faces is always 7. If the edge of the cubical die measures 5 cm and each hemispherical depression is of diameter 1.4 cm, find the total surface area of the die so formed.	
Sol.	Number of hemispherical depressions $= 21$ Total surface area of the die formed = TSA of cube + CSA of 21 hemispheres – Base area of 21 hemispherical depressions	**1**

	$= 6 \times 5^2 + 21 \times 2 \times \frac{22}{7} \times (0.7)^2 - 21 \times \frac{22}{7} \times (0.7)^2$ $= 182.34 \text{ cm}^2$	**1+1+1** **1**
35.	The following table shows the number of patients of different age group who were discharged from the hospital in a particular month : **Age (in years) / Number of Patients Discharged** 5-15: 6 15-25: 11 25-35: 21 35-45: 23 45-55: 14 55-65: 5 **Total: 80** Find the 'mean' and the 'mode' of the above data.	
Sol.	Age (in years) / Number of patients (f_i) / Class Mark (x_i) / $f_i\, x_i$ 5-15 / 6 / 10 / 60 15-25 / 11 / 20 / 220 25-35 / 21 / 30 / 630 35-45 / 23 / 40 / 920 45-55 / 14 / 50 / 700 55-65 / 5 / 60 / 300 Total / $\sum f_i = 80$ / / $\sum f_i x_i = 2830$ Mean $= \frac{2830}{80}$ $= \frac{283}{8}$ or 35.38 years Modal class is 35 - 45 Mode $= 35 + \frac{23-21}{2\times23-21-14} \times 10$ $= \frac{405}{11}$ or 36.82 years (approx.)	**1½ for correct table** **1** **½** **½** **1** **½**

	SECTION - E **This section consists of 3 case-study based questions of 4 marks each.**	
36.	The Olympic symbol comprising five interlocking rings represents the union of the five continents of the world and the meeting of athletes from all over the world at the Olympic games. In order to spread awareness about Olympic games, students of Class-X took part in various activities organised by the school. One such group of students made 5 circular rings in the school lawn with the help of ropes. Each circular ring required 44 m of rope. Also, in the shaded regions as shown in the figure, students made rangoli showcasing various sports and games. It is given that ΔOAB is an equilateral triangle and all unshaded regions are congruent.  Based on above information, answer the following questions : (i) Find the radius of each circular ring. (ii) What is the measure of $\angle AOB$? (iii) (a) Find the area of shaded region R_1. **OR** (iii) (b) Find the length of rope around the unshaded regions.	
Sol.	(i) $2 \times \frac{22}{7} \times r = 44$ $\Rightarrow r = 7$ m (ii) $\angle AOB = 60°$ (iii) (a) Area of shaded region R_1 = area of circle – area of 2 segments $= \frac{22}{7} \times 7 \times 7 - 2 \times \left(\frac{60}{360} \times \frac{22}{7} \times 7 \times 7 - \frac{\sqrt{3}}{4} \times 7 \times 7\right)$ $= \left(\frac{308}{3} + \frac{49\sqrt{3}}{2}\right)$ m^2 or 145.05 m^2 (approx.) **OR** (iii) (b) Length of rope around unshaded regions $= 8 \times$ length of arc $= 8 \times \frac{60}{360} \times 2 \times \frac{22}{7} \times 7$ $= \frac{176}{3}$ m or 58.66 m (approx.)	½ ½ **1** **1** **1** ½ **1** ½

37.

Cable cars at hill stations are one of the major tourist attractions. On a hill station, the length of cable car ride from base point to top most point on the hill is 5000 m. Poles are installed at equal intervals on the way to provide support to the cables on which car moves.

The distance of first pole from base point is 200 m and subsequent poles are installed at equal interval of 150 m. Further, the distance of last pole from the top is 300 m.

Based on above information, answer the following questions using Arithmetic Progression :

(i) Find the distance of 10^{th} pole from the base.

(ii) Find the distance between 15^{th} pole and 25^{th} pole.

(iii) (a) Find the time taken by cable car to reach 15^{th} pole from the top if it is moving at the speed of 5m/sec and coming from top.

OR

(iii) (b) Find the total number of poles installed along the entire journey.

Sol.

AP formed is $200, 350, 500, ...$

(i) Distance of 10^{th} pole from base $= a_{10}$

$= 200 + 9 \times 150$

$= 1550$ m **1**

(ii) Distance between 15^{th} pole and 25^{th} pole $= a_{25} - a_{15}$

$= 10 \times 150 = 1500$ m **1**

(iii) (a) Distance of 15^{th} pole from the top $= 300 + 14 \times 150$

$= 2400$ m **1**

Time taken by cable car $= \frac{2400}{5} = 480$ seconds or 8 minutes **1**

OR

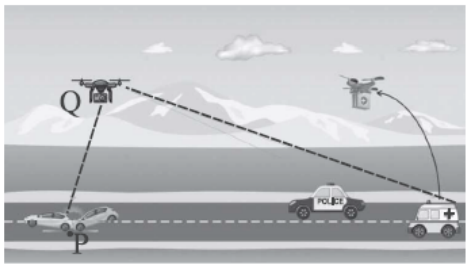
(iii) (b) Distance of last pole from the base $= (5000 - 300)$ m $= 4700$ m ½

$\therefore\ a_n = 4700$

$\Rightarrow 200 + (n - 1)150 = 4700$ **1**

Solving, we get $n = 31$ ½

38. A drone was used to facilitate movement of an ambulance on the straight highway to a point P on the ground where there was an accident.



The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point Q, 100 m vertically above the point P. The angle of depression of the ambulance was found to be 30° at a particular instant.

Based on above information, answer the following questions :

(i) Represent the above situation with the help of a diagram.

(ii) Find the distance between the ambulance and the site of accident (P) at the particular instant. (Use $\sqrt{3} = 1.73$)

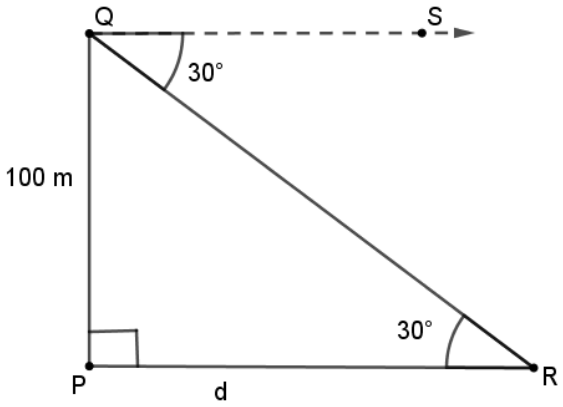
(iii) (a) Find the time (in seconds) in which the angle of depression changes from 30° to 45°.

OR

(iii) (b) How long (in seconds) will the ambulance take to reach point P from a point T on the highway such that angle of depression of the ambulance at T is 60° from the drone ?

Sol.

(i)

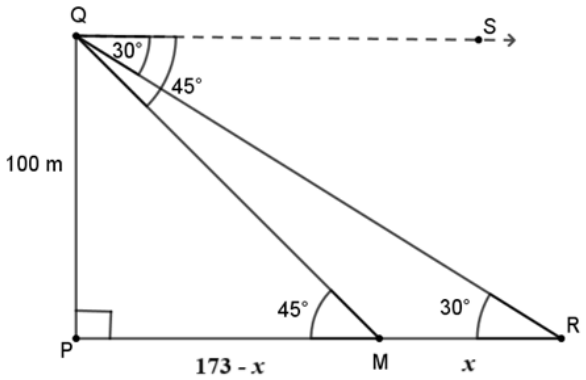


For correct figure **1**

(ii) In Δ PQR, $\frac{100}{d} = \tan 30° = \frac{1}{\sqrt{3}}$ ½

$\Rightarrow d = 100\sqrt{3} = 173$ m ½

(iii) (a)



For correct figure ½

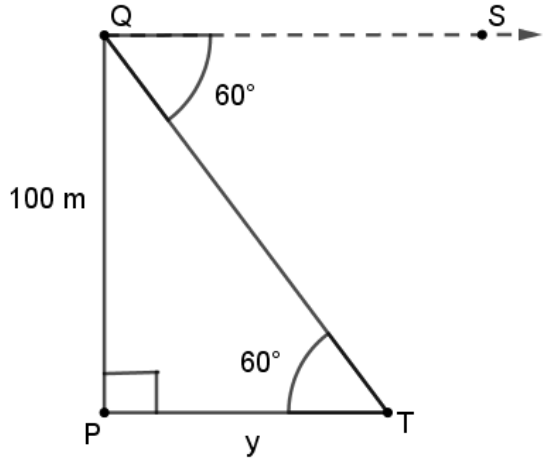
In Δ PQM, $\frac{100}{173-x} = \tan 45° = 1$ ½

$\Rightarrow x = 73$ m ½

Time taken $= \frac{73\times18}{60\times5} = \frac{219}{50}$ or 4.4 seconds (approx.) ½

OR

(iii) (b)



For correct figure ½

In Δ PQT, $\frac{100}{y} = \tan 60° = \sqrt{3}$ ½

$\Rightarrow$ y = $\frac{100}{\sqrt{3}} = \frac{100\sqrt{3}}{3}$ or $\frac{173}{3}$ m ½

Time taken $= \frac{100\sqrt{3}\times18}{3\times60\times5} = 2\sqrt{3}$ or 3.5 seconds (approx.) ½

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **FIVE** Sections – **A, B, C, D** and **E**.*

(iii) *In Section–**A**, question numbers **1** to **18** are Multiple Choice Questions (MCQs) and question numbers **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section–**B**, question numbers **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In Section–**C**, question numbers **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In Section–**D**, question numbers **32** to **35** are Long Answer (LA) type questions, carrying **5** marks each.*

(vii) *In Section–**E**, question numbers **36** to **38** are Case Study based integrated questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in **2** questions in Section–**B**, **2** questions in Section–**C**, **2** questions in Section–**D** and **3** questions of **2** marks in Section–**E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **NOT** allowed.*

• • •

SECTION – A

This section consists of 20 multiple choice questions of 1 mark each.

1. $\left(\sqrt{3}+2\right)^2+\left(\sqrt{3}-2\right)^2$ is a/an **1**

(A) positive rational number (B) negative rational number

(C) positive irrational number (D) negative irrational number

2. Let $x = a^2 b^3 c^n$ and $y = a^3 b^m c^2$, where a, b, c are prime numbers. If LCM of x and y is $a^3 b^4 c^3$, then the value of m + n is **1**

(A) 10 (B) 7

(C) 6 (D) 5

3. For any prime number p, if p divides a^2, where a is any real number then p also divides **1**

(A) a (B) $a^{\frac{1}{2}}$

(C) $a^{\frac{3}{2}}$ (D) $a^{\frac{1}{8}}$

4. Which of the following equations is a quadratic equation ? **1**

(A) $x^2 + 1 = (x - 1)^2$ (B) $\left(x+\sqrt{x}\right)^2 = 2x\sqrt{x}$

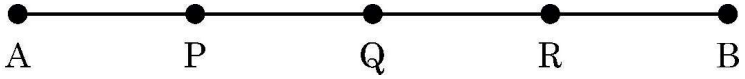
(C) $x^3 + 3x^2 = (x + 1)^3$ (D) $(x + 1)(x - 1) = (x + 1)^2$

5. If $x^2 + bx + b = 0$ has two real and distinct roots, then the value of b can be **1**

(A) 0 (B) 4

(C) 3 (D) –3

6. In the figure given below, points P, Q, R divides the line segment AB in four equal parts. **1**



The point Q divides PB in the ratio

(A) 1 : 3 (B) 2 : 3

(C) 1 : 2 (D) 1 : 1

• • •

7. A bag contains red balls and black balls in the ratio 3 : 7. A ball is drawn at random. The probability that ball so drawn is black in colour, is **1**

(A) $\frac{3}{7}$ (B) 0.3

(C) 0.7 (D) $\frac{1}{7}$

8. Which of the following statements is false ? **1**

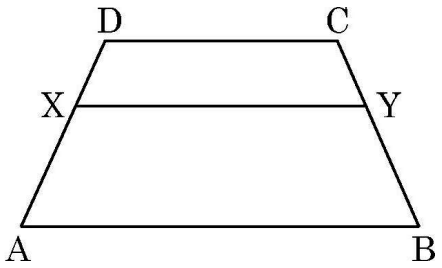
(A) Two right triangles are always similar.

(B) Two squares are always similar.

(C) Two equilateral triangles are always similar.

(D) Two circles are always similar.

9. In the adjoining figure, ABCD is a trapezium in which XY || AB || CD. If $AX = \frac{2}{3}AD$, then CY : YB = **1**



(A) 2 : 3 (B) 3 : 2

(C) 1 : 3 (D) 1 : 2

10. Which of the following statements is false ? **1**

(A) Infinite number of tangents can be drawn to a circle.

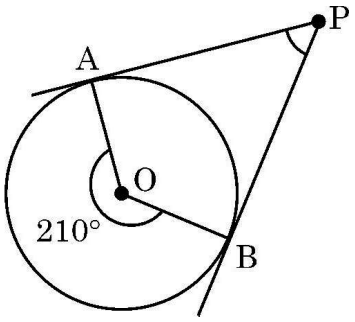
(B) Infinite number of tangents can be drawn to a circle from a point outside the circle.

(C) Infinite number of secants can be drawn to a circle from a point outside the circle.

(D) Angle between tangent and diameter at point of contact is 90°.

• • •

11. In the adjoining figure, PA and PB are tangents to a circle with centre O. The measure of angle APB is **1**



(A) 210° (B) 150°
(C) 105° (D) 30°

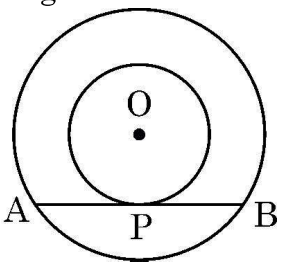
12. $\frac{1-\tan^2 30^\circ}{1+\tan^2 30^\circ}$ is equal to **1**

(A) $\sin 60^\circ$ (B) $\cos 60^\circ$
(C) $\tan 60^\circ$ (D) $\sec 60^\circ$

13. An observer 1.8 m tall stands away from a chimney at a distance of 38.2 m along the ground. The angle of elevation of top of chimney from the eyes of observer is 45°. The height of chimney above the ground is **1**

(A) 38.2 m (B) 36.4 m
(C) 40 m (D) $(38.2)\sqrt{2}$ m

14. In the adjoining figure, the sum of radii of two concentric circles is 16 cm. The length of chord AB which touches the inner circle at P is 16 cm. The difference of the radii of the given circles is **1**



(A) 8 cm (B) 4 cm
(C) 2 cm (D) 3 cm

15. A cone of height 12 cm and slant height 13 cm is surmounted on a hemisphere having radius equal to that of cone. The entire height of the solid is **1**

(A) 17 cm (B) 18 cm
(C) 22 cm (D) 23 cm

• • •

16. If x median + y mean = z mode; is the empirical relationship between mean, median and mode, then the value of $x + y + z$ is **1**

(A) 6 (B) 3

(C) 2 (D) 1

17. Following data shows the marks obtained by 100 students in a class test : **1**

Marks obtained	20	29	28	33	42	38	43	25
Number of students	6	28	24	15	2	4	1	20

The median will be the average of which two observations ?

(A) 29 and 33 (B) 25 and 28

(C) 28 and 29 (D) 33 and 38

18. The probability of getting a composite number greater than 3 on throwing a die is **1**

(A) $\frac{1}{6}$ (B) $\frac{1}{3}$

(C) $\frac{1}{2}$ (D) $\frac{2}{3}$

Directions : In Question Numbers **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option from following :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. **Assertion (A) :** For an acute angle θ, $\sin\theta = \frac{3}{5} \Rightarrow \cos\theta = -\frac{4}{5}$.

Reason (R) : For any value of θ, $(0^\circ \leq \theta \leq 90^\circ)$

$\sin^2\theta + \cos^2\theta = 1$. **1**

20. **Assertion (A) :** For an A.P., 3,6,9, ..., 198, 10^{th} term from the end is 168.

Reason (R) : If 'a' and 'l' are the first term and last term of an A.P. with common difference 'd', then n^{th} term from the end of the given A.P. is $l - (n - 1)\,d$. **1**

• • •

SECTION – B

This section has 5 very short answer type questions of 2 marks each.

21. (a) The cost of 2 kg apples and 1 kg of grapes on a day was found to be ₹ 320. The cost of 4 kg apples and 2 kg grapes was found to be ₹ 600. If cost of 1 kg of apples and 1 kg of grapes is ₹ x and ₹ y respectively, represent the given situation algebraically as a system of equations and check whether the system so obtained is consistent or not. **2**

OR

(b) Solve for x and y :

$\sqrt{2}\,x + \sqrt{3}\,y = 5$ and

$\sqrt{3}\,x - \sqrt{8}\,y = -\sqrt{6}$ **2**

22. The coordinates of the end points of the line segment AB are A(–2, –2) and B(2, –4). P is the point on AB such that $BP = \frac{4}{7}AB$. Find the coordinates of point P. **2**

23. (a) It is given that sin (A – B) = sin A cos B – cos A sin B. Use it to find the value of sin 15°. **2**

OR

(b) If sin A = y, then express cos A and tan A in terms of y. **2**

24. AD and PS are medians of triangles ABC and PQR respectively such that $\Delta ABD \sim \Delta PQS$. Prove that $\Delta ABC \sim \Delta PQR$. **2**

25. While shuffling a pack of 52 cards, one card was accidently dropped. Find the probability that the dropped card

(i) is not a face card.

(ii) is a black king. **2**

• • •

SECTION – C

This section has 6 short answer type questions of 3 marks each.

26. (a) Prove that $\sqrt{3}$ is an irrational number. **3**

OR

(b) State true or false for each of the following statements and justify in each case : **3**

(i) $2 \times 3 \times 5 \times 7 + 7$ is a composite number.

(ii) $2 \times 3 \times 5 \times 7 + 1$ is a composite number.

27. Obtain the zeroes of the polynomial $7x^2 + 18x - 9$. Hence, write a polynomial each of whose zeroes is twice the zeroes of given polynomial. **3**

28. Solve the following system of equations graphically : **3**

$2x - y - 2 = 0$

$-4x + y + 4 = 0$

Also, find the absolute difference between the ordinates of the points where given lines cut y – axis.

29. Find a relation between x and y such that P(x, y) is equidistant from the points A(3, 5) and B(7, 1). Hence, write the coordinates of the points on x-axis and y-axis which are equidistant from points A and B. **3**

30. (a) Prove the following trigonometric identity : **3**

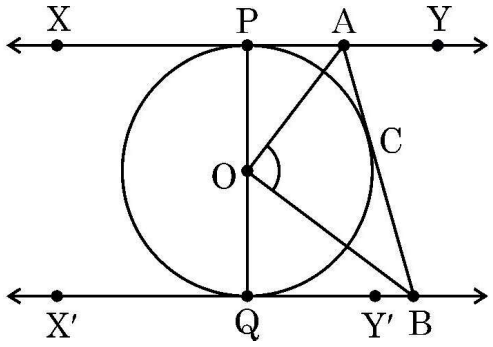
$$\frac{1 + \text{cosec A}}{\text{cosec A}} = \frac{\cos^2 A}{1 - \sin A}$$

OR

(b) Let 2A + B and A + 2B be acute angles such that $\sin(2A + B) = \frac{\sqrt{3}}{2}$ and $\tan(A + 2B) = 1$. Find the value of $\cot(4A - 7B)$. **3**

• • •

31. In the adjoining figure, XY and X′Y′ are parallel tangents to a circle with centre O. Another tangent AB touches the circle at C intersecting XY at A and X′Y′ at B. Prove that AB subtends right angle at the centre of the circle; or ∠AOB = 90°. **3**



SECTION – D

This section has 4 long answer questions of 5 marks each.

32. (a) A 2-digit number is seven times the sum of its digits and two (2) more than 5 times the product of its digits. Find the number. **5**

OR

(b) Find the value(s) of p for which the quadratic equation given as $(p + 4)\,x^2 - (p + 1)\,x + 1 = 0$ has real and equal roots. Also, find the roots of the equation(s) so obtained. **5**

33. If a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points then it divides the two sides in the same ratio. Prove it.
Also, state the converse of the above statement. **5**

34. (a) From one of the faces of a solid wooden cube of side 14 cm, maximum number of hemispheres of diameter 1.4 cm are scooped out. Find the total number of hemispheres that can be scooped out. Also, find the total surface area of the remaining solid. **5**

OR

(b) From a solid cylinder of height 24 cm and radius 5 cm, two cones of height 12 cm and radius 5 cm are hollowed out. Find the volume and surface area of the remaining solid. **5**

• • •

35. Medical check-up was carried out for 35 students of a class and their weights were recorded as follows : **5**

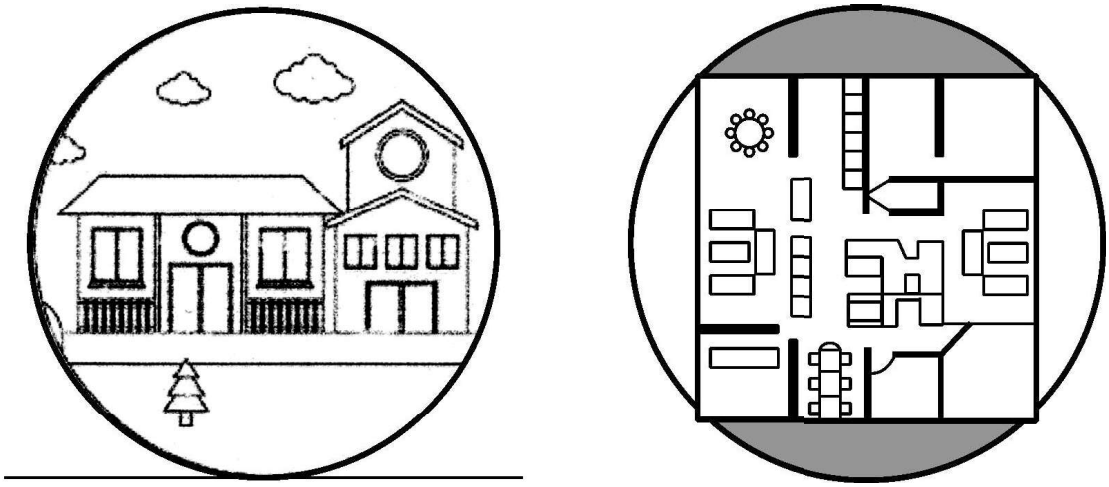
Weight (in kg)	38-40	40-42	42-44	44-46	46-48	48-50	50-52
Number of Students	3	2	4	5	14	4	3

Find the difference between the mean weight and the median weight.

SECTION – E

This section has 3 case study based questions of 4 marks each.

36. A farmer has a circular piece of land. He wishes to construct his house in the form of largest possible square within the land as shown below.



The radius of circular piece of land is 35 m.

Based on given information, answer the following questions :

(i) Find the length of wire needed to fence the entire land. **1**

(ii) Find the length of each side of the square land on which house will be constructed. **1**

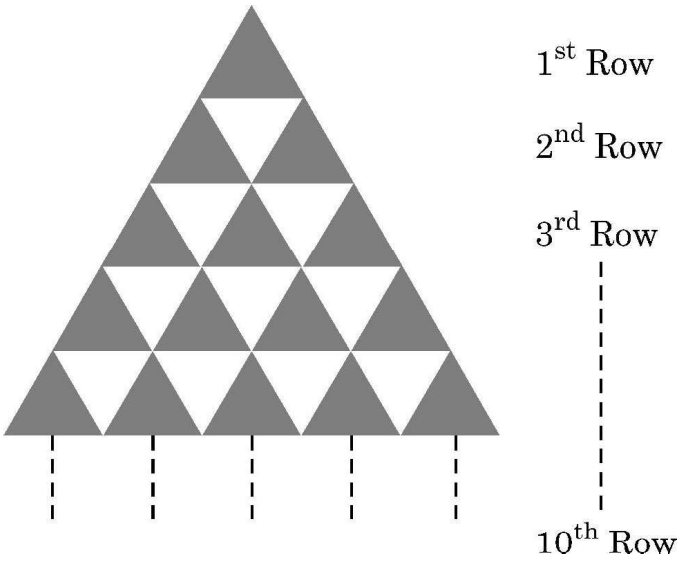
(iii) (a) The farmer wishes to grow grass on the shaded region around the house. Find the cost of growing the grass at the rate of ₹ 50 per square metre. **2**

OR

(iii) (b) Find the ratio of area of land on which house is built to remaining area of circular piece of land. **2**

• • •

37. In an equilateral triangle of side 10 cm, equilateral triangles of side 1 cm are formed as shown in the figure below, such that there is one triangle in the first row, three triangles in the second row, five triangles in the third row and so on.



Based on given information, answer the following questions using Arithmetic Progression.

(i) How many triangles will be there in bottom most row ? **1**

(ii) How many triangles will be there in fourth row from the bottom ? **1**

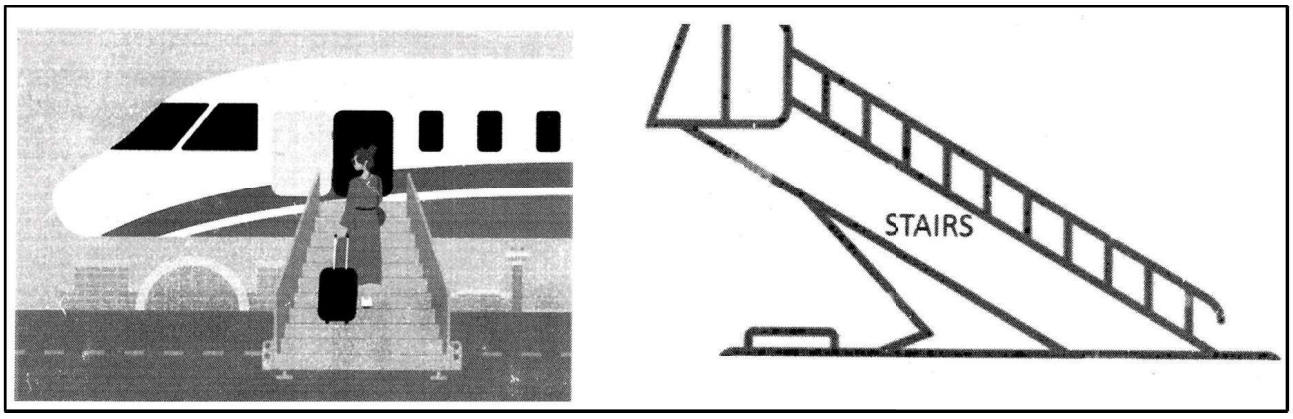
(iii) (a) Find the total number of triangles of side 1 cm each till 8^{th} row. **2**

OR

(iii) (b) How many more number of triangles are there from 5^{th} row to 10^{th} row than in first 4 rows ? Show working. **2**

38. Passenger boarding stairs, sometimes referred to as boarding ramps, stair cars or aircraft steps, provide a mobile means to travel between the aircraft doors and the ground. Larger aircraft have door sills 5 to 20 feet (1 foot = 30 cm) high. Stairs facilitate safe boarding and de-boarding.

• • •



An aircraft has a door sill at a height of 15 feet above the ground. A stair car is placed at a horizontal distance of 15 feet from the plane.

Based on given information, answer the questions given in part (i) and (ii).

(i) Find the angle at which stairs are inclined to reach the door sill 15 feet high above the ground. **1**

(ii) Find the length of stairs used to reach the door sill. **1**

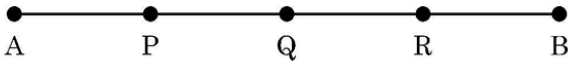
Further, answer any **one** of the following questions :

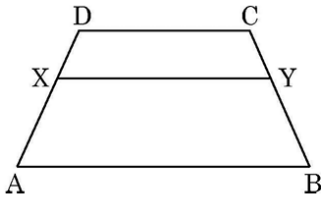
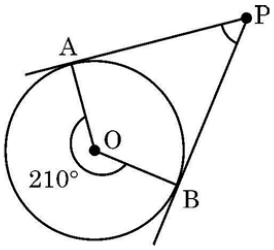
(iii) (a) If the 20 feet long stairs is inclined at an angle of 60° to reach the door sill, then find the height of the door sill above the ground. (use $\sqrt{3} = 1.732$) **2**

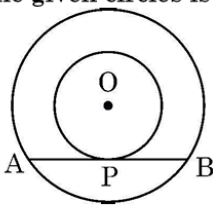
OR

(iii) (b) What should be the shortest possible length of stairs to reach the door sill of the plane 20 feet above the ground, if the angle of elevation cannot exceed 30° ? Also, find the horizontal distance of base of stair car from the plane. **2**

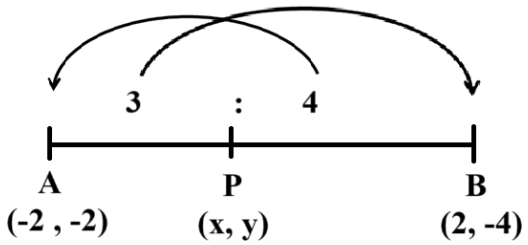
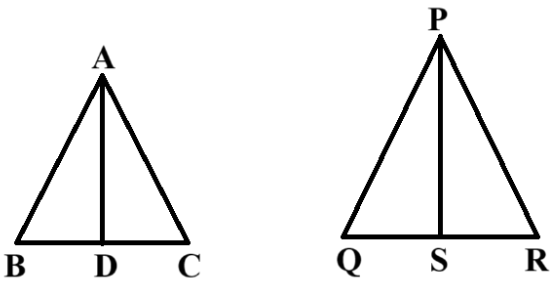
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/5/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **This section consists of 20 multiple choice questions of 1 mark each.**	
1.	$\left(\sqrt{3}+2\right)^2+\left(\sqrt{3}-2\right)^2$ is a/an (A) positive rational number (B) negative rational number (C) positive irrational number (D) negative irrational number	
Sol.	(A) positive rational number	**1**
2.	Let $x = a^2 b^3 c^n$ and $y = a^3 b^m c^2$, where a, b, c are prime numbers. If LCM of x and y is $a^3 b^4 c^3$, then the value of m + n is (A) 10 (B) 7 (C) 6 (D) 5	
Sol.	(B) 7	**1**
3.	For any prime number p, if p divides a^2, where a is any real number then p also divides (A) a (B) $a^{\frac{1}{2}}$ (C) $a^{\frac{3}{2}}$ (D) $a^{\frac{1}{8}}$	
Sol.	(A) a	**1**
4.	Which of the following equations is a quadratic equation ? (A) $x^2 + 1 = (x-1)^2$ (B) $\left(x+\sqrt{x}\right)^2 = 2x\sqrt{x}$ (C) $x^3 + 3x^2 = (x+1)^3$ (D) $(x+1)(x-1) = (x+1)^2$	
Sol.	(B) $\left(x+\sqrt{x}\right)^2 = 2x\sqrt{x}$	**1**
5.	If $x^2 + bx + b = 0$ has two real and distinct roots, then the value of b can be (A) 0 (B) 4 (C) 3 (D) –3	
Sol.	(D) – 3	**1**
6.	In the figure given below, points P, Q, R divides the line segment AB in four equal parts.  The point Q divides PB in the ratio (A) 1 : 3 (B) 2 : 3 (C) 1 : 2 (D) 1 : 1	
Sol.	(C) 1 : 2	**1**
7.	A bag contains red balls and black balls in the ratio 3 : 7. A ball is drawn at random. The probability that ball so drawn is black in colour, is (A) $\frac{3}{7}$ (B) 0.3 (C) 0.7 (D) $\frac{1}{7}$	
Sol.	(C) 0.7	**1**

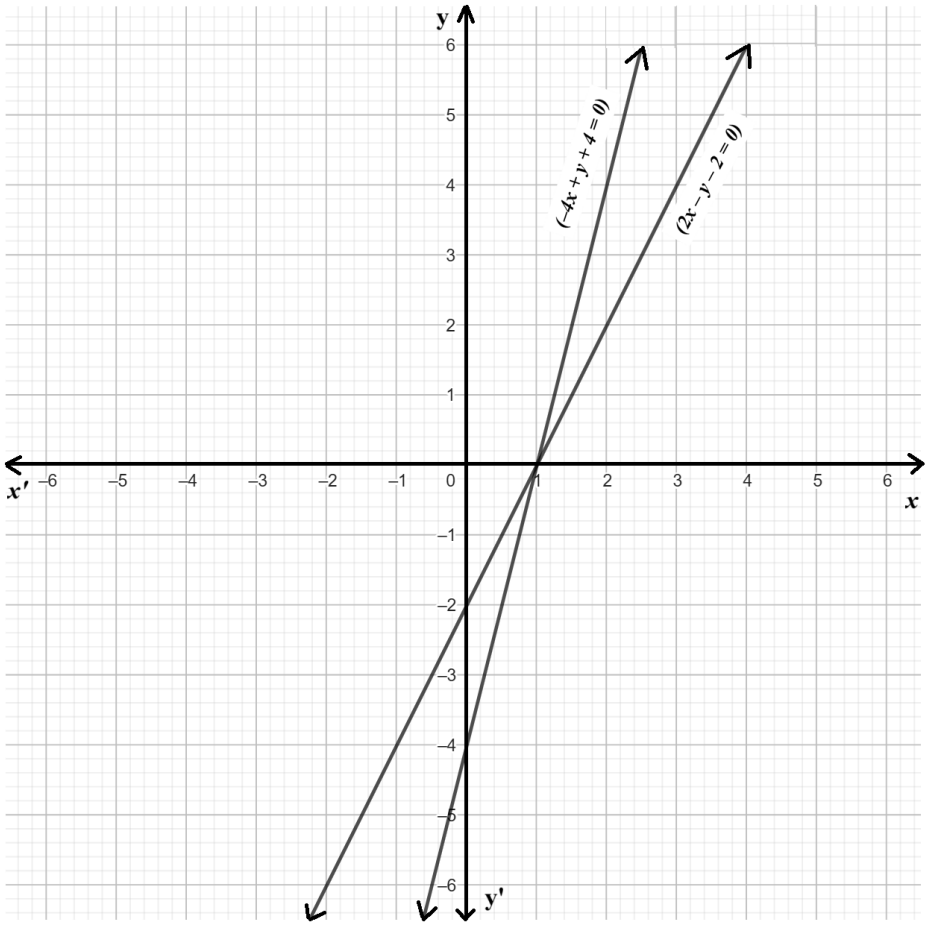
8.	Which of the following statements is false ? (A) Two right triangles are always similar. (B) Two squares are always similar. (C) Two equilateral triangles are always similar. (D) Two circles are always similar.	
Sol.	(A) Two right triangles are always similar.	**1**
9.	In the adjoining figure, ABCD is a trapezium in which XY $\|\|$ AB $\|\|$ CD. If $AX = \frac{2}{3}AD$, then CY : YB =  (A) 2 : 3 (B) 3 : 2 (C) 1 : 3 (D) 1 : 2	
Sol.	(D) 1 : 2	**1**
10.	Which of the following statements is false ? (A) Infinite number of tangents can be drawn to a circle. (B) Infinite number of tangents can be drawn to a circle from a point outside the circle. (C) Infinite number of secants can be drawn to a circle from a point outside the circle. (D) Angle between tangent and diameter at point of contact is 90°.	
Sol.	(B) Infinite number of tangents can be drawn to a circle from a point outside the circle.	**1**
11.	In the adjoining figure, PA and PB are tangents to a circle with centre O. The measure of angle APB is  (A) 210° (B) 150° (C) 105° (D) 30°	
Sol.	(D) 30°	**1**
12.	$\frac{1-\tan^2 30^\circ}{1+\tan^2 30^\circ}$ is equal to (A) sin 60° (B) cos 60° (C) tan 60° (D) sec 60°	
Sol.	(B) cos 60°	**1**

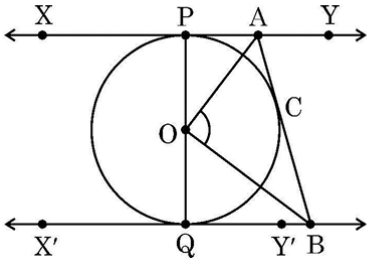
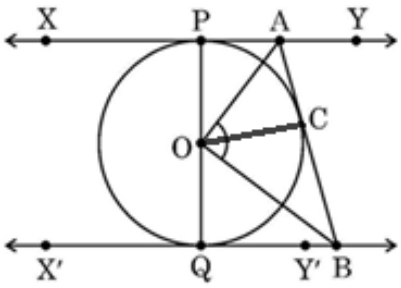
13.	An observer 1.8 m tall stands away from a chimney at a distance of 38.2 m along the ground. The angle of elevation of top of chimney from the eyes of observer is 45°. The height of chimney above the ground is (A) 38.2 m (B) 36.4 m (C) 40 m (D) $(38.2)\sqrt{2}$ m	
Sol.	(C) 40 m	**1**
14.	In the adjoining figure, the sum of radii of two concentric circles is 16 cm. The length of chord AB which touches the inner circle at P is 16 cm. The difference of the radii of the given circles is  (A) 8 cm (B) 4 cm (C) 2 cm (D) 3 cm	
Sol.	(B) 4 cm	**1**
15.	A cone of height 12 cm and slant height 13 cm is surmounted on a hemisphere having radius equal to that of cone. The entire height of the solid is (A) 17 cm (B) 18 cm (C) 22 cm (D) 23 cm	
Sol.	(A) 17 cm	**1**
16.	If x median + y mean = z mode; is the empirical relationship between mean, median and mode, then the value of $x + y + z$ is (A) 6 (B) 3 (C) 2 (D) 1	
Sol.	(C) 2	**1**
17.	Following data shows the marks obtained by 100 students in a class test : **Marks obtained** | 20 | 29 | 28 | 33 | 42 | 38 | 43 | 25 **Number of students** | 6 | 28 | 24 | 15 | 2 | 4 | 1 | 20 The median will be the average of which two observations ? (A) 29 and 33 (B) 25 and 28 (C) 28 and 29 (D) 33 and 38	
Sol.	(C) 28 and 29	**1**
18.	The probability of getting a composite number greater than 3 on throwing a die is (A) $\frac{1}{6}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) $\frac{2}{3}$	
Sol.	(B) $\frac{1}{3}$	**1**

	Directions : In Question Numbers **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option from following : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	**Assertion (A) :** For an acute angle θ, $\sin\theta = \frac{3}{5} \Rightarrow \cos\theta = -\frac{4}{5}$. **Reason (R) :** For any value of θ, $(0^\circ \leq \theta \leq 90^\circ)$ $\sin^2\theta + \cos^2\theta = 1$.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
20	**Assertion (A) :** For an A.P., 3,6,9, …, 198, 10^{th} term from the end is 168. **Reason (R) :** If 'a' and 'l' are the first term and last term of an A.P. with common difference 'd', then n^{th} term from the end of the given A.P. is $l - (n - 1)\,d$.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
	SECTION B **This section has 5 very short answer type questions of 2 marks each.**	
21 (a)	The cost of 2 kg apples and 1 kg of grapes on a day was found to be ₹ 320. The cost of 4 kg apples and 2 kg grapes was found to be ₹ 600. If cost of 1 kg of apples and 1 kg of grapes is ₹ x and ₹ y respectively, represent the given situation algebraically as a system of equations and check whether the system so obtained is consistent or not.	
Sol.	$2x + y = 320$ $4x + 2y = 600$ Here, $\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{1}{2}, \frac{c_1}{c_2} = \frac{320}{600} = \frac{8}{15}$ As $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2} \therefore$ System of equations is not consistent.	½ ½ ½ ½
	OR	
21 (b)	Solve for x and y : $\sqrt{2}\,x + \sqrt{3}\,y = 5$ and $\sqrt{3}\,x - \sqrt{8}\,y = -\sqrt{6}$	
Sol.	$(\sqrt{2}\,x + \sqrt{3}y = 5) \times \sqrt{3} \Rightarrow \sqrt{6}\,x + 3y = 5\sqrt{3}$ $(\sqrt{3}\,x - \sqrt{8}y = -\sqrt{6}) \times \sqrt{2} \Rightarrow \sqrt{6}\,x - 4y = -2\sqrt{3}$ Solving the equations, we get $x = \sqrt{2}$ and $y = \sqrt{3}$	½ ½ ½ + ½

22.	The coordinates of the end points of the line segment AB are A(–2, –2) and B(2, –4). P is the point on AB such that BP = $\frac{4}{7}$ AB. Find the coordinates of point P.	
Sol.	 P (x, y) divides AB in the ratio 3: 4 $x = \frac{3\times 2 + 4\times(-2)}{4+3} \Rightarrow x = -\frac{2}{7}$ $y = \frac{3\times(-4) + 4\times(-2)}{4+3} \Rightarrow y = -\frac{20}{7}$ ∴ Coordinates of P are $\left(-\frac{2}{7}, -\frac{20}{7}\right)$	½ ½ ½ ½
23 (a)	It is given that sin (A – B) = sin A cos B – cos A sin B. Use it to find the value of sin 15°.	
Sol.	sin 15° = sin (45° – 30°) = sin 45° cos 30° – cos 45° sin 30° $= \frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\times\frac{1}{2}$ $= \frac{\sqrt{3}-1}{2\sqrt{2}}$ or $\frac{\sqrt{6}-\sqrt{2}}{4}$	½ **1** ½
	OR	
23 (b)	If sin A = y, then express cos A and tan A in terms of y.	
Sol.	$\cos A = \sqrt{1-\sin^2 A} = \sqrt{1-y^2}$ $\tan A = \frac{\sin A}{\cos A} = \frac{y}{\sqrt{1-y^2}}$	**1** **1**
24.	AD and PS are medians of triangles ABC and PQR respectively such that ΔABD ~ ΔPQS. Prove that ΔABC ~ ΔPQR.	
Sol.	Correct figure  Since Δ ABD ~ Δ PQS ∴ $\frac{AB}{PQ} = \frac{BD}{QS}$ or $\frac{AB}{PQ} = \frac{2BD}{2QS}$	½

	$\Rightarrow \frac{AB}{PQ} = \frac{BC}{QR}$	½
	$\angle B = \angle Q$	½
	$\therefore \quad \Delta ABC \sim \Delta PQR$	½
25.	While shuffling a pack of 52 cards, one card was accidently dropped. Find the probability that the dropped card (i) is not a face card. (ii) is a black king.	
Sol.	(i) P (not a face card) = $\frac{40}{52}$ or $\frac{10}{13}$	**1**
	(ii) P (black king) = $\frac{2}{52}$ or $\frac{1}{26}$	**1**
	SECTION C **This section has 6 short answer type questions of 3 marks each.**	
26 (a)	Prove that $\sqrt{3}$ is an irrational number.	
Sol.	Let $\sqrt{3}$ be a rational number. $\therefore \sqrt{3} = \frac{p}{q}$, where $q \neq 0$ and let p & q be coprimes. $\Rightarrow 3q^2 = p^2$ $\Rightarrow p^2$ is divisible by 3. $\Rightarrow$ p is divisible by 3. ----- ① Let p = 3a, where 'a' is some integer $\therefore 9a^2 = 3q^2$ $\Rightarrow q^2 = 3a^2$ $\Rightarrow q^2$ is divisible by 3 $\Rightarrow$ q is divisible by 3 ----- ② $\therefore$ 3 divides both p & q. ① and ② leads to contradiction as p and q are coprimes. Hence, $\sqrt{3}$ is an irrational number.	½ **1** **1** ½
	OR	
26 (b)	State true or false for each of the following statements and justify in each case : (i) $2 \times 3 \times 5 \times 7 + 7$ is a composite number. (ii) $2 \times 3 \times 5 \times 7 + 1$ is a composite number.	
Sol.	(i) True, $\because 2 \times 3 \times 5 \times 7 + 7 = 7 \times (2 \times 3 \times 5 + 1)$ has more than two factors. (ii) False, $\because 2 \times 3 \times 5 \times 7 + 1 = 211$ has only two factors.	**1** ½ **1** ½
27.	Obtain the zeroes of the polynomial $7x^2 + 18x - 9$. Hence, write a polynomial each of whose zeroes is twice the zeroes of given polynomial.	
Sol.	$7x^2 + 18x - 9$ $= (7x - 3)(x + 3)$ $\therefore$ Zeroes are $-3, \frac{3}{7}$	 **1**

	New zeroes are $-6, \frac{6}{7}$	½
	Sum of new zeroes = $(-6) + \frac{6}{7} = -\frac{36}{7}$	½
	Product of new zeroes = $(-6) \times \frac{6}{7} = -\frac{36}{7}$	½
	∴ Required polynomial is $x^2 + \frac{36}{7}x - \frac{36}{7}$ or $7x^2 + 36x - 36$	½
28.	Solve the following system of equations graphically : $2x - y - 2 = 0$ $-4x + y + 4 = 0$ Also, find the absolute difference between the ordinates of the points where given lines cut y – axis.	
Sol.	Correct graph  Solution is (1, 0) or $x = 1, y = 0$ Absolute difference = 2 (consider – 2 also)	**2** ½ ½
29.	Find a relation between x and y such that P(x, y) is equidistant from the points A(3, 5) and B(7, 1). Hence, write the coordinates of the points on x-axis and y-axis which are equidistant from points A and B.	
Sol.	$PA = PB \Rightarrow PA^2 = PB^2$ $(x - 3)^2 + (y - 5)^2 = (x - 7)^2 + (y - 1)^2$ $\Rightarrow x - y = 2$ ∴ Required point on x-axis is (2, 0) & required point on y-axis is (0, – 2)	½ **1** ½ ½ ½

30 (a)	Prove the following trigonometric identity : $\frac{1 + \text{cosec A}}{\text{cosec A}} = \frac{\cos^2 A}{1 - \sin A}$	
Sol.	LHS = $\frac{1 + \frac{1}{\sin A}}{\frac{1}{\sin A}}$ $= \sin A + 1$ $= \frac{(\sin A + 1)(1 - \sin A)}{1 - \sin A}$ $= \frac{1 - \sin^2 A}{1 - \sin A}$ $= \frac{\cos^2 A}{1 - \sin A}$ = RHS	½ **1** ½ ½ ½
	OR	
30 (b)	Let 2A + B and A + 2B be acute angles such that $\sin(2A + B) = \frac{\sqrt{3}}{2}$ and tan(A + 2B) = 1. Find the value of cot(4A – 7B).	
Sol.	$\sin (2A + B) = \frac{\sqrt{3}}{2} \Rightarrow 2A + B = 60°$ --- ① $\tan (A + 2B) = 1 \Rightarrow A + 2B = 45°$ --- ② Solving ① & ②, we get A = 25° and B = 10° cot (4A – 7B) = cot 30° $= \sqrt{3}$	½ ½ ½ + ½ ½ ½
31.	In the adjoining figure, XY and X′Y′ are parallel tangents to a circle with centre O. Another tangent AB touches the circle at C intersecting XY at A and X′Y′ at B. Prove that AB subtends right angle at the centre of the circle; or ∠AOB = 90°. 	
Sol.	Join OC.  ΔPOA ≅ ΔCOA ∠POA = ∠COA Similarly, ∠QOB = ∠COB ∠POA + ∠QOB + ∠COA + ∠COB = 180°	½ ½ ½ ½ ½

	$\Rightarrow 2(\angle COA + \angle COB) = 180°$ $\Rightarrow \angle COA + \angle COB = 90°$ $\therefore \quad \angle AOB = 90°$	 ½
	SECTION D **This section has 4 long answer questions of 5 marks each.**	
32 (a)	A 2-digit number is seven times the sum of its digits and two (2) more than 5 times the product of its digits. Find the number.	
Sol.	Let digit at unit place be x and digit at tens place be y $\therefore$ number = 10y + x ATQ $10y + x = 7(x + y)$ $\Rightarrow \quad 3y = 6x$ or $y = 2x$ --- ① Also, $10y + x = 5xy + 2$ --- ② from ① and ②, we get $10x^2 - 21x + 2 = 0$ $\Rightarrow \quad (x - 2)(10x - 1) = 0$ $\therefore x = 2$ So, y = 4 $\therefore$ Required number is 42.	**1** **1** ½ **1** ½ ½ ½
	OR	
32 (b)	Find the value(s) of p for which the quadratic equation given as $(p + 4)x^2 - (p + 1)x + 1 = 0$ has real and equal roots. Also, find the roots of the equation(s) so obtained.	
Sol.	For real and equal roots, D = 0 $\therefore \quad [-(p + 1)]^2 - 4(p + 4) = 0$ $\Rightarrow p^2 - 2p - 15 = 0$ $\Rightarrow (p - 5)(p + 3) = 0$ $\therefore p = 5, -3$ For p = 5, $9x^2 - 6x + 1 = 0$ $\Rightarrow (3x - 1)(3x - 1) = 0$ $\therefore x = \frac{1}{3}, \frac{1}{3}$ For p = – 3, $x^2 + 2x + 1 = 0$ $\Rightarrow (x + 1)(x + 1) = 0$ $\therefore x = -1, -1$ Hence roots are $\frac{1}{3}, \frac{1}{3}$ and – 1, – 1 for p = 5 and p = – 3 respectively.	½ ½ **1** **1** **1** **1**

33.	If a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points then it divides the two sides in the same ratio. Prove it. Also, state the converse of the above statement.	
Sol.	Correct figure, given, to prove, construction Correct proof Correct statement of converse of given statement	**2** **2** **1**
34 (a)	From one of the faces of a solid wooden cube of side 14 cm, maximum number of hemispheres of diameter 1.4 cm are scooped out. Find the total number of hemispheres that can be scooped out. Also, find the total surface area of the remaining solid.	
Sol.	Total number of hemispheres = $\frac{14 \times 14}{1.4 \times 1.4}$ = 100 Total Surface Area of remaining solid = Surface Area of Cube + Curved Surface Area of 100 hemispheres – Area of 100 circles $= 6 \times 14 \times 14 + 100 \times 2 \times \frac{22}{7} \times 0.7 \times 0.7 - 100 \times \frac{22}{7} \times 0.7 \times 0.7$ = 1330 ∴ Total surface area of remaining solid is 1330 cm^2.	**1** **1** **2** **1**
	OR	
34 (b)	From a solid cylinder of height 24 cm and radius 5 cm, two cones of height 12 cm and radius 5 cm are hollowed out. Find the volume and surface area of the remaining solid.	
Sol.	Volume of remaining solid = Volume of cylinder –Volume of two cones $= \frac{22}{7} \times 5 \times 5 \times 24 - 2 \times \frac{1}{3} \times \frac{22}{7} \times 5 \times 5 \times 12$ $= \frac{8800}{7}$ or 1257.14 cm^3 approx. $l = \sqrt{(12)^2 + (5)^2}$ = 13 cm Surface Area of remaining solid = Curved Surface Area of cylinder + Curved Surface Area of two cones $= 2 \times \frac{22}{7} \times 5 \times 24 + 2 \times \frac{22}{7} \times 5 \times 13$ $= \frac{8140}{7}$ or 1162.85 cm^2 approx.	**1** **1** **1** **1** **1**

35. Medical check-up was carried out for 35 students of a class and their weights were recorded as follows :

Weight (in kg)	38-40	40-42	42-44	44-46	46-48	48-50	50-52
Number of Students	3	2	4	5	14	4	3

Find the difference between the mean weight and the median weight.

Sol.

Weight (in kg)	Number of Students (f_i)	x_i	$u_i = \frac{x_i - 45}{2}$	$f_i u_i$	cf
38 – 40	3	39	– 3	– 9	3
40 – 42	2	41	– 2	– 4	5
42 – 44	4	43	– 1	– 4	9
44 – 46	5	45 = a	0	0	14
46 – 48	14	47	1	14	28
48 – 50	4	49	2	8	32
50 – 52	3	51	3	9	35
Total	35			14	

Correct table **1½**

Mean = $45 + \frac{14}{35} \times 2$ **1**

$= 45.8$ ½

∴ Mean weight is 45.8 kg

Median Class is 46 – 48 ½

Median = $46 + \frac{\frac{35}{2} - 14}{14} \times 2$ ½

$= 46.5$ ½

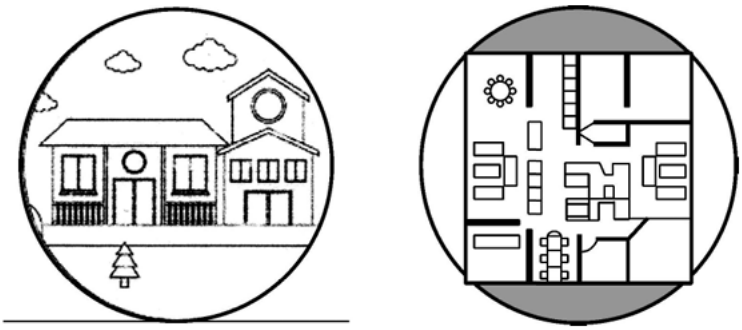
∴ Median weight is 46.5 kg

Difference of mean weight and median weight = 46.5 – 45.8 = 0.7 kg ½

SECTION E

This section has 3 case study based questions of 4 marks each.

36. A farmer has a circular piece of land. He wishes to construct his house in the form of largest possible square within the land as shown below.



The radius of circular piece of land is 35 m.

Based on given information, answer the following questions :

(i) Find the length of wire needed to fence the entire land.

(ii) Find the length of each side of the square land on which house will be constructed.

(iii) (a) The farmer wishes to grow grass on the shaded region around the house. Find the cost of growing the grass at the rate of ₹ 50 per square metre.

OR

(iii) (b) Find the ratio of area of land on which house is built to remaining area of circular piece of land.

Sol.

(i) Length of wire = $2 \times \frac{22}{7} \times 35$ ½

= 220 m ½

(ii) Diagonal of square = 70 m ½

Length of each side of the square land = $\frac{70}{\sqrt{2}}$ or $35\sqrt{2}$ m ½

(iii) (a) Area on which grass is grown = Area of two segments

$= 2 \times \left[\frac{90}{360} \times \frac{22}{7} \times 35 \times 35 - \frac{1}{2} \times 35 \times 35\right]$ **1**

= 700 m^2 ½

Cost of growing the grass = 700 × 50 = ₹ 35000 ½

OR

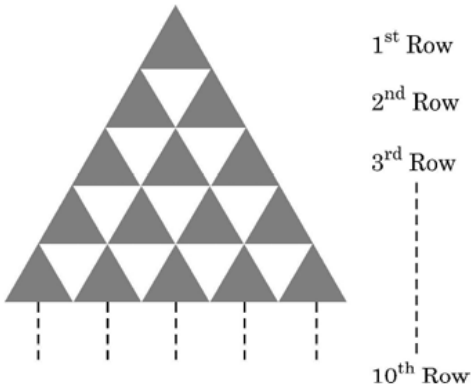
(iii) (b) Required ratio = $\frac{\text{area of square}}{\text{area of circle} - \text{area of square}}$

$= \frac{35\sqrt{2} \times 35\sqrt{2}}{\frac{22}{7} \times 35 \times 35 - 35\sqrt{2} \times 35\sqrt{2}}$ **1½**

$= \frac{2450}{1400}$ or $\frac{7}{4}$ ½

∴ Required ratio is 7 : 4

37. In an equilateral triangle of side 10 cm, equilateral triangles of side 1 cm are formed as shown in the figure below, such that there is one triangle in the first row, three triangles in the second row, five triangles in the third row and so on.



Based on given information, answer the following questions using Arithmetic Progression.

(i) How many triangles will be there in bottom most row ?

(ii) How many triangles will be there in fourth row from the bottom ?

(iii) (a) Find the total number of triangles of side 1 cm each till 8^{th} row.

OR

(iii) (b) How many more number of triangles are there from 5^{th} row to 10^{th} row than in first 4 rows ? Show working.

Sol. Given A.P. is 1, 3, 5, …

(i) $a_{10} = 1 + 9 \times 2 = 19$ **1**

(ii) a_4 (from bottom) $= 19 + 3 \times (-2) = 13$ **1**

(iii) (a) $S_8 = \frac{8}{2} \times [2 \times 1 + 7 \times 2]$ **1**

$= 64$ **1**

OR

(iii) (b) Number of triangles from 5^{th} row to 10^{th} row $= S_{10} - S_4$

$= \frac{10}{2} \times [2 \times 1 + 9 \times 2] - \frac{4}{2} \times [2 \times 1 + 3 \times 2]$

$= 84$ **1**

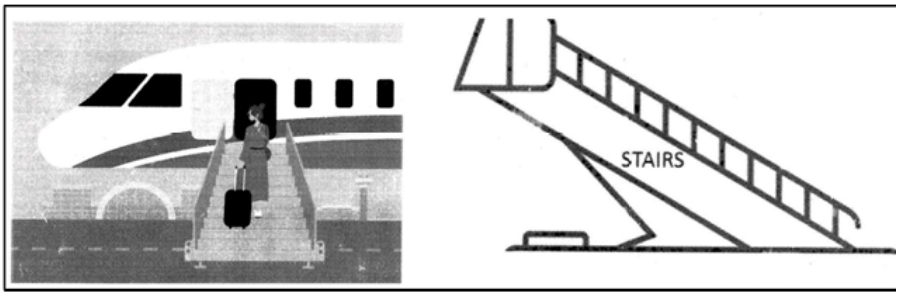
Number of triangles in first 4 rows, $S_4 = \frac{4}{2} \times [2 \times 1 + 3 \times 2]$

$= 16$ ½

Required number of triangles $= 84 - 16 = 68$ ½

38.

Passenger boarding stairs, sometimes referred to as boarding ramps, stair cars or aircraft steps, provide a mobile means to travel between the aircraft doors and the ground. Larger aircraft have door sills 5 to 20 feet (1 foot = 30 cm) high. Stairs facilitate safe boarding and de-boarding.



An aircraft has a door sill at a height of 15 feet above the ground. A stair car is placed at a horizontal distance of 15 feet from the plane.

Based on given information, answer the questions given in part (i) and (ii).

(i) Find the angle at which stairs are inclined to reach the door sill 15 feet high above the ground.

(ii) Find the length of stairs used to reach the door sill.

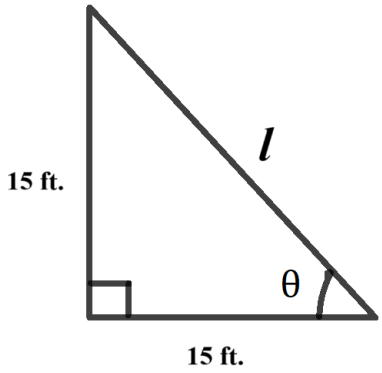
Further, answer any **one** of the following questions :

(iii) (a) If the 20 feet long stairs is inclined at an angle of 60° to reach the door sill, then find the height of the door sill above the ground. (use $\sqrt{3} = 1.732$)

OR

(iii) (b) What should be the shortest possible length of stairs to reach the door sill of the plane 20 feet above the ground, if the angle of elevation cannot exceed 30° ? Also, find the horizontal distance of base of stair car from the plane.

Sol.



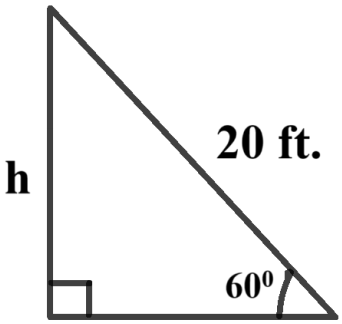
(i) $\tan\theta = \frac{15}{15} = 1$ ½

$\Rightarrow \theta = 45°$ ½

(ii) $\frac{15}{l} = \sin 45°$ ½

$\Rightarrow l = 15\sqrt{2}$ ft. or 21.21 ft. approx. ½

(iii) (a)



$\frac{h}{20} = \sin 60° = \frac{\sqrt{3}}{2}$ **1**

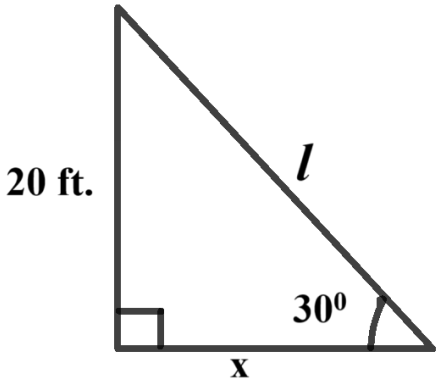
$\Rightarrow h = 10\sqrt{3}$ ½

$= 10 \times 1.732$

$= 17.32$ ft. ½

OR

(iii) (b)



$\frac{20}{l} = \sin 30° = \frac{1}{2}$ ½

$\Rightarrow l = 40$ ft. ½

$\frac{20}{x} = \tan 30° = \frac{1}{\sqrt{3}}$ ½

$\Rightarrow x = 20\sqrt{3}$ ft. or 34.64 ft. approx. ½

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **FIVE** Sections – **A, B, C, D** and **E**.*

(iii) *In Section–**A** question numbers **1** to **18** are Multiple Choice Questions (MCQs) and question numbers **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section–**B** question numbers **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In Section–**C** question numbers **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In Section–**D** question numbers **32** to **35** are Long Answer (LA) type questions, carrying **5** marks each.*

(vii) *In Section–**E** question numbers **36** to **38** are **Case Study based integrated** question carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.*

(viii) *There is no overall choice. However, an internal choice has been provided in **2** questions in Section–**B**, **2** questions in Section–**C**, **2** questions in Section–**D** and **3** questions of **2** marks in Section–**E**.*

(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculators is **NOT** allowed.*

• • •

SECTION – A

This section consists of 20 multiple choice questions of 1 mark each.

1. $\sqrt{0.4}$ is a/an **1**

(A) natural number (B) integer

(C) rational number (D) irrational number

2. Which of the following cannot be the unit digit of 8^n, where n is a natural number ? **1**

(A) 4 (B) 2

(C) 0 (D) 6

3. Which of the following quadratic equations has real and equal roots ? **1**

(A) $(x + 1)^2 = 2x + 1$ (B) $x^2 + x = 0$

(C) $x^2 - 4 = 0$ (D) $x^2 + x + 1 = 0$

4. If the zeroes of the polynomial $ax^2 + bx + \frac{2a}{b}$ are reciprocal of each other, then the value of b is **1**

(A) 2 (B) $\frac{1}{2}$

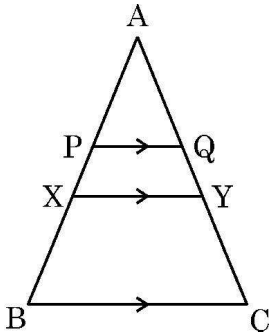
(C) –2 (D) $-\frac{1}{2}$

5. The distance of the point A(–3, –4) from x-axis is **1**

(A) 3 (B) 4

(C) 5 (D) 7

6. In the adjoining figure, PQ || XY || BC, AP = 2 cm, PX = 1.5 cm and BX = 4 cm. If QY = 0.75 cm, then AQ + CY = **1**



(A) 6 cm (B) 4.5 cm

(C) 3 cm (D) 5.25 cm

• • •

7. Given $\Delta ABC \sim \Delta PQR$, $\angle A = 30°$ and $\angle Q = 90°$. The value of $(\angle R + \angle B)$ is **1**

(A) 90° (B) 120°

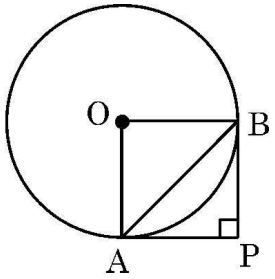
(C) 150° (D) 180°

8. Two coins are tossed simultaneously. The probability of getting atleast one head is **1**

(A) $\frac{1}{4}$ (B) $\frac{1}{2}$

(C) $\frac{3}{4}$ (D) 1

9. In the adjoining figure, PA and PB are tangents to a circle with centre O such that $\angle P = 90°$. If $AB = 3\sqrt{2}$ cm, then the diameter of the circle is **1**



(A) $3\sqrt{2}$ cm (B) $6\sqrt{2}$ cm

(C) 3 cm (D) 6 cm

10. For a circle with centre O and radius 5 cm, which of the following statements is true ? **1**

P : Distance between every pair of parallel tangents is 5 cm.

Q : Distance between every pair of parallel tangents is 10 cm.

R : Distance between every pair of parallel tangents must be between 5 cm and 10 cm.

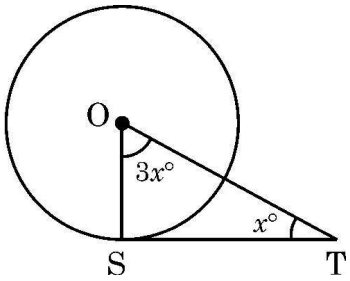
S : There does not exist a point outside the circle from where length of tangent is 5 cm.

(A) P (B) Q

(C) R (D) S

• • •

11. In the adjoining figure, TS is a tangent to a circle with centre O. The value of $2x°$ is **1**



(A) 22.5 (B) 45

(C) 67.5 (D) 90

12. If $x\left(\frac{2\tan 30°}{1+\tan^2 30°}\right) = y\left(\frac{2\tan 30°}{1-\tan^2 30°}\right)$, then $x : y =$ **1**

(A) 1 : 1 (B) 1 : 2

(C) 2 : 1 (D) 4 : 1

13. A peacock sitting on the top of a tree of height 10 m observes a snake moving on the ground. If the snake is $10\sqrt{3}$ m away from the base of the tree, then angle of depression of the snake from the eye of the peacock is **1**

(A) 30° (B) 45°

(C) 60° (D) 90°

14. If a cone of greatest possible volume is hollowed out from a solid wooden cylinder, then the ratio of the volume of remaining wood to the volume of cone hollowed out is **1**

(A) 1 : 1 (B) 1 : 3

(C) 2 : 1 (D) 3 : 1

15. If the mode of some observations is 10 and sum of mean and median is 25, then the mean and median respectively are **1**

(A) 12 and 13 (B) 13 and 12

(C) 10 and 15 (D) 15 and 10

16. If the maximum number of students has obtained 52 marks out of 80, then **1**

(A) 52 is the mean of the data. (B) 52 is the median of the data.

(C) 52 is the mode of the data. (D) 52 is the range of the data.

• • •

17. The system of equations $2x + 1 = 0$ and $3y - 5 = 0$ has **1**

(A) unique solution (B) two solutions

(C) no solution (D) infinite number of solutions

18. In a right triangle ABC, right-angled at A, if $\sin B = \frac{1}{4}$, then the value of sec B is **1**

(A) 4 (B) $\frac{\sqrt{15}}{4}$

(C) $\sqrt{15}$ (D) $\frac{4}{\sqrt{15}}$

Directions : In Question Numbers **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**.

Choose the correct option from the following :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. **Assertion (A) :** For any two prime numbers p and q, their HCF is 1 and LCM is p + q. **1**

Reason (R) : For any two natural numbers, HCF × LCM = product of numbers.

20. In an experiment of throwing a die, **1**

Assertion (A) : Event E_1 : getting a number less than 3 and Event E_2 : getting a number greater than 3 are complementary events.

Reason (R) : If two events E and F are complementary events, then P(E) + P(F) = 1.

• • •

SECTION – B

This section has 5 very short answer type questions of 2 marks each.

21. (a) Solve the following pair of equations algebraically : **2**

$$101x + 102y = 304$$

$$102x + 101y = 305$$

OR

(b) In a pair of supplementary angles, the greater angle exceeds the smaller by 50°. Express the given situation as a system of linear equations in two variables and hence obtain the measure of each angle. **2**

22. (a) If $a \sec \theta + b \tan \theta = m$ and $b \sec \theta + a \tan \theta = n$, **2**

prove that $a^2 + n^2 = b^2 + m^2$

OR

(b) Use the identity : $\sin^2 A + \cos^2 A = 1$ to prove that $\tan^2 A + 1 = \sec^2 A$.

Hence, find the value of tan A, when $\sec A = \frac{5}{3}$, where A is an acute angle. **2**

23. Prove that abscissa of a point P which is equidistant from points with coordinates A(7, 1) and B(3, 5) is 2 more than its ordinate. **2**

24. P is a point on the side BC of ΔABC such that $\angle APC = \angle BAC$. Prove that $AC^2 = BC \cdot CP$. **2**

25. The number of red balls in a bag is three more than the number of black balls. If the probability of drawing a red ball at random from the given bag is $\frac{12}{23}$, find the total number of balls in the given bag. **2**

• • •

SECTION – C

This section has 6 short answer type questions of 3 marks each.

26. (a) Prove that $\sqrt{5}$ is an irrational number. **3**

OR

(b) Let p, q and r be three distinct prime numbers. **3**
Check whether $p \cdot q \cdot r + q$ is a composite number or not.
Further, give an example for 3 distinct primes p, q, r such that
(i) $p \cdot q \cdot r + 1$ is a composite number.
(ii) $p \cdot q \cdot r + 1$ is a prime number.

27. Find the zeroes of the polynomial $p(x) = 3x^2 - 4x - 4$. Hence, write a polynomial whose each of the zeroes is 2 more than zeroes of $p(x)$. **3**

28. Check whether the following pair of equations is consistent or not. If consistent, solve graphically **3**
$x + 3y = 6$
$3y - 2x = -12$

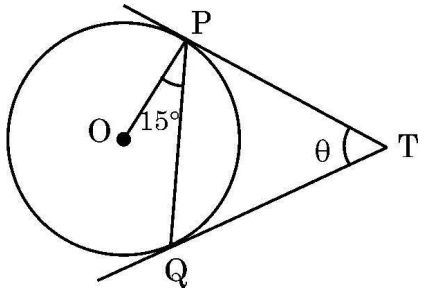
29. If the points A(6, 1), B(p, 2), C(9, 4) and D(7, q) are the vertices of a parallelogram ABCD, then find the values of p and q. Hence, check whether ABCD is a rectangle or not. **3**

30. (a) Prove that : $\frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta} + \cot\theta = 0$. **3**

OR

(b) Given that $\sin\theta + \cos\theta = x$, prove that $\sin^4\theta + \cos^4\theta = \frac{2 - (x^2 - 1)^2}{2}$. **3**

31. In the adjoining figure, TP and TQ are tangents drawn to a circle with centre O. If $\angle OPQ = 15°$ and $\angle PTQ = \theta$, then find the value of $\sin 2\theta$. **3**

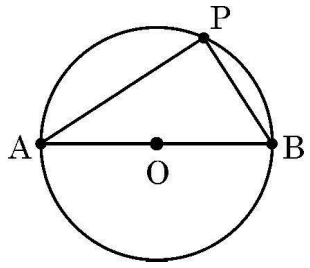


• • •

SECTION – D

This section has 4 long answer questions of 5 marks each.

32. (a) There is a circular park of diameter 65 m as shown in the following figure, where AB is a diameter. **5**



An entry gate is to be constructed at a point P on the boundary of the park such that distance of P from A is 35 m more than the distance of P from B. Find distance of point P from A and B respectively.

OR

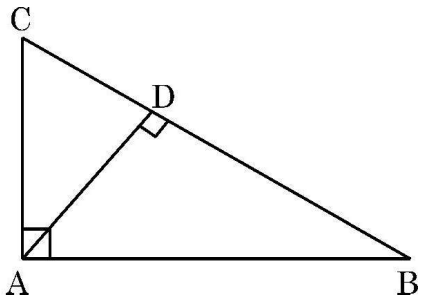
(b) Find the smallest value of p for which the quadratic equation $x^2 - 2(p + 1)x + p^2 = 0$ has real roots. Hence, find the roots of the equation so obtained. **5**

33. (a) If a line drawn parallel to one side of triangle intersecting the other two sides in distinct points divides the two sides in the same ratio, then it is parallel to third side. **5**

State and prove the converse of the above statement.

OR

(b) In the adjoining figure, ΔCAB is a right triangle, right angled at A and $AD \perp BC$. Prove that $\Delta ADB \sim \Delta CDA$. Further, if BC = 10 cm and CD = 2 cm, find the length of AD. **5**



34. From one face of a solid cube of side 14 cm, the largest possible cone is carved out. Find the volume and surface area of the remaining solid. $\left(\text{Use } \pi = \frac{22}{7}, \sqrt{5} = 2.2\right)$ **5**

• • •

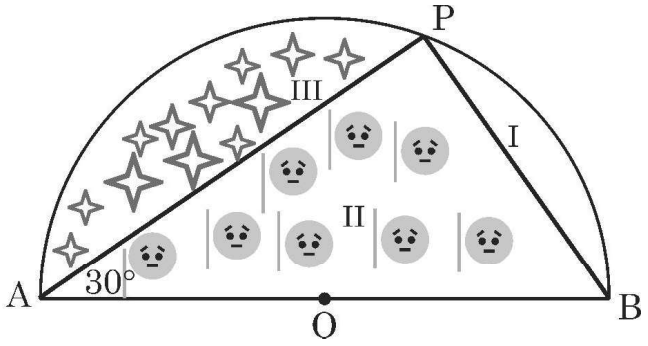
35. Following distribution shows the marks of 230 students in a particular subject. If the median marks are 46, then find the values of x and y. **5**

Marks	Number of Students
10 – 20	12
20 – 30	30
30 – 40	x
40 – 50	65
50 – 60	y
60 – 70	25
70 – 80	18

SECTION – E

This section has 3 case study based questions of 4 marks each.

36. Anurag purchased a farmhouse which is in the form of a semicircle of diameter 70 m. He divides it into three parts by taking a point P on the semicircle in such a way that $\angle PAB = 30°$ as shown in the following figure, where O is the centre of semicircle.



In part I, he planted saplings of Mango tree, in part II, he grew tomatoes and in part III, he grew oranges. Based on given information, answer the following questions.

(i) What is the measure of $\angle POA$? **1**

(ii) Find the length of wire needed to fence entire piece of land. **1**

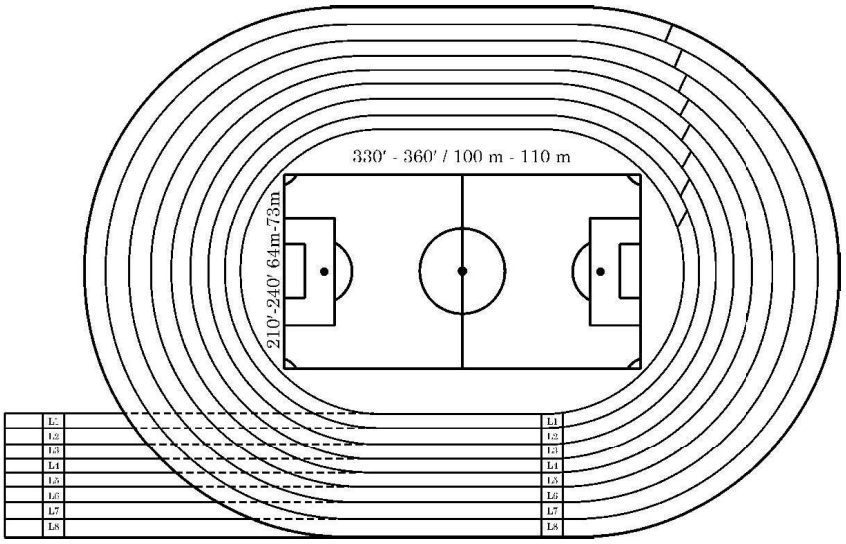
(iii) (a) Find the area of region in which saplings of Mango tree are planted. **2**

OR

(iii) (b) Find the length of wire needed to fence the region III. **2**

• • •

37. In order to organise, Annual Sports Day, a school prepared an eight lane running track with an integrated football field inside the track area as shown below :



The length of innermost lane of the track is 400 m and each subsequent lane is 7.6 m longer than the preceding lane.

Based on given information, answer the following questions, using concept of Arithmetic Progression.

(i) What is the length of the 6^{th} lane ? **1**

(ii) How long is the 8^{th} lane than that of 4^{th} lane ? **1**

(iii) (a) While practicing for a race, a student took one round each in first six lanes. Find the total distance covered by the student. **2**

OR

(iii) (b) A student took one round each in lane 4 to lane 8. Find the total distance covered by the student. **2**

38. The Statue of Unity situated in Gujarat is the world's largest Statue which stands over a 58 m high base. As part of the project, a student constructed an inclinometer and wishes to find the height of Statue of Unity using it.

He noted following observations from two places :

Situation – I :

The angle of elevation of the top of Statue from Place A which is $80\sqrt{3}$ m away from the base of the Statue is found to be 60°.

• • •

Situation – II :

The angle of elevation of the top of Statue from a Place B which is 40 m above the ground is found to be 30° and entire height of the Statue including the base is found to be 240 m.

Based on given information, answer the following questions :

(i) Represent the Situation – I with the help of a diagram. **1**

(ii) Represent the Situation – II with the help of a diagram. **1**

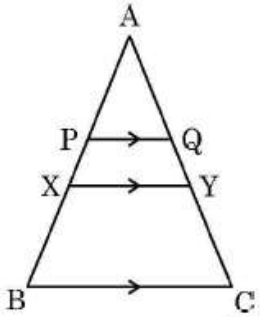
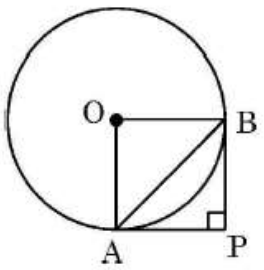
(iii) (a) Calculate the height of Statue excluding the base and also find the height including the base with the help of Situation – I. **2**

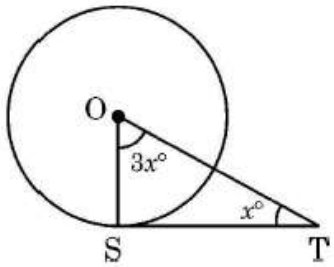
OR

(iii) (b) Find the horizontal distance of point B (Situation – II) from the Statue and the value of tan α, where α is the angle of elevation of top of base of the Statue from point B. **2**

MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/6/1)

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A **This section consists of 20 multiple choice questions of 1 mark each.**	
1.	$\sqrt{0.4}$ is a/an (A) natural number (B) integer (C) rational number (D) irrational number	
Sol.	(D) irrational number	**1**
2.	Which of the following cannot be the unit digit of 8^n, where n is a natural number ? (A) 4 (B) 2 (C) 0 (D) 6	
Sol.	(C) 0	**1**
3.	Which of the following quadratic equations has real and equal roots ? (A) $(x+1)^2 = 2x+1$ (B) $x^2 + x = 0$ (C) $x^2 - 4 = 0$ (D) $x^2 + x + 1 = 0$	
Sol.	(A) $(x+1)^2 = 2x+1$	**1**
4.	If the zeroes of the polynomial $ax^2 + bx + \frac{2a}{b}$ are reciprocal of each other, then the value of b is (A) 2 (B) $\frac{1}{2}$ (C) –2 (D) $-\frac{1}{2}$	
Sol.	(A) 2	**1**
5.	The distance of the point A(–3, –4) from x-axis is (A) 3 (B) 4 (C) 5 (D) 7	
Sol.	(B) 4	**1**

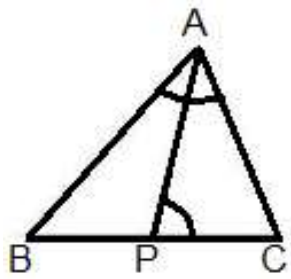
6.	In the adjoining figure, PQ ‖ XY ‖ BC, AP = 2 cm, PX = 1.5 cm and BX = 4 cm. If QY = 0.75 cm, then AQ + CY =  (A) 6 cm (B) 4.5 cm (C) 3 cm (D) 5.25 cm	
Sol.	(C) 3 cm	**1**
7.	Given $\Delta ABC \sim \Delta PQR$, $\angle A = 30°$ and $\angle Q = 90°$. The value of $(\angle R + \angle B)$ is (A) 90° (B) 120° (C) 150° (D) 180°	
Sol.	(C) 150°	**1**
8.	Two coins are tossed simultaneously. The probability of getting atleast one head is (A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) 1	
Sol.	(C) $\frac{3}{4}$	**1**
9.	In the adjoining figure, PA and PB are tangents to a circle with centre O such that $\angle P = 90°$. If AB = $3\sqrt{2}$ cm, then the diameter of the circle is  (A) $3\sqrt{2}$ cm (B) $6\sqrt{2}$ cm (C) 3 cm (D) 6 cm	
Sol.	(D) 6 cm	**1**

10.	For a circle with centre O and radius 5 cm, which of the following statements is true ? **P** : Distance between every pair of parallel tangents is 5 cm. **Q** : Distance between every pair of parallel tangents is 10 cm. **R** : Distance between every pair of parallel tangents must be between 5 cm and 10 cm. **S** : There does not exist a point outside the circle from where length of tangent is 5 cm. (A) P (B) Q (C) R (D) S	
Sol.	(B) Q	**1**
11.	In the adjoining figure, TS is a tangent to a circle with centre O. The value of $2x°$ is  (A) 22.5 (B) 45 (C) 67.5 (D) 90	
Sol.	(B) 45	**1**
12.	If $x\left(\frac{2\tan 30°}{1+\tan^2 30°}\right) = y\left(\frac{2\tan 30°}{1-\tan^2 30°}\right)$, then $x : y =$ (A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1	
Sol.	(C) 2:1	**1**
13.	A peacock sitting on the top of a tree of height 10 m observes a snake moving on the ground. If the snake is $10\sqrt{3}$ m away from the base of the tree, then angle of depression of the snake from the eye of the peacock is (A) 30° (B) 45° (C) 60° (D) 90°	
Sol.	(A) 30°	**1**

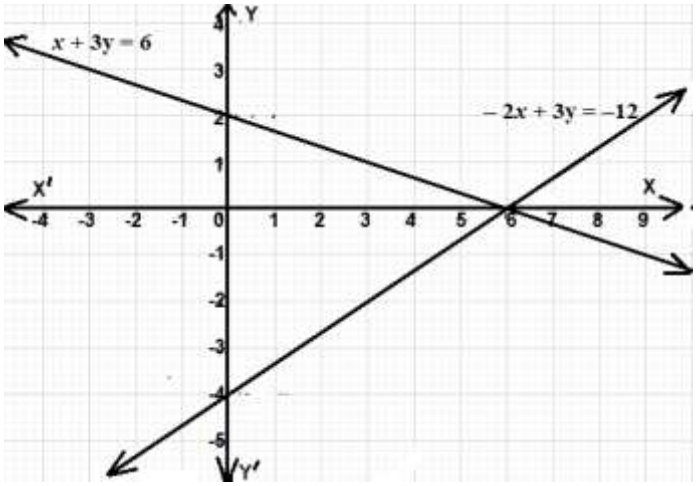
14.	If a cone of greatest possible volume is hollowed out from a solid wooden cylinder, then the ratio of the volume of remaining wood to the volume of cone hollowed out is (A) 1 : 1 (B) 1 : 3 (C) 2 : 1 (D) 3 : 1	
Sol.	(C) 2:1	**1**
15.	If the mode of some observations is 10 and sum of mean and median is 25, then the mean and median respectively are (A) 12 and 13 (B) 13 and 12 (C) 10 and 15 (D) 15 and 10	
Sol.	(B) 13 and 12	**1**
16.	If the maximum number of students has obtained 52 marks out of 80, then (A) 52 is the mean of the data. (B) 52 is the median of the data. (C) 52 is the mode of the data. (D) 52 is the range of the data.	
Sol.	(C) 52 is the mode of the data.	**1**
17.	The system of equations $2x + 1 = 0$ and $3y - 5 = 0$ has (A) unique solution (B) two solutions (C) no solution (D) infinite number of solutions	
Sol.	(A) unique solution	**1**
18.	In a right triangle ABC, right-angled at A, if $\sin B = \frac{1}{4}$, then the value of sec B is (A) 4 (B) $\frac{\sqrt{15}}{4}$ (C) $\sqrt{15}$ (D) $\frac{4}{\sqrt{15}}$	
Sol.	(D) $\frac{4}{\sqrt{15}}$	**1**

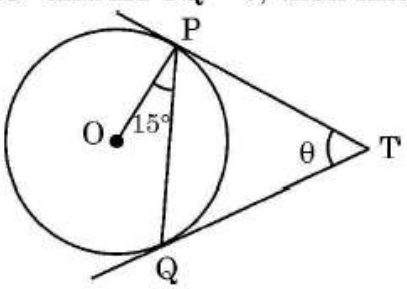
	Directions : In Question Numbers **19** and **20**, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option from the following : (A) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	**Assertion (A) :** For any two prime numbers p and q, their HCF is 1 and LCM is p + q. **Reason (R) :** For any two natural numbers, HCF × LCM = product of numbers.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
20.	In an experiment of throwing a die, **Assertion (A) :** Event E_1 : getting a number less than 3 and Event E_2 : getting a number greater than 3 are complementary events. **Reason (R) :** If two events E and F are complementary events, then P(E) + P(F) = 1.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
	SECTION B **This section has 5 very short answer type questions of 2 marks each.**	
21. (a)	Solve the following pair of equations algebraically : $101x + 102y = 304$ $102x + 101y = 305$	
Sol.	Adding equations we get $x + y = 3$ Subtracting equations we get $-x + y = -1$ Solving to get $x = 2$ and $y = 1$	½ ½ ½ + ½
	OR	

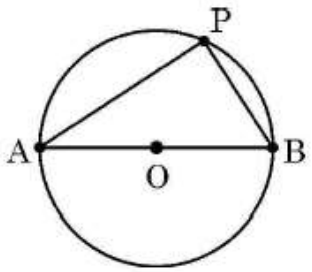
21. (b)	In a pair of supplementary angles, the greater angle exceeds the smaller by 50°. Express the given situation as a system of linear equations in two variables and hence obtain the measure of each angle.	
Sol.	Let smaller angle be x and greater angle be y ATQ, $x + y = 180$ Also $y = x + 50$ Solving we get $x = 65°$ and $y = 115°$	 ½ ½ ½ + ½
22. (a)	If $a \sec\theta + b \tan\theta = m$ and $b \sec\theta + a \tan\theta = n$, prove that $a^2 + n^2 = b^2 + m^2$	
Sol.	$m^2 = a^2 \sec^2\theta + b^2 \tan^2\theta + 2ab \sec\theta \tan\theta$ $n^2 = b^2 \sec^2\theta + a^2 \tan^2\theta + 2ab \sec\theta \tan\theta$ $m^2 - n^2 = a^2(\sec^2\theta - \tan^2\theta) + b^2(\tan^2\theta - \sec^2\theta)$ $\Rightarrow m^2 - n^2 = a^2 - b^2$ or $a^2 + n^2 = m^2 + b^2$	½ ½ ½ ½
	OR	
22. (b)	Use the identity : $\sin^2A + \cos^2A = 1$ to prove that $\tan^2A + 1 = \sec^2A$. Hence, find the value of tan A, when sec A $= \frac{5}{3}$, where A is an acute angle.	
Sol.	$\sin^2A + \cos^2A = 1$ Dividing both sides by $\cos^2A$, we get $\frac{\sin^2A}{\cos^2A} + \frac{\cos^2A}{\cos^2A} = \frac{1}{\cos^2A}$ $\tan^2A + 1 = \sec^2A$ $\tan^2A + 1 = \left(\frac{5}{3}\right)^2$ $\tan A = \frac{4}{3}$	 ½ ½ ½ ½
23.	Prove that abscissa of a point P which is equidistant from points with coordinates A(7, 1) and B(3, 5) is 2 more than its ordinate.	
Sol.	Let P (x, y) be equidistant from A(7, 1) and B(3, 5) PA = PB $\Rightarrow$ $PA^2 = PB^2$ $(x-7)^2 + (y-1)^2 = (x-3)^2 + (y-5)^2$ $x^2 + 49 - 14x + y^2 + 1 - 2y = x^2 + 9 - 6x + y^2 + 25 - 10y$	 ½ ½ ½

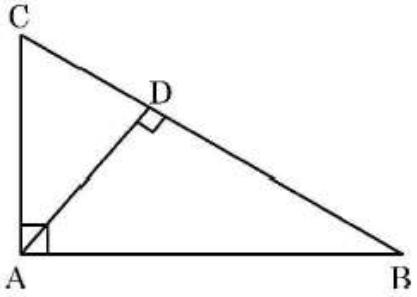
	$x = 2 + y$ Thus, abscissa of the point P is 2 more than its ordinate.	½
24.	P is a point on the side BC of ΔABC such that ∠APC = ∠BAC. Prove that $AC^2 = BC \cdot CP$.	
Sol.	 Correct figure ∠ APC = ∠ BAC ∠ ACP = ∠ ACB ∴ Δ APC ~ Δ BAC $AC^2 = BC.CP$	½ **1** ½
25.	The number of red balls in a bag is three more than the number of black balls. If the probability of drawing a red ball at random from the given bag is $\frac{12}{23}$, find the total number of balls in the given bag.	
Sol.	Let number of black balls = x then number of red balls = $x + 3$ ∴ total number of balls = $2x + 3$ ATQ, $\frac{x+3}{2x+3} = \frac{12}{23}$ $x = 33$ Total number of balls = 69	 ½ ½ ½ ½
	SECTION C **This section has 6 short answer type questions of 3 marks each.**	
26. (a)	Prove that $\sqrt{5}$ is an irrational number.	
Sol.	Let $\sqrt{5}$ be a rational number. $\therefore \sqrt{5} = \frac{p}{q}$, where $q \neq 0$ and let p & q be the coprimes. $\Longrightarrow 5q^2 = p^2$ $\Longrightarrow p^2$ is divisible by 5. $\Longrightarrow$ p is divisible by 5. ----- ① Let p = 5a, where 'a' is some integer $\therefore 25a^2 = 5q^2$ $\Longrightarrow q^2 = 5a^2$	½ **1**

	$\Rightarrow q^2$ is divisible by 5. $\Rightarrow$ q is divisible by 5. ----- ② $\therefore$ 5 divides both p & q. ① and ② leads to contradiction as p and q are coprimes. Hence, $\sqrt{5}$ is an irrational number.	**1** ½
	OR	
26. (b)	Let p, q and r be three distinct prime numbers. Check whether $p \cdot q \cdot r + q$ is a composite number or not. Further, give an example for 3 distinct primes p, q, r such that (i) $p \cdot q \cdot r + 1$ is a composite number. (ii) $p \cdot q \cdot r + 1$ is a prime number.	
Sol.	p. q. r + q = q(pr + 1) Thus, the given number has more than 2 factors. Hence it is composite. (i) Taking p = 3, q = 5 and r = 7 pqr + 1 = 3.5.7 + 1 = 106 is a composite number or any other correct example (ii) Taking p = 2, q = 3 and r = 5 pqr + 1 = 2.3.5 + 1 = 31 is a prime number or any other correct example	½ ½ **1** **1**
27.	Find the zeroes of the polynomial $p(x) = 3x^2 - 4x - 4$. Hence, write a polynomial whose each of the zeroes is 2 more than zeroes of $p(x)$.	
Sol.	$p(x) = 3x^2 - 4x - 4$ Zeroes are $-\frac{2}{3}$ and 2 New zeroes are $\frac{4}{3}$ and 4 Sum of new zeroes = $\frac{4}{3} + 4 = \frac{16}{3}$ Product of new zeroes = $\frac{4}{3} \times 4 = \frac{16}{3}$ Required polynomial is $x^2 - \frac{16x}{3} + \frac{16}{3}$ or $3x^2 - 16x + 16$	**1** ½ ½ ½ ½
28.	Check whether the following pair of equations is consistent or not. If consistent, solve graphically $x + 3y = 6$ $3y - 2x = -12$	
Sol.	$x + 3y = 6$ $-2x + 3y = -12$ $\frac{a_1}{a_2} = \frac{1}{-2}; \frac{b_1}{b_2} = \frac{3}{3} = 1$	½

	$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ Hence the pair of equations is consistent.  Correct graph Solution is (6, 0) or $x = 6$ and $y = 0$	½ 1½ ½
29.	If the points A(6, 1), B(p, 2), C(9, 4) and D(7, q) are the vertices of a parallelogram ABCD, then find the values of p and q. Hence, check whether ABCD is a rectangle or not.	
Sol.	Diagonals of a parallelogram bisect each other. ∴ Co-ordinates of mid point of diagonal AC = Co-ordinates of mid-point of diagonal BD. $\left(\frac{6+9}{2}, \frac{1+4}{2}\right) = \left(\frac{p+7}{2}, \frac{2+q}{2}\right)$ $\Rightarrow \frac{p+7}{2} = \frac{15}{2}$ and $\frac{2+q}{2} = \frac{5}{2}$ ∴ p = 8 and q = 3 Diagonal AC = $\sqrt{3^2 + 3^2} = 3\sqrt{2}$ Diagonal BD = $\sqrt{(-1)^2 + 1^2} = \sqrt{2}$ AC ≠ BD ∴ ABCD is not a rectangle	**1** ½ ½ ½ ½
30. (a)	Prove that : $\frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta} + \cot\theta = 0.$	
Sol.	LHS $= \frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta} + \cot\theta$ $= \frac{\cos\theta(1 - 2\cos^2\theta)}{\sin\theta(1 - 2\sin^2\theta)} + \cot\theta$ $= \frac{\cos\theta}{\sin\theta}\left[\frac{\sin^2\theta + \cos^2\theta - 2\cos^2\theta}{\sin^2\theta + \cos^2\theta - 2\sin^2\theta}\right] + \cot\theta$ $= \frac{\cot\theta(\sin^2\theta - \cos^2\theta)}{(\cos^2\theta - \sin^2\theta)} + \cot\theta$ $= -\cot\theta + \cot\theta$ = 0 = RHS	 ½ **1** **1** ½

	OR	
30. (b)	Given that $\sin\theta + \cos\theta = x$, prove that $\sin^4\theta + \cos^4\theta = \frac{2-(x^2-1)^2}{2}$.	
Sol.	Given: $\sin\theta + \cos\theta = x$ Squaring both sides $\sin^2\theta + \cos^2\theta + 2\cos\theta\sin\theta = x^2$ $2\sin\theta\cos\theta = x^2 - 1$ RHS $= \frac{2-(2\sin\theta\cos\theta)^2}{2}$ $= \frac{2-4\sin^2\theta\cos^2\theta}{2}$ $= 1 - 2\sin^2\theta\cos^2\theta$ $= (\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta$ $= (\sin^4\theta + \cos^4\theta)$ = LHS	**1** ½ ½ ½ ½
31.	In the adjoining figure, TP and TQ are tangents drawn to a circle with centre O. If $\angle OPQ = 15°$ and $\angle PTQ = \theta$, then find the value of $\sin 2\theta$.  	
Sol.	$\angle$ QPT = 75° $\angle$ PQT = 75° $\theta = 30°$ $\sin 2\theta = \sin 2(30°)$ $= \sin 60° = \frac{\sqrt{3}}{2}$	½ ½ **1** ½ ½

	SECTION D **This section has 4 long answer questions of 5 marks each.**	
32. (a)	There is a circular park of diameter 65 m as shown in the following figure, where AB is a diameter.  An entry gate is to be constructed at a point P on the boundary of the park such that distance of P from A is 35 m more than the distance of P from B. Find distance of point P from A and B respectively.	
Sol.	Let distance of gate at P from point B is x m Then distance of gate at P from point A is $(35 + x)$ m In right Δ APB $(x + 35)^2 + x^2 = (65)^2$ $x^2 + 35x - 1500 = 0$ $(x + 60)(x - 25) = 0$ $x = 25$ Hence, $x + 35 = 60$ Distance of P from A = 60 m Distance of P from B = 25 m	½ **1** **2** ½ ½ ½
	OR	
32. (b)	Find the smallest value of p for which the quadratic equation $x^2 - 2(p + 1)x + p^2 = 0$ has real roots. Hence, find the roots of the equation so obtained.	
Sol.	For real roots, D $\geq$ 0 $[-2(p + 1)]^2 - 4p^2 \geq 0$ $\Rightarrow p \geq -\frac{1}{2}$ $\therefore$ smallest value of $p = -\frac{1}{2}$ At $p = -\frac{1}{2}$ given equation becomes $x^2 - 2\left(\frac{-1}{2} + 1\right)x + \left(\frac{-1}{2}\right)^2 = 0$ $x^2 - x + \frac{1}{4} = 0$ or $4x^2 - 4x + 1 = 0$ $(2x - 1)(2x - 1) = 0$ $\therefore$ roots are $\frac{1}{2}, \frac{1}{2}$	½ ½ **1** ½ ½ **1** ½ ½

33. (a)	If a line drawn parallel to one side of triangle intersecting the other two sides in distinct points divides the two sides in the same ratio, then it is parallel to third side. State and prove the converse of the above statement.	
Sol.	Correct Statement of BPT Correct figure, Given, To Prove, Construction Correct Proof of BPT **NOTE*** Given statement in English version is not a correct statement. Full marks may be awarded to any attempt in English medium.	**1** **2** **2**
	OR	
33. (b)	In the adjoining figure, ΔCAB is a right triangle, right angled at A and $AD \perp BC$. Prove that $\Delta ADB \sim \Delta CDA$. Further, if BC = 10 cm and CD = 2 cm, find the length of AD.  	
Sol.	Δ ABC ~ Δ DAC ----- (1) Similarly, Δ ABC ~ Δ DBA ----- (2) From equations (1) and (2) Δ DAC ~ Δ DBA or Δ ADB ~ Δ CDA $\frac{AD}{CD} = \frac{BD}{AD}$ $AD^2 = BD \times CD$ $= 8 \times 2$ $\therefore$ AD = 4 cm.	**1** ½ **1** ½ ½ **1** ½
34.	From one face of a solid cube of side 14 cm, the largest possible cone is carved out. Find the volume and surface area of the remaining solid. $\left(\text{Use } \pi = \frac{22}{7}, \sqrt{5} = 2.2\right)$	
Sol.	Diameter of cone = 14 cm Radius = 7 cm Height of cone = 14 cm Slant height $l = \sqrt{14^2 + 7^2} = 7\sqrt{5} = 15.4$ cm Volume of remaining solid = Volume of cube – Volume of cone $= (14)^3 - \frac{1}{3} \times \frac{22}{7} \times (7)^2 \times 14$ $= \frac{6076}{3}$ cm^3	 ½ ½ **1** **1** ½

Surface area of remaining solid = Surface area of cube – Area of circle + Curved surface area of cone

$= 6 \times 14 \times 14 - \frac{22}{7} \times 7 \times 7 + \frac{22}{7} \times 7 \times 15.4$ **1**

$= 1360.8 \text{ cm}^2$ **½**

35. Following distribution shows the marks of 230 students in a particular subject. If the median marks are 46, then find the values of x and y.

Marks	Number of Students
10 – 20	12
20 – 30	30
30 – 40	x
40 – 50	65
50 – 60	y
60 – 70	25
70 – 80	18

Sol.

Marks	Number of Students	Cf
10 – 20	12	12
20 – 30	30	42
30 – 40	x	$42 + x$
40 – 50	65	$107 + x$
50 – 60	y	$107 + x + y$
60 – 70	25	$132 + x + y$
70 – 80	18	$150 + x + y$
	230	

Correct table **1**

$150 + x + y = 230$

$x + y = 80$ **1**

Median is 46

∴ Median class is 40 – 50 **½**

$46 = 40 + \left[\frac{\frac{230}{2} - (42 + x)}{65}\right] \times 10$ **1**

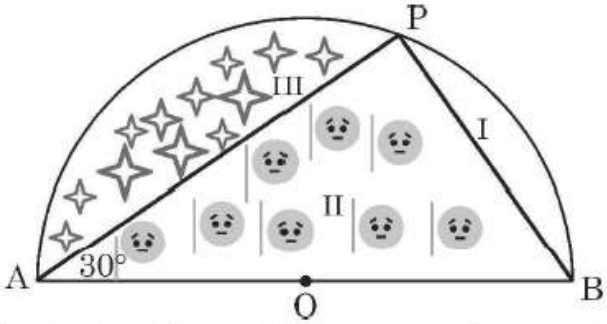
On solving, we get $x = 34$ **1**

and $y = 46$ **½**

SECTION E

This section has 3 case study-based questions of 4 marks each.

36. Anurag purchased a farmhouse which is in the form of a semicircle of diameter 70 m. He divides it into three parts by taking a point P on the semicircle in such a way that $\angle PAB = 30°$ as shown in the following figure, where O is the centre of semicircle.



In part I, he planted saplings of Mango tree, in part II, he grew tomatoes and in part III, he grew oranges. Based on given information, answer the following questions.

(i) What is the measure of $\angle POA$?

(ii) Find the length of wire needed to fence entire piece of land.

(iii) (a) Find the area of region in which saplings of Mango tree are planted.

OR

(iii) (b) Find the length of wire needed to fence the region III.

Sol.

(i) $\angle POA = 120°$ **1**

(ii) Length of wire needed to fence entire piece of land = $\frac{22}{7} \times 35 + 70 = 180$ m **1**

(iii) Required area = $\frac{60}{360} \times \frac{22}{7} \times (35)^2 - \frac{\sqrt{3}}{4} \times (35)^2$ **1**

$= \left(\frac{1925}{3} - \frac{1225\sqrt{3}}{4}\right)$ m^2 or 111.89 m^2 (approx.) **1**

OR

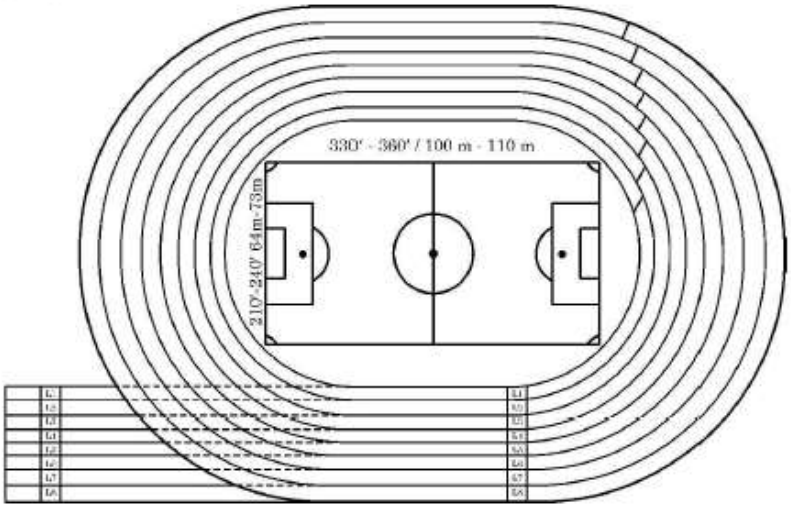
(iii) In Δ APB, $\frac{AP}{AB} = \cos 30°$

$AP = 35\sqrt{3}$ m **1**

Required length of wire = $\frac{120}{360} \times 2 \times \frac{22}{7} \times 35 + 35\sqrt{3}$ **½**

$= \left(\frac{220}{3} + 35\sqrt{3}\right)$ m or 133.8 m (approx.) **½**

37. In order to organise, Annual Sports Day, a school prepared an eight lane running track with an integrated football field inside the track area as shown below :



The length of innermost lane of the track is 400 m and each subsequent lane is 7.6 m longer than the preceding lane.

Based on given information, answer the following questions, using concept of Arithmetic Progression.

(i) What is the length of the 6^{th} lane ?

(ii) How long is the 8^{th} lane than that of 4^{th} lane ?

(iii) (a) While practicing for a race, a student took one round each in first six lanes. Find the total distance covered by the student.

OR

(iii) (b) A student took one round each in lane 4 to lane 8. Find the total distance covered by the student.

Sol. Here AP is 400, 407.6, 415.2, …

(i) $a_6 = 400 + 5\,(7.6) = 438$ m **1**

(ii) $a_8 - a_4 = 30.4$ m **1**

(iii) $S_6 = \frac{6}{2}\,(2 \times 400 + 5 \times 7.6)$ **1**

$= 2514$ m **1**

OR

(iii) Total distance covered = $S_8 - S_3$

$= \frac{8}{2}\,(2 \times 400 + 7 \times 7.6) - \frac{3}{2}\,(2 \times 400 + 2 \times 7.6)$ **1**

$= 2190$ m **1**

38. The Statue of Unity situated in Gujarat is the world's largest Statue which stands over a 58 m high base. As part of the project, a student constructed an inclinometer and wishes to find the height of Statue of Unity using it.

He noted following observations from two places :

Situation – I :

The angle of elevation of the top of Statue from Place A which is $80\sqrt{3}$ m away from the base of the Statue is found to be 60°.

Situation – II :

The angle of elevation of the top of Statue from a Place B which is 40 m above the ground is found to be 30° and entire height of the Statue including the base is found to be 240 m.

Based on given information, answer the following questions :

(i) Represent the Situation – I with the help of a diagram.

(ii) Represent the Situation – II with the help of a diagram.

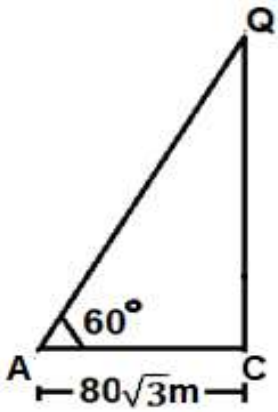
(iii) (a) Calculate the height of Statue excluding the base and also find the height including the base with the help of Situation – I.

OR

(iii) (b) Find the horizontal distance of point B (Situation – II) from the Statue and the value of tan α, where α is the angle of elevation of top of base of the Statue from point B.

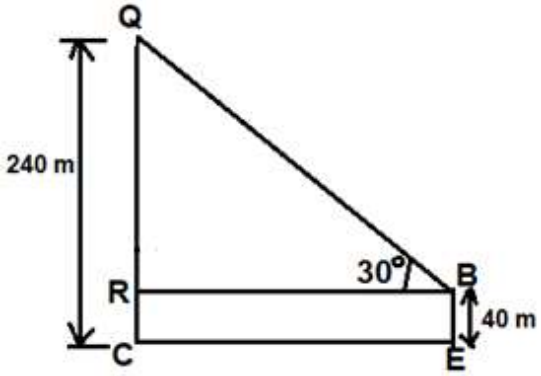
Sol.

(i)



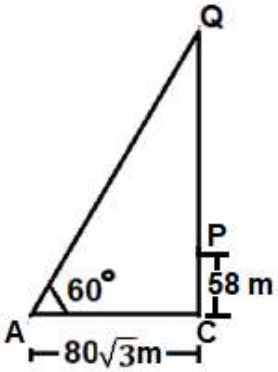
Correct figure **1**

(ii)



Correct figure **1**

(iii) (a)



In Δ ACQ

$\frac{QC}{AC} = \tan 60° = \sqrt{3}$

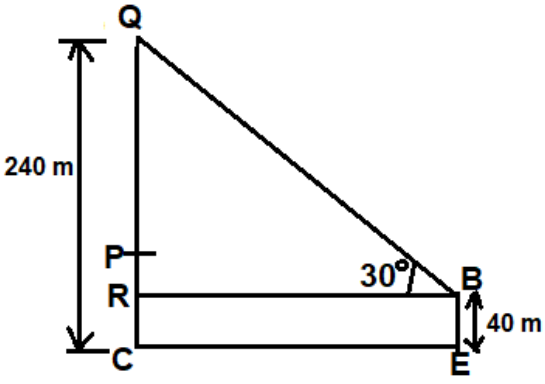
QC = 240 m

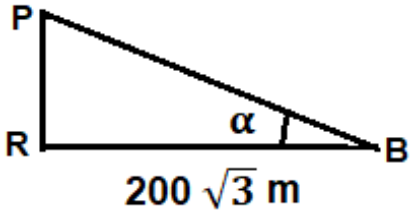
Height of statue including base = 240 m **1**

Height of statue excluding base = 240 – 58 = 182 m **1**

OR

(iii) (b)



	QR = 240 – 40 = 200 m	½
	In Δ QRB	
	$\frac{QR}{RB} = \tan 30° = \frac{1}{\sqrt{3}}$	
	Horizontal distance RB = $200\sqrt{3}$ m	½
		
	Correct figure	½
	In Δ PRB	
	$\tan \alpha = \frac{PR}{BR}$	
	$= \frac{18}{200\sqrt{3}}$ or $\frac{3\sqrt{3}}{100}$	½

• • •

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A**, **B**, **C**, **D** and **E**.*

(iii) *In **Section A,** Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **Section B,** Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C,** Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D,** Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.*

(vii) *In **Section E,** Questions no. **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks questions in each case study.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*

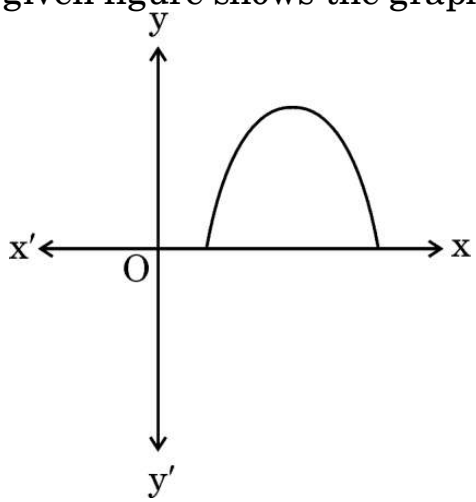
(ix) *Draw neat diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*

(x) *Use of calculator is **not** allowed.*

SECTION A

*This section has **20** Multiple Choice Questions (MCQs) carrying **1** mark each. 20×1=20*

1. If the given figure shows the graph of polynomial $y = ax^2 + bx + c$, then :



(A) $a < 0$ (B) $b^2 < 4ac$

(C) $c > 0$ (D) a and b are of same sign

• • •

2. The total number of factors of the square of a prime number is :

(A) 1 (B) 2

(C) 3 (D) 4

3. The value of 'k' for which the pair of linear equations $(k + 1)x + 2(1 - k)y = 15$; $4y = 3x - 8$ has no solution, is :

(A) 3 (B) $\frac{1}{5}$

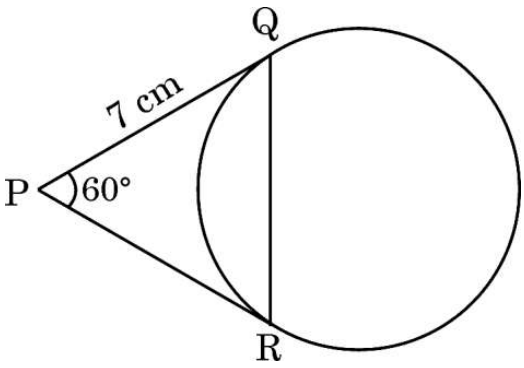
(C) 5 (D) $\frac{37}{8}$

4. The 6^{th} term of the AP $\sqrt{27}$, $\sqrt{75}$, $\sqrt{147}$, ... is :

(A) $\sqrt{243}$ (B) $\sqrt{363}$

(C) $\sqrt{300}$ (D) $\sqrt{507}$

5. In the given figure, PQ and PR are tangents to the circle such that PQ = 7 cm and $\angle$ RPQ = 60°.



The length of chord QR is :

(A) 5 cm (B) 7 cm

(C) 9 cm (D) 14 cm

6. Raina is 1·5 m tall. At an instant, his shadow is 1·8 m long. At the same instant, the shadow of a pole is 9 m long. How tall is the pole ?

(A) 6·5 m (B) 7·5 m

(C) 8·5 m (D) 6·2 m

• • •

7. Cards numbered 10, 11, 12, ..., 30 are kept in a box and shuffled thoroughly. Rohit draws a card at random from the box. The probability that the number on the card is a multiple of 4 or 5 is :

(A) $\frac{9}{20}$ (B) $\frac{9}{21}$

(C) $\frac{10}{20}$ (D) $\frac{10}{21}$

8. M is a point on y-axis at a distance of 4 units from x-axis and it lies below the x-axis. The distance of point M from point Q (5, 1) is :

(A) $\sqrt{2}$ units (B) $\sqrt{34}$ units

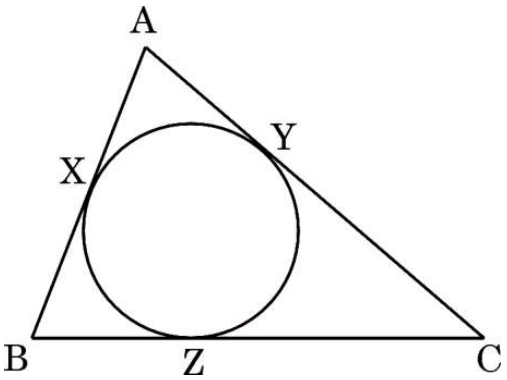
(C) $\sqrt{50}$ units (D) $\sqrt{90}$ units

9. If $x = p\cos^3\alpha$ and $y = q\sin^3\alpha$, then the value of $\left(\frac{x}{p}\right)^{2/3} + \left(\frac{y}{q}\right)^{2/3}$ is :

(A) 1 (B) 2

(C) p (D) q

10. In the given figure, a circle inscribed in Δ ABC, touches AB, BC and CA at X, Z and Y, respectively.



If AB = 12 cm, AY = 8 cm and CY = 6 cm, then the length of BC is :

(A) 14 cm (B) 12 cm

(C) 10 cm (D) 8 cm

• • •

11. If the sum of the first 'n' terms of an AP is $2n^2 + 5n$, then its common difference is :

(A) 2 (B) 4

(C) 5 (D) 7

12. The numerical value of the area of a circle is equal to that of the perimeter of a semicircular disc, both having equal radius. The radius is :

(A) 1 unit (B) 2 units

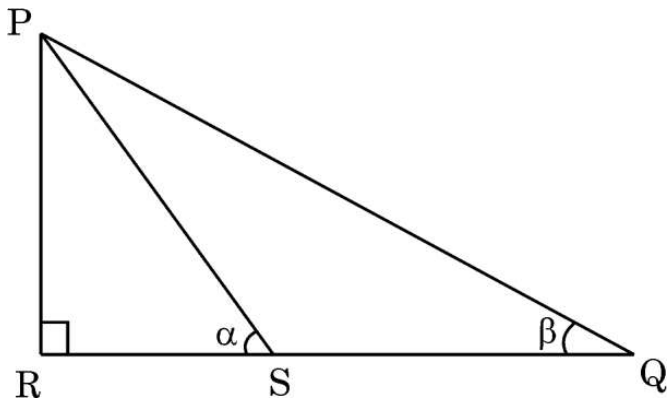
(C) $\frac{\pi + 2}{\pi}$ units (D) $\frac{2\pi + 2}{\pi}$ units

13. Two dice are thrown simultaneously and the product of the numbers appearing on the tops is noted. The probability of the product to be less than 6 is :

(A) $\frac{1}{6}$ (B) $\frac{1}{4}$

(C) $\frac{5}{18}$ (D) $\frac{7}{18}$

14. Find the value of $\frac{\tan \alpha}{\tan \beta}$ from the following diagram. It is given that RS : SQ = 1 : 2.



(A) 1 (B) 2

(C) 3 (D) 4

• • •

15. A(– 4, 5) and C(8, 2) are the two opposite vertices of a parallelogram ABCD. Its diagonals intersect each other at P(a, b). The relation between 'a' and 'b' is :

(A) $b = a - 1{\cdot}5$ (B) $b = a + 1{\cdot}5$

(C) $b = a - 4{\cdot}5$ (D) $b = a + 4{\cdot}5$

16. If the perimeter of a square is equal to that of a circle, then the ratio of their areas is :

(A) 7 : 22 (B) 11 : 14

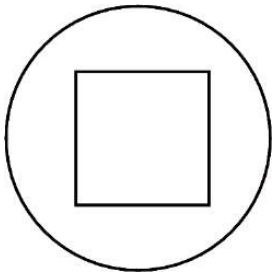
(C) 22 : 7 (D) 14 : 11

17. The length of the string of a kite flying 50 m above the ground with an elevation of 60° is :

(A) $\frac{100}{\sqrt{3}}$ m (B) $100\sqrt{3}$ m

(C) 150 m (D) $\frac{50}{\sqrt{3}}$ m

18. There is a square lawn of side 8 m inside a circular park of radius 20 m. Mr. Joseph wants to plant a sapling in the park.



The probability that he can plant it outside the lawn is :

(A) $\frac{32}{400\,\pi}$ (B) $\frac{64}{400\,\pi}$

(C) $\frac{400\,\pi - 32}{400\,\pi}$ (D) $\frac{400\,\pi - 64}{400\,\pi}$

• • •

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.*

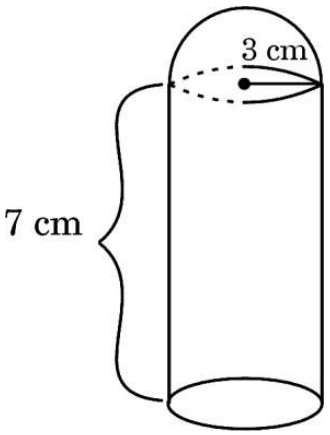
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* In the given figure, a toy is in the form of a cylinder surmounted by a hemisphere of the same radius. If the radius of the cylinder is 3 cm and its height is 7 cm, then the volume of toy is 81π cm^3.



Reason (R): Volume of the given solid is the sum of the volume of the cylinder and the volume of the hemisphere.

20. *Assertion (A) :* The quadratic equation $x^2 + 4x + 5 = 0$ has real roots.

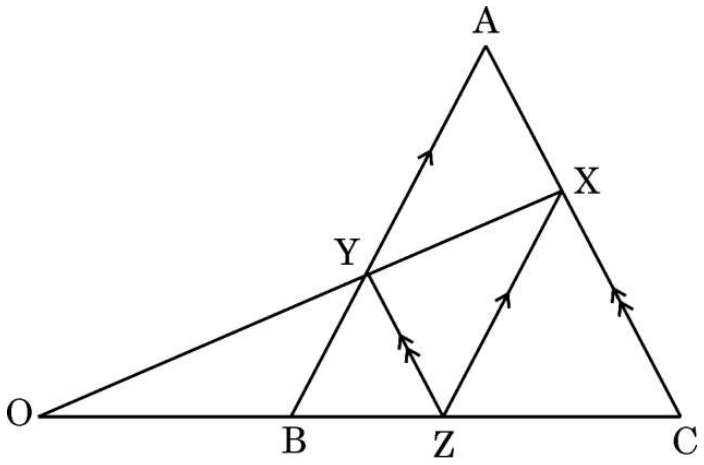
Reason (R): The quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$ has real roots if $b^2 - 4ac \geq 0$.

• • •

SECTION B

*This section has **5** Very Short Answer (VSA) type questions carrying **2** marks each.* *5×2=10*

21. In the given figure, Z is a point on the side BC of ΔABC such that XZ ∥ AB and YZ ∥ AC. If XY and CB produced meet at O, then prove that $ZO^2 = OB \times OC$.

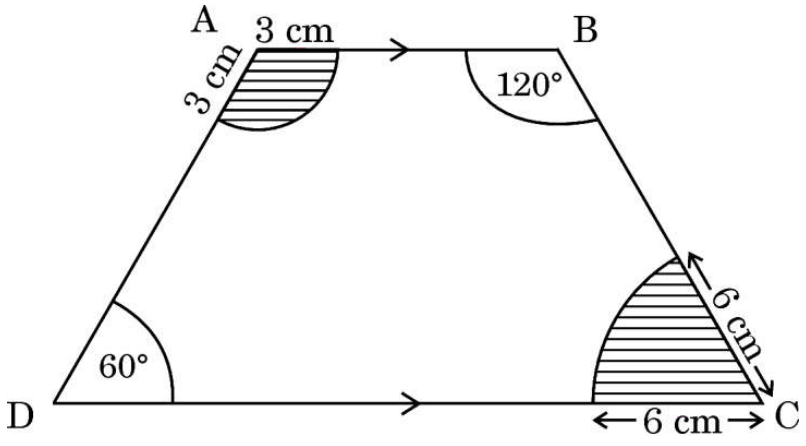


22. If LCM of 51 and 85 can be expressed in the form of 6z – 9, then find the value of z.

23. (a) The perimeter of a sector of a circle of radius 15 cm is 80 cm. Find the area of the sector.

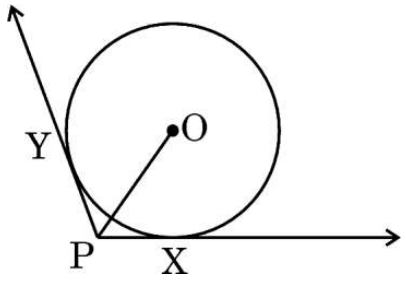
OR

(b) In the given figure, ABCD is a trapezium with AB ∥ DC. Find the area of the shaded region. (Keep the answer in terms of π).



• • •

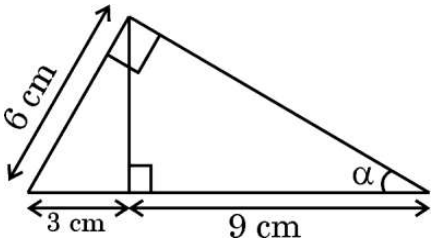
24. PX and PY are two tangents drawn from an external point P to a circle with centre O. If $\angle XPY = 120°$, then prove that PX + PY = PO.



25. (a) If $\sin(2A + 3B) = 1$ and $\cos(2A - 3B) = \frac{\sqrt{3}}{2}$, $0° < 2A + 3B \leq 90°$, $A > B$, then find A and B.

OR

(b) From the given figure, find the value of $\sin \alpha$.



SECTION C

*This section has **6** Short Answer (SA) type questions carrying **3** marks each.* $6 \times 3 = 18$

26. (a) One healthcare center working for the welfare of the patients suffering from 'Dengue', recorded the following information :

Age of Patients	*Number of Patients*
0 – 15	8
15 – 30	5
30 – 45	x
45 – 60	16
60 – 75	12
75 – 90	9

If the modal age of the patients is 54, then find the value of x.

OR

• • •

(b) Weekly expenditure on Ayurvedic medicines of few households in a locality is recorded below.

Weekly Expenditure (in ₹)	*Number of Households*
100 – 150	4
150 – 200	5
200 – 250	y
250 – 300	2
300 – 350	2

If the mean expenditure for this is ₹ 211, then find the value of the missing frequency 'y'.

27. Prove that :

$$\frac{1}{\cot^2 A} + \frac{1}{1+\tan^2 A} = \frac{1}{1-\sin^2 A} - \frac{1}{\text{cosec}^2 A}$$

28. A quadrilateral circumscribes a circle. Prove that the opposite sides of the quadrilateral subtend supplementary angles at the centre of the circle.

29. α, β are the zeroes of the quadratic polynomial $p(x) = x^2 - 4x + k$, such that $\alpha - \beta = 8$. Find the value of k.

30. (a) Check graphically whether the pair of linear equations $2x + 3y = 12$; $5x - 3y = 9$ is consistent. If so, solve it graphically.

OR

• • •

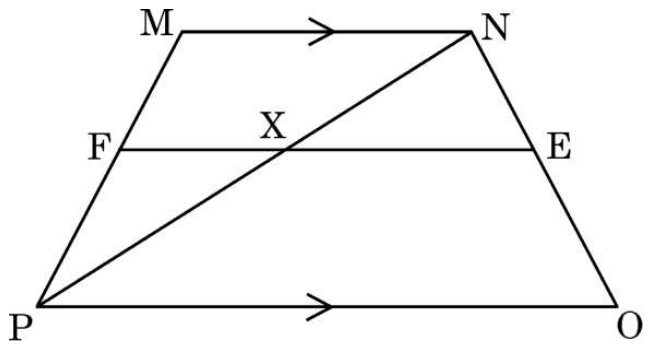
(b) A 2-digit number is obtained by either multiplying the sum of the digits by 7 and then adding 3 or by multiplying the difference of the digits by 19 and then subtracting 1. It is given that the digit at ten's place is greater than that of unit's place. Find the 2-digit number.

31. Ranjita, Neha and Salma start weaving sweaters at the same time for the children of an orphan home. They need 15, 18 and 20 days, respectively, to complete a sweater. After how many days will all of them start making a new sweater again ? By that time how many sweaters will have been competed by them ?

SECTION D

*This section has **4** Long Answer (LA) type questions carrying **5** marks each.* *4×5=20*

32. In the figure, MNOP is a trapezium with, MN ∥ PO and PO = 2 MN. A line segment FE drawn parallel to MN intersects MP at F and NO at E such that $\frac{NE}{EO} = \frac{3}{4}$. Diagonal PN intersects FE at X. Prove that 7 FE = 10 MN.



• • •

33. The median of the following distribution is 545. If the sum of all frequencies is 100, then find the values of x and y.

Class	*Frequency*
0 – 100	3
100 – 200	4
200 – 300	5
300 – 400	x
400 – 500	17
500 – 600	20
600 – 700	19
700 – 800	y
800 – 900	8
900 – 1000	3

34. (a) The denominator of a fraction is 2 more than the numerator. If 2 is added to both its numerator and denominator, then the sum of the new fraction and the original fraction is $\frac{46}{35}$. Find the original fraction.

OR

(b) At present, Sourav's age is 3 years more than the square of his son Ravi's age. When Ravi grows to his father's present age, Sourav's age would be 6 years less than 13 times the present age of Ravi. Find present ages of Ravi and Sourav.

35. (a) From a solid cylinder of height 2·4 cm and radius 0·7 cm, a conical cavity of the same height and same radius is hollowed out. Find the volume and total surface area of the remaining solid.

OR

(b) A carpenter is making a wooden toy (lattu) which is conical in shape and surmounted by a hemisphere. The ratio of the height of the hemisphere and the cone is 3 : 4. If the radius of the cone and the hemisphere is 2·1 cm, find the volume of wood required to make this toy. Also, find the area to be painted after making the toy.

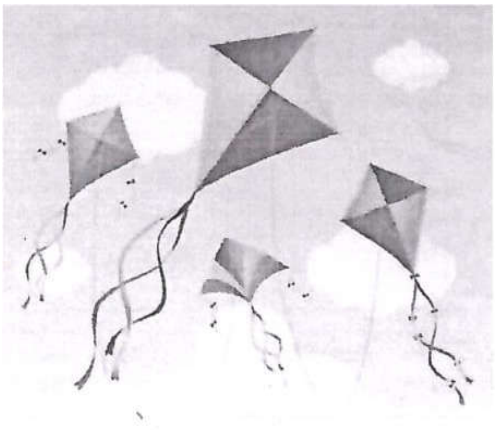
• • •

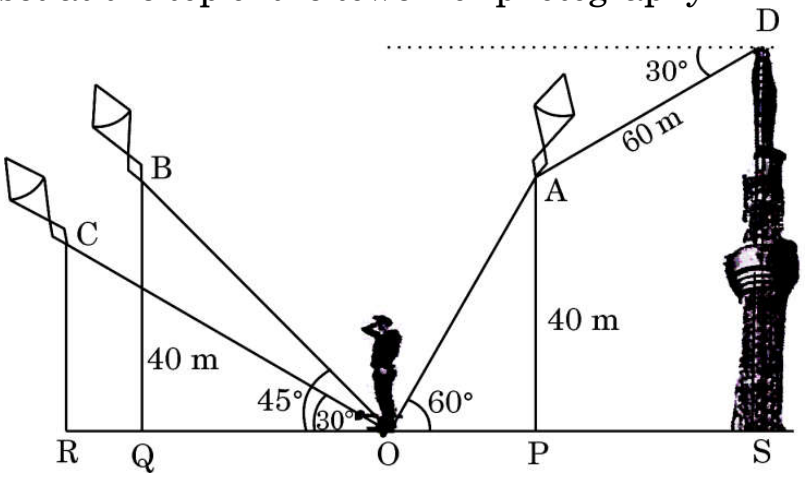
SECTION E

*This section has **3** case study based questions carrying **4** marks each.* *3×4=12*

Case Study – 1

36. The International Kite Festival takes place every year on 14th January. The main attractions of the festival include national and international Kite Flyers' Parade, kite flying, traditional stalls etc. On this day, few kite flyers, had assembled at a point 'O' on the ground. The position of 3 kites A, B, C was such that A and B were at the same vertical height of 40 m from the ground level. The angles of elevation of A, B and C from O were 60°, 45° and 30° respectively. A vertical tower, SD has been erected at point S and a camera is set at the top of the tower for photography.





Based on the information given above, answer the following questions :

(i) What is the length of the string of the kite at A ? *1*

(ii) If the length of the string of kite at C is 40 m, then find the height of that kite C from the ground. *1*

(iii) (a) What is the horizontal distance between the kites at A and B ? *2*

OR

(iii) (b) If the angle of depression of the kite at A is 30° from the camera at D and the distance between A and D is 60 m, then find the height of the tower. *2*

• • •

Case Study – 2

37. In the month of September, villagers of Ankurhut were falling ill with high temperature. Paracetamol was one of the highest sold medicines during that phase. A survey was conducted to estimate the overall sale of Paracetamol of each pharmacy during the last 7 days. It was observed that the number of Paracetamol sold in different shops were all 3-digit numbers, divisible by 13, taken in order.

Based on the information given above, answer the following questions :

(i) How many Paracetamols were sold by the 7^{th} pharmacy ? *1*

(ii) What was the difference between the number of Paracetamols sold by the 14^{th} and the 9^{th} pharmacy ? *1*

(iii) (a) How many Paracetamols were sold by the 9^{th} pharmacy from the last ? *2*

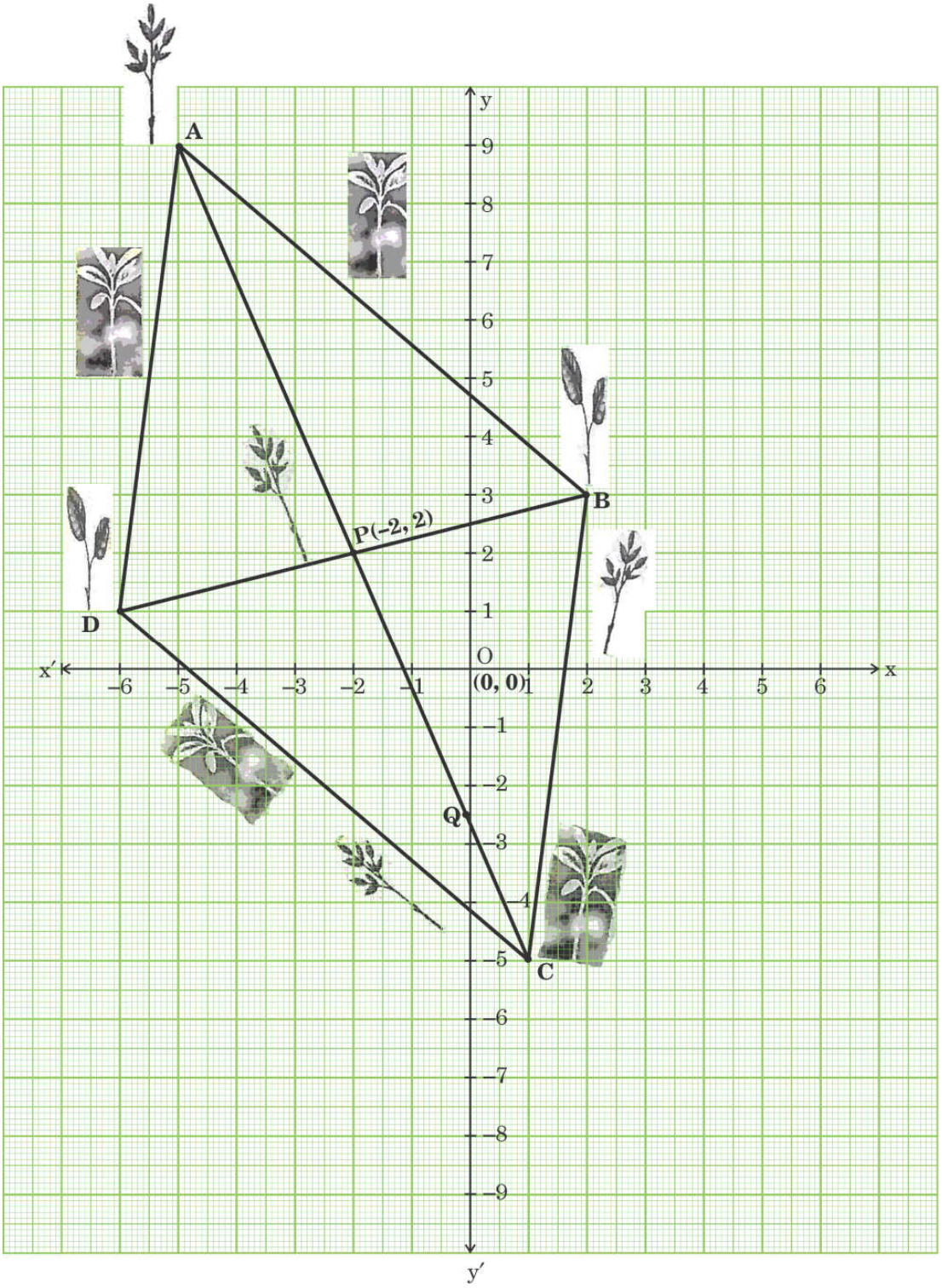
OR

(iii) (b) What was the total number of Paracetamols sold in that week ? *2*

• • •

Case Study – 3

38. Trees act the natural filters. By planting trees in and around school premises, we create cleaner and healthier air for students and local residents, reducing respiratory problems. A school in Noida has proposed and organised a community drive on tree plantation under the title "Save Earth, Plant Trees". Students of that school have planted saplings in the field such that it formed a quadrilateral as shown in the figure ABCD.



• • •

Based on the information given above, answer the following questions :

(i) Find the distance between the two saplings at A and D. *1*

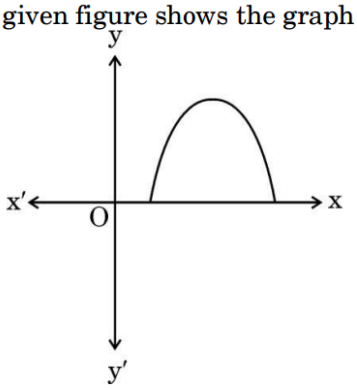
(ii) (a) One student plants one sapling at the mid-point of AD. Then he moves along a straight line parallel to DB and sows another sapling on AB. What are the coordinates of the positions of these two new saplings ? *2*

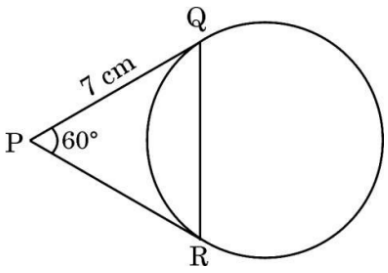
OR

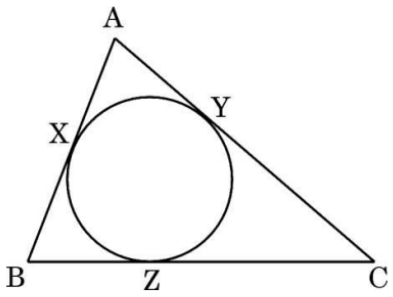
(ii) (b) A new sapling is kept at a point M on DB such that DM : MB = 3 : 1. Find the coordinates of M. *2*

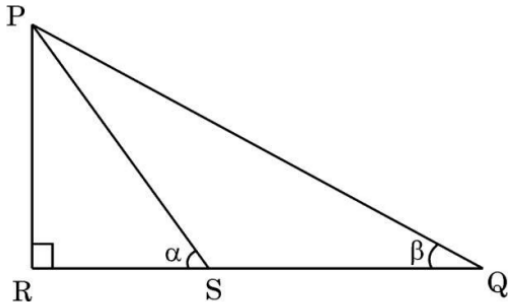
(iii) The line segments AC and BD bisect each other at P(–2, 2). Find the coordinates of C. *1*

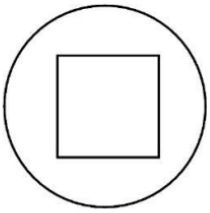
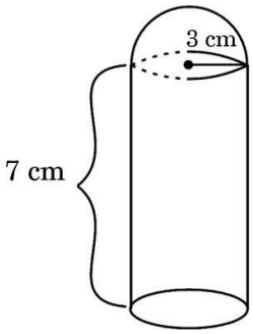
MARKING SCHEME
MATHEMATICS (Subject Code–041)
(PAPER CODE: 30/S/1)

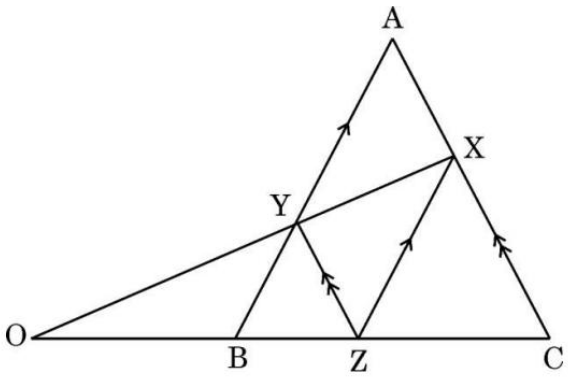
Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	SECTION A This section has **20** Multiple Choice Questions (MCQs) carrying 1 mark each.	
1.	If the given figure shows the graph of polynomial $y = ax^2 + bx + c$, then :  (A) $a < 0$ (B) $b^2 < 4ac$ (C) $c > 0$ (D) a and b are of same sign	
Sol.	(A) $a < 0$	**1**
2.	The total number of factors of the square of a prime number is : (A) 1 (B) 2 (C) 3 (D) 4	
Sol.	(C) 3	**1**
3.	The value of 'k' for which the pair of linear equations $(k + 1)x + 2(1 - k)y = 15$; $4y = 3x - 8$ has no solution, is : (A) 3 (B) $\frac{1}{5}$ (C) 5 (D) $\frac{37}{8}$	
Sol.	(C) 5	**1**
4.	The 6^{th} term of the AP $\sqrt{27}$, $\sqrt{75}$, $\sqrt{147}$, ... is : (A) $\sqrt{243}$ (B) $\sqrt{363}$ (C) $\sqrt{300}$ (D) $\sqrt{507}$	
Sol.	(D) $\sqrt{507}$	**1**

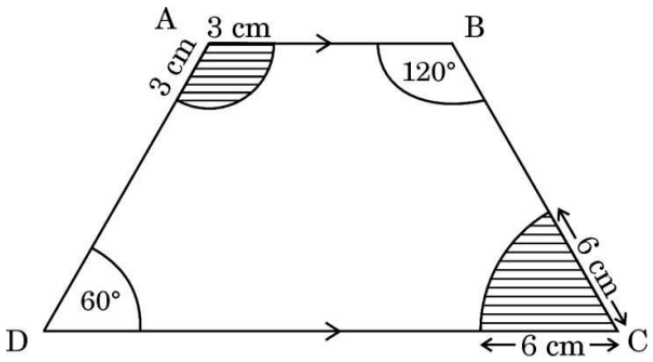
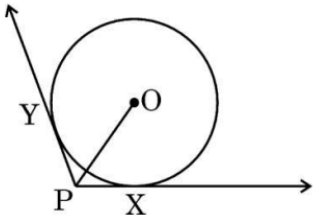
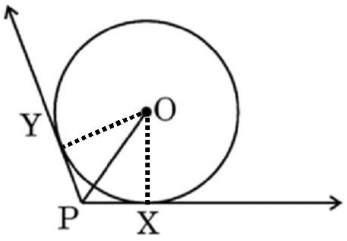
5.	In the given figure, PQ and PR are tangents to the circle such that PQ = 7 cm and $\angle$ RPQ = 60°.  The length of chord QR is : (A) 5 cm (B) 7 cm (C) 9 cm (D) 14 cm	
Sol.	(B) 7 cm	**1**
6.	Raina is 1·5 m tall. At an instant, his shadow is 1·8 m long. At the same instant, the shadow of a pole is 9 m long. How tall is the pole ? (A) 6·5 m (B) 7·5 m (C) 8·5 m (D) 6·2 m	
Sol.	(B) 7.5 cm	**1**
7.	Cards numbered 10, 11, 12, ..., 30 are kept in a box and shuffled thoroughly. Rohit draws a card at random from the box. The probability that the number on the card is a multiple of 4 or 5 is : (A) $\frac{9}{20}$ (B) $\frac{9}{21}$ (C) $\frac{10}{20}$ (D) $\frac{10}{21}$	
Sol.	(B) $\frac{9}{21}$	**1**
8.	M is a point on y-axis at a distance of 4 units from x-axis and it lies below the x-axis. The distance of point M from point Q (5, 1) is : (A) $\sqrt{2}$ units (B) $\sqrt{34}$ units (C) $\sqrt{50}$ units (D) $\sqrt{90}$ units	
Sol.	(C) $\sqrt{50}$ units	**1**
9.	If $x = p\cos^3\alpha$ and $y = q\sin^3\alpha$, then the value of $\left(\frac{x}{p}\right)^{2/3} + \left(\frac{y}{q}\right)^{2/3}$ is : (A) 1 (B) 2 (C) p (D) q	
Sol.	(A) 1	**1**

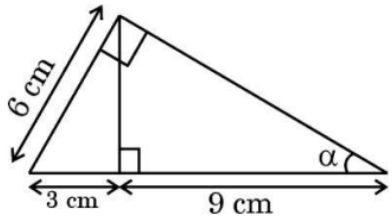
10.	In the given figure, a circle inscribed in Δ ABC, touches AB, BC and CA at X, Z and Y, respectively.  If AB = 12 cm, AY = 8 cm and CY = 6 cm, then the length of BC is : (A) 14 cm (B) 12 cm (C) 10 cm (D) 8 cm	
Sol.	(C) 10 cm	**1**
11.	If the sum of the first 'n' terms of an AP is $2n^2 + 5n$, then its common difference is : (A) 2 (B) 4 (C) 5 (D) 7	
Sol.	(B) 4	**1**
12.	The numerical value of the area of a circle is equal to that of the perimeter of a semicircular disc, both having equal radius. The radius is : (A) 1 unit (B) 2 units (C) $\frac{\pi+2}{\pi}$ units (D) $\frac{2\pi+2}{\pi}$ units	
Sol.	(C) $\frac{\pi+2}{\pi}$ units	**1**
13.	Two dice are thrown simultaneously and the product of the numbers appearing on the tops is noted. The probability of the product to be less than 6 is : (A) $\frac{1}{6}$ (B) $\frac{1}{4}$ (C) $\frac{5}{18}$ (D) $\frac{7}{18}$	
Sol.	(C) $\frac{5}{18}$	**1**

14.	Find the value of $\frac{\tan \alpha}{\tan \beta}$ from the following diagram. It is given that RS : SQ = 1 : 2.  (A) 1 (B) 2 (C) 3 (D) 4	
Sol.	(C) 3	**1**
15.	A(– 4, 5) and C(8, 2) are the two opposite vertices of a parallelogram ABCD. Its diagonals intersect each other at P(a, b). The relation between 'a' and 'b' is : (A) b = a – 1·5 (B) b = a + 1·5 (C) b = a – 4·5 (D) b = a + 4·5	
Sol.	(B) b = a + 1.5	**1**
16.	If the perimeter of a square is equal to that of a circle, then the ratio of their areas is : (A) 7 : 22 (B) 11 : 14 (C) 22 : 7 (D) 14 : 11	
Sol.	(B) 11 : 14	**1**
17.	The length of the string of a kite flying 50 m above the ground with an elevation of 60° is : (A) $\frac{100}{\sqrt{3}}$ m (B) $100\sqrt{3}$ m (C) 150 m (D) $\frac{50}{\sqrt{3}}$ m	
Sol.	(A) $\frac{100}{\sqrt{3}}$ m	**1**

18.	There is a square lawn of side 8 m inside a circular park of radius 20 m. Mr. Joseph wants to plant a sapling in the park.  The probability that he can plant it outside the lawn is : (A) $\frac{32}{400\,\pi}$ (B) $\frac{64}{400\,\pi}$ (C) $\frac{400\,\pi - 32}{400\,\pi}$ (D) $\frac{400\,\pi - 64}{400\,\pi}$	
Sol.	(D) $\frac{400\pi - 64}{400\pi}$	**1**
	Questions number ***19*** *and* ***20*** *are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.* (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.	
19.	*Assertion (A) :* In the given figure, a toy is in the form of a cylinder surmounted by a hemisphere of the same radius. If the radius of the cylinder is 3 cm and its height is 7 cm, then the volume of toy is $81\,\pi$ cm^3.  *Reason (R):* Volume of the given solid is the sum of the volume of the cylinder and the volume of the hemisphere.	
Sol.	(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).	**1**

20.	*Assertion (A) :* The quadratic equation $x^2 + 4x + 5 = 0$ has real roots. *Reason (R):* The quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$ has real roots if $b^2 - 4ac \geq 0$.	
Sol.	(D) Assertion (A) is false, but Reason (R) is true.	**1**
	SECTION B This section has **5** Very Short Answer (VSA) type questions carrying 2 marks each.	
21.	In the given figure, Z is a point on the side BC of ΔABC such that XZ ‖ AB and YZ ‖ AC. If XY and CB produced meet at O, then prove that $ZO^2 = OB \times OC$.  	
Sol.	In ΔOZX, ZX ‖ BY (As XZ ‖ AB) $\therefore \frac{OB}{OZ} = \frac{OY}{OX}$ --- ① In ΔOCX, ZY ‖ CX (As YZ ‖ AC) $\therefore \frac{OZ}{OC} = \frac{OY}{OX}$ --- ② Using ① and ②, we get $\frac{OB}{OZ} = \frac{OZ}{OC}$ $\Longrightarrow OZ^2 = OB \times OC$	**1** ½ ½
22.	If LCM of 51 and 85 can be expressed in the form of $6z - 9$, then find the value of z.	
Sol.	$51 = 3 \times 17$, $85 = 5 \times 17$ LCM (51, 85) $= 3 \times 5 \times 17 = 255$ Now, $6z - 9 = 255$ $\Longrightarrow z = 44$	**1** ½ ½
23 (a)	The perimeter of a sector of a circle of radius 15 cm is 80 cm. Find the area of the sector.	
Sol.	Perimeter of sector $= 30 + l = 80$ $\Longrightarrow l = 50$ cm $\therefore$ Area of the sector $= \frac{1}{2} \times 15 \times 50$ $= 375$ cm^2	**1** **1**
	OR	

23 (b)	In the given figure, ABCD is a trapezium with AB ∥ DC. Find the area of the shaded region. (Keep the answer in terms of π).  	
Sol.	ABCD is a trapezium. ∴ ∠A = 120° and ∠C = 60° Area of shaded region = $\frac{120}{360} \times \pi \times (3)^2 + \frac{60}{360} \times \pi \times (6)^2$ $= 9\,\pi$ cm^2	½ 1 ½
24.	PX and PY are two tangents drawn from an external point P to a circle with centre O. If ∠ XPY = 120°, then prove that PX + PY = PO.  	
Sol.	Join OX and OY.  ∠ XPY = 120° ⟹ ∠ XPO = 60° Now, cos 60° = $\frac{1}{2} = \frac{PX}{OP}$ ⟹ 2 PX = OP As PX = PY ∴ PX + PY = OP	½ 1 ½
25 (a)	If sin(2A + 3B) = 1 and cos(2A − 3B) = $\frac{\sqrt{3}}{2}$, 0° < 2A + 3B ≤ 90°, A > B, then find A and B.	
Sol.	sin (2A + 3B) = 1 ⟹ 2A + 3B = 90° --- ① cos (2A − 3B) = $\frac{\sqrt{3}}{2}$ ⟹ 2A − 3B = 30° --- ② Solving ① and ②, we get A = 30° and B = 10°	½ ½ ½ + ½
	OR	

25 (b)	From the given figure, find the value of sin α.  	
Sol.	$\sin \alpha = \frac{\text{Perpendicular}}{\text{Hypotenuse}}$ $\sin \alpha = \frac{6}{3+9} = \frac{1}{2}$	**2**
	SECTION C This section has **6** Short Answer (SA) type questions carrying 3 marks each.	
26 (a)	One healthcare center working for the welfare of the patients suffering from 'Dengue', recorded the following information : *Age of Patients* | *Number of Patients* 0 – 15 | 8 15 – 30 | 5 30 – 45 | x 45 – 60 | 16 60 – 75 | 12 75 – 90 | 9 If the modal age of the patients is 54, then find the value of x.	
Sol.	Modal class is 45 – 60	**½**
	Mode = 54	
	$\therefore 45 + \left(\frac{16-x}{2\times16-x-12}\right) \times 15 = 54$	**1½**
	$\Longrightarrow x = 10$	**1**
	OR	

26 (b)

Weekly expenditure on Ayurvedic medicines of few households in a locality is recorded below.

Weekly Expenditure (in ₹)	*Number of Households*
100 – 150	4
150 – 200	5
200 – 250	y
250 – 300	2
300 – 350	2

If the mean expenditure for this is ₹ 211, then find the value of the missing frequency 'y'.

Sol.

Class Interval	x_i	f_i	$u_i=\frac{x_i-225}{50}$	$f_i\,u_i$
100 – 150	125	4	– 2	– 8
150 – 200	175	5	– 1	– 5
200 – 250	225	y	0	0
250 – 300	275	2	1	2
300 – 350	325	2	2	4
		13 + y		– 7

Correct table **1½**

Mean = 211

$\Rightarrow 225 + \frac{(-7)}{13+y} \times 50 = 211$ **1**

$\Rightarrow y = 12$ **½**

27.

Prove that :

$$\frac{1}{\cot^2 A} + \frac{1}{1+\tan^2 A} = \frac{1}{1-\sin^2 A} - \frac{1}{\operatorname{cosec}^2 A}$$

Sol.

$\text{LHS} = \tan^2 A + \frac{1}{\sec^2 A}$

$= \tan^2 A + \cos^2 A$ **1**

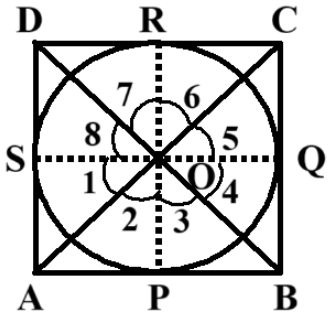
$\text{RHS} = \frac{1}{\cos^2 A} - \sin^2 A$

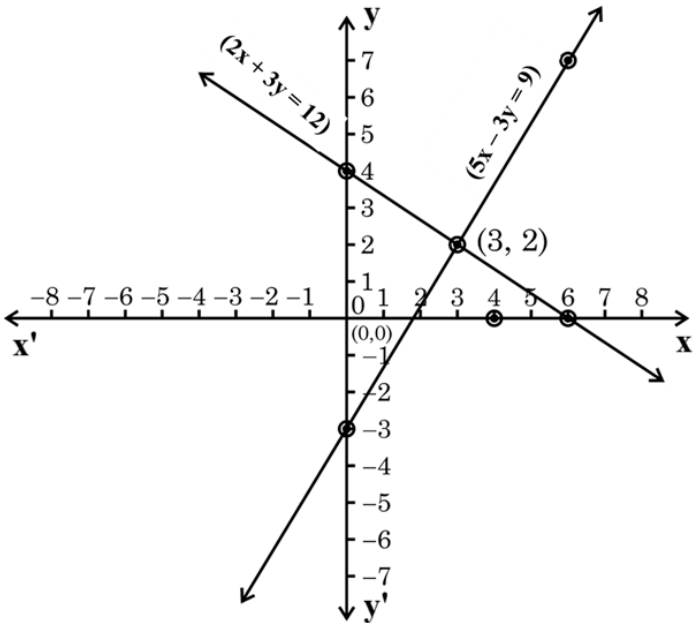
$= \sec^2 A - \sin^2 A$ **1**

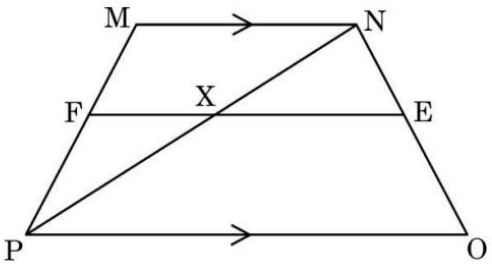
$= \tan^2 A + 1 - \sin^2 A$

$= \tan^2 A + \cos^2 A$ **1**

$\therefore$ LHS = RHS

28.	A quadrilateral circumscribes a circle. Prove that the opposite sides of the quadrilateral subtend supplementary angles at the centre of the circle.	
Sol.	Correct figure  Δ OPA $\cong \Delta$ OSA $\Rightarrow \angle 1 = \angle 2$ Similarly, $\angle 3 = \angle 4$, $\angle 5 = \angle 6$, $\angle 7 = \angle 8$ Now, $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$ $\Rightarrow 2(\angle 1 + \angle 4 + \angle 5 + \angle 8) = 360°$ $\Rightarrow (\angle 1 + \angle 8) + (\angle 4 + \angle 5) = 180°$ $\Rightarrow \angle AOD + \angle BOC = 180°$	½ **1** ½ **1**
29.	α, β are the zeroes of the quadratic polynomial $p(x) = x^2 - 4x + k$, such that $\alpha - \beta = 8$. Find the value of k.	
Sol.	$p(x) = x^2 - 4x + k$ Here, $\alpha + \beta = 4$ and $\alpha\beta = k$ $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$ $\Rightarrow (8)^2 = (4)^2 - 4k$ $\Rightarrow k = -12$	**1** **1½** ½

30 (a)	Check graphically whether the pair of linear equations $2x + 3y = 12$; $5x - 3y = 9$ is consistent. If so, solve it graphically.	
Sol.	Correct graph of $2x + 3y = 12$ Correct graph of $5x - 3y = 9$  As lines are intersecting, therefore given system of linear equations is consistent. Solution is $x = 3$, $y = 2$	**1** **1** **½** **½**
	OR	
30 (b)	A 2-digit number is obtained by either multiplying the sum of the digits by 7 and then adding 3 or by multiplying the difference of the digits by 19 and then subtracting 1. It is given that the digit at ten's place is greater than that of unit's place. Find the 2-digit number.	
Sol.	Let the unit's place digit be y and ten's digit be x. So, number be $10x + y$ Therefore, $10x + y = 7(x + y) + 3$ $\Rightarrow x - 2y = 1$ --- ① Also, $10x + y = 19(x - y) - 1$ $\Rightarrow -9x + 20y = -1$ --- ② Solving ① and ②, we get $x = 9, y = 4$ ∴ the required number is 94.	 **1** **1** **½** **½**

31.	Ranjita, Neha and Salma start weaving sweaters at the same time for the children of an orphan home. They need 15, 18 and 20 days, respectively, to complete a sweater. After how many days will all of them start making a new sweater again ? By that time how many sweaters will have been competed by them ?	
Sol.	LCM (15, 18, 20) = 180 They will start new sweater again after 180 days. Total number of sweaters completed in 180 days = $\frac{180}{15} + \frac{180}{18} + \frac{180}{20}$ $= 31$	**1** **1½** **½**
	SECTION D This section has **4** Long Answer (LA) type questions carrying 5 marks each.	
32.	In the figure, MNOP is a trapezium with, MN ∥ PO and PO = 2 MN. A line segment FE drawn parallel to MN intersects MP at F and NO at E such that $\frac{NE}{EO} = \frac{3}{4}$. Diagonal PN intersects FE at X. Prove that 7 FE = 10 MN.  	
Sol.	$\frac{NE}{EO} = \frac{3}{4} \Rightarrow \frac{NE}{NO} = \frac{3}{7}$ XE ∥ PO Therefore, $\frac{NX}{NP} = \frac{NE}{NO} = \frac{XE}{PO} = \frac{3}{7}$ $\because$ PO = 2 MN $\therefore \frac{XE}{MN} = \frac{6}{7}$ --- (1) Also, $\frac{NX}{NP} = \frac{3}{7} \Rightarrow \frac{XP}{NP} = \frac{4}{7}$ Now, FX ∥ MN $\therefore \frac{XP}{NP} = \frac{FX}{MN} = \frac{4}{7}$ --- (2) Using (1) and (2), $\frac{XE}{MN} + \frac{XF}{MN} = \frac{6}{7} + \frac{4}{7} = \frac{10}{7}$ $\Rightarrow \frac{EF}{MN} = \frac{10}{7}$ or 7 FE = 10 MN	**½** **1** **½** **½** **1** **1** **½**

33. The median of the following distribution is 545. If the sum of all frequencies is 100, then find the values of x and y.

Class	*Frequency*
0 – 100	3
100 – 200	4
200 – 300	5
300 – 400	x
400 – 500	17
500 – 600	20
600 – 700	19
700 – 800	y
800 – 900	8
900 – 1000	3

Sol.

C.I.	*f*	*cf*
0 – 100	3	3
100 – 200	4	7
200 – 300	5	12
300 – 400	x	12 + x
400 – 500	17	29 + x
500 – 600	20	49 + x
600 – 700	19	68 + x
700 – 800	y	68 + x + y
800 – 900	8	76 + x + y
900 – 100	3	79 + x + y

Correct table **1**

Therefore, $79 + x + y = 100$

$\Longrightarrow x + y = 21$ **1**

Median class is 500 – 600. **½**

Median = 545

$\therefore 500 + \left(\frac{\frac{100}{2} - (29+x)}{20}\right) \times 100 = 545$ **1**

$\Longrightarrow x = 12$ **1**

and $y = 9$ **½**

34 (a) The denominator of a fraction is 2 more than the numerator. If 2 is added to both its numerator and denominator, then the sum of the new fraction and the original fraction is $\frac{46}{35}$. Find the original fraction.

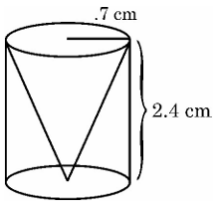
Sol.

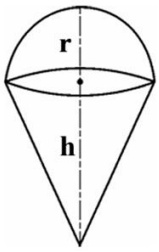
Let the fraction be $\frac{x}{x+2}$ **½**

Therefore, $\frac{x}{x+2} + \frac{x+2}{x+4} = \frac{46}{35}$ **2**

$\Longrightarrow 24x^2 + 4x - 228 = 0$ or $6x^2 + x - 57 = 0$ **1**

$\Longrightarrow (6x + 19)(x - 3) = 0$ **½**

	$x \neq -\frac{19}{6}$ $\therefore x = 3$ So, the required fraction is $\frac{3}{5}$	 ½ ½
	OR	
34 (b)	At present, Sourav's age is 3 years more than the square of his son Ravi's age. When Ravi grows to his father's present age, Sourav's age would be 6 years less than 13 times the present age of Ravi. Find present ages of Ravi and Sourav.	
Sol.	Let the present age of Ravi be 'r' years and the present age of Sourav be 's' years Therefore, $s = 3 + r^2$ --- ① Ravi grows to father's present age in $(s - r)$ years. $\therefore$ father's age after $(s - r)$ years $= (2s - r)$ years and Ravi's age after $(s - r)$ years = 's' years Therefore, $2s - r = 13r - 6$ or $s = 7r - 3$ --- ② Using ① and ②, $r^2 - 7r + 6 = 0$ $\Rightarrow (r - 6)(r - 1) = 0$ $\Rightarrow r = 6, 1$ Ignoring $r = 1$ as $s \neq 4$ $r = 6$ Hence $s = 39$	 **1** **1** **1** **1** ½ ½
35 (a)	From a solid cylinder of height 2·4 cm and radius 0·7 cm, a conical cavity of the same height and same radius is hollowed out. Find the volume and total surface area of the remaining solid.	
Sol.	 Volume of the remaining solid = Volume of cylinder – volume of cone $= \frac{22}{7} \times (0.7)^2 \times 2.4 - \frac{1}{3} \times \frac{22}{7} \times (0.7)^2 \times 2.4$ $= 2.464 \text{ cm}^3$ Slant height of cone $= \sqrt{(0.7)^2 + (2.4)^2} = 2.5$ cm Total Surface area = CSA of cylinder + CSA of cone + Area of base $= 2 \times \frac{22}{7} \times 0.7 \times 2.4 + \frac{22}{7} \times 0.7 \times 2.5 + \frac{22}{7} \times (0.7)^2$ $= 17.6 \text{ cm}^2$	 ½ + ½ **1** ½ ½+½+½ **1**
	OR	

35 (b)	A carpenter is making a wooden toy (lattu) which is conical in shape and surmounted by a hemisphere. The ratio of the height of the hemisphere and the cone is 3 : 4. If the radius of the cone and the hemisphere is 2·1 cm, find the volume of wood required to make this toy. Also, find the area to be painted after making the toy.	
Sol.	 Given r : h = 3 : 4 Let r = 3x , h = 4x $\because$ r = 3x = 2.1 $\Longrightarrow$ x = 0.7 Hence h = 2.8 cm Volume of wood required to make the toy = Volume of cone + Volume of hemisphere $= \frac{1}{3} \times \frac{22}{7} \times (2.1)^2 \times 2.8 + \frac{2}{3} \times \frac{22}{7} \times (2.1)^3$ $= 32.34 \text{ cm}^3$ Slant height of cone = $\sqrt{(2.1)^2 + (2.8)^2} = 3.5$ cm Total Surface Area = CSA of cone + CSA of hemisphere $= \frac{22}{7} \times 2.1 \times 3.5 + 2 \times \frac{22}{7} \times (2.1)^2$ $= 50.82 \text{ cm}^2$	½ ½ ½ + ½ **1** ½ ½ + ½ ½

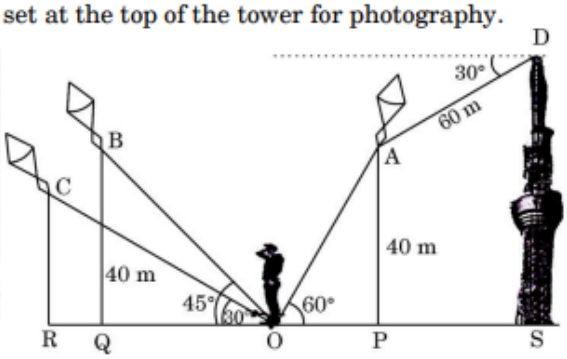
SECTION E

This section has **3** case study based questions carrying 4 marks each.

36.

Case Study – 1

The International Kite Festival takes place every year on 14th January. The main attractions of the festival include national and international Kite Flyers' Parade, kite flying, traditional stalls etc. On this day, few kite flyers, had assembled at a point 'O' on the ground. The position of 3 kites A, B, C was such that A and B were at the same vertical height of 40 m from the ground level. The angles of elevation of A, B and C from O were 60°, 45° and 30° respectively. A vertical tower, SD has been erected at point S and a camera is set at the top of the tower for photography.



Based on the information given above, answer the following questions :

(i) What is the length of the string of the kite at A ?

(ii) If the length of the string of kite at C is 40 m, then find the height of that kite C from the ground.

(iii) (a) What is the horizontal distance between the kites at A and B ?

OR

(iii) (b) If the angle of depression of the kite at A is 30° from the camera at D and the distance between A and D is 60 m, then find the height of the tower.

Sol.

(i) $\sin 60° = \frac{\sqrt{3}}{2} = \frac{40}{OA}$ ½

$\Rightarrow OA = \frac{80}{\sqrt{3}}$ m or $\frac{80\sqrt{3}}{3}$ m ½

(ii) $\sin 30° = \frac{1}{2} = \frac{RC}{40}$ ½

$\Rightarrow RC = 20$ m ½

(iii) (a) $\tan 45° = 1 = \frac{40}{OQ}$

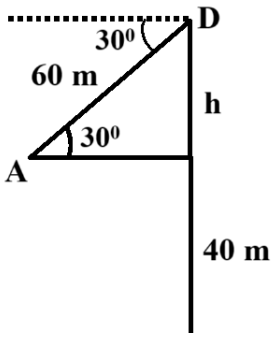
$\Rightarrow OQ = 40$ m ½

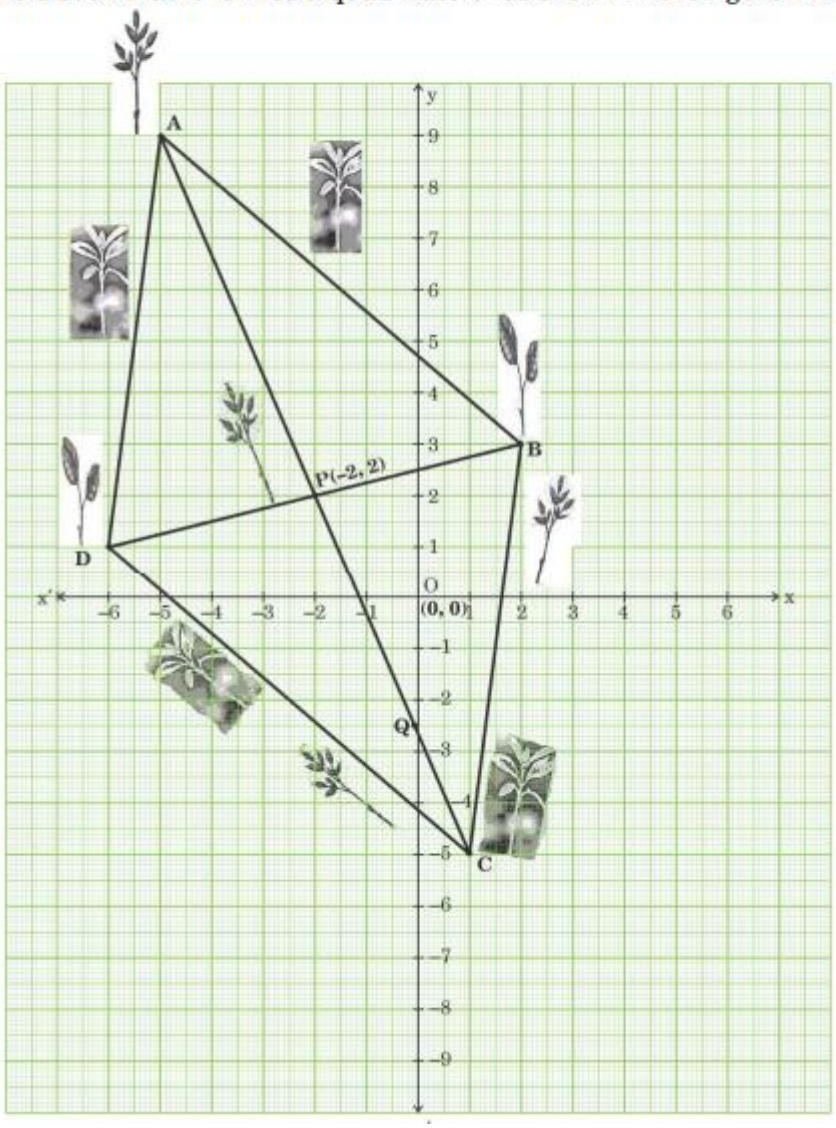
Also, $\tan 60° = \sqrt{3} = \frac{40}{OP}$

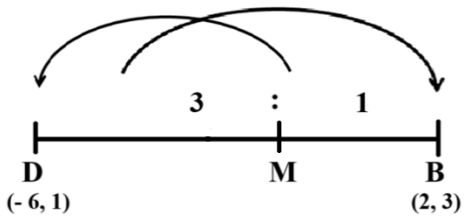
$\Rightarrow OP = \frac{40}{\sqrt{3}}$ m or $\frac{40\sqrt{3}}{3}$ m 1

$AB = PQ = \left(40 + \frac{40}{\sqrt{3}}\right)$ m or $\left(40 + \frac{40\sqrt{3}}{3}\right)$ m ½

OR

	(b)  $\sin 30° = \frac{1}{2} = \frac{h}{60}$ $\Rightarrow$ h = 30 m Height of the tower = 40 + 30 = 70 m	**1** ½ ½
37.	**Case Study – 2** In the month of September, villagers of Ankurhut were falling ill with high temperature. Paracetamol was one of the highest sold medicines during that phase. A survey was conducted to estimate the overall sale of Paracetamol of each pharmacy during the last 7 days. It was observed that the number of Paracetamol sold in different shops were all 3-digit numbers, divisible by 13, taken in order. Based on the information given above, answer the following questions : (i) How many Paracetamols were sold by the 7th pharmacy ? (ii) What was the difference between the number of Paracetamols sold by the 14th and the 9th pharmacy ? (iii) (a) How many Paracetamols were sold by the 9th pharmacy from the last ? **OR** (iii) (b) What was the total number of Paracetamols sold in that week ?	
Sol.	(i) A.P. formed is 104, 117, 130, … with a = 104 and d = 13 $a_7 = 104 + 6 \times 13 = 182$	½ ½

	(ii) $a_{14} - a_9 = 5 \times 13 = 65$ (iii) (a) Last term of A.P. is 988 and d = – 13 $a_9 = 988 + 8 \times (-13) = 884$ **OR** (b) Last term of A.P. is 988 and d = – 13 $988 = 104 + (n - 1) \times 13$ $\Rightarrow n = 69$ $S_{69} = \frac{69}{2} \times (104 + 988)$ $= 37674$	**1** **1** **1** **1** **1**
38.	**Case Study – 3** Trees act the natural filters. By planting trees in and around school premises, we create cleaner and healthier air for students and local residents, reducing respiratory problems. A school in Noida has proposed and organised a community drive on tree plantation under the title "Save Earth, Plant Trees". Students of that school have planted saplings in the field such that it formed a quadrilateral as shown in the figure ABCD.  	

	Based on the information given above, answer the following questions : (i) Find the distance between the two saplings at A and D. (ii) (a) One student plants one sapling at the mid-point of AD. Then he moves along a straight line parallel to DB and sows another sapling on AB. What are the coordinates of the positions of these two new saplings ? **OR** (ii) (b) A new sapling is kept at a point M on DB such that DM : MB = 3 : 1. Find the coordinates of M. (iii) The line segments AC and BD bisect each other at P(– 2, 2). Find the coordinates of C.	
Sol.	(i) Observing the graph, coordinators of points are A (– 5, 9) and D (– 6, 1) AD = $\sqrt{(-6+5)^2+(1-9)^2} = \sqrt{65}$ (ii) (a) Mid point of AD = $\left(\frac{-6-5}{2}, \frac{1+9}{2}\right)$ i.e. $\left(\frac{-11}{2}, 5\right)$ Student will sow another sapling at mid point of AB. Point B is (2, 3) Mid point of AB = $\left(\frac{2-5}{2}, \frac{3+9}{2}\right)$ i.e. $\left(\frac{-3}{2}, 6\right)$ **OR** (b)  Coordinates of M = $\left(\frac{6-6}{4}, \frac{9+1}{4}\right)$ i.e. $\left(0, \frac{5}{2}\right)$ (iii) Coordinates of C are (1, – 5)	½ ½ 1 1 1 1 1