PHYSICS

XII – ELECTRIC POTENTIAL AND CAPACITANCE

SECTION A

1. **A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting spherical shell. Let the potential difference between the surface of the solid sphere and the outer surface of the shell be V. If the shell is now given a charge -3Q the new potential difference between the same two surfaces is :–**

(1) V

(2) 2V

(3) 4V

(4) –2V

2. **A non - conducting ring is of radius 0.5 m. 1.11 × 10^{-10} coulombs charge is non uniformly distributed over the circumference of ring which produces electric field E around itself. If l = 0 is the centre of the ring, then the value of $\int_{l=\infty}^{l=o} -\vec{E}.\,dl$ is**

(1) 2V

(2) –2V

(3) –1V

(4) Zero

3. Two concentric spheres of radii R and r have similar charges with equal surface charge densities (σ). What is the electric potential at their common centre?

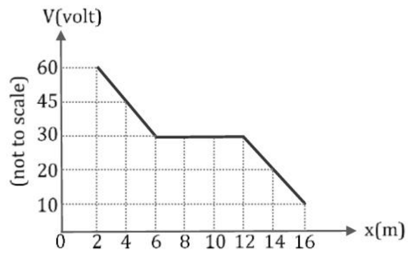
(1) $\frac{\sigma}{\varepsilon}$

(2) $\frac{\sigma}{\varepsilon}$ (R – r)

(3) $\frac{\sigma}{\varepsilon}$ (R + r)

(4) None of these

4. **The variation of potential with distance x from a fixed point is shown in figure. The electric field at x =13 m is :–**



(1) 7.5 volt/meter

(2) –7.5 volt/meter

(3) 5 volt/meter

(4) –5 volt/meter

5. **Choose the incorrect statement :–**

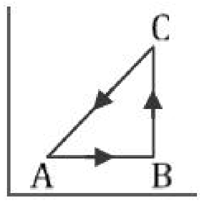
(1) The potential energy per unit positive charge in an electric field at some point is called the electric potential.

(2) The work required to be done to move a point charge from one point to another in an electric field depends on the position of the points

(3) The potential energy of the system will increase if a positive charge is moved against the Coulombian force

(4) The value of fundamental charge is not equivalent to the electronic charge.

6. **As shown in figure, on bringing a charge Q from point A to B and from B to C, the work done are 2 joules and –3 joules respectively. The work done in bringing the charge from C to A will be**



(1) –1 joule

(2) 1 joule

(3) 2 joules

(4) 5 joules

7. A 5 C charge experiences a force of 2000 N when moved between two points along the field separated by a distance of 2 cm in a uniform electric field. The potential difference between the two points is :–

(1) 8 volts
(2) 80 volts
(3) 800 volts
(4) 8000 volts

8. The electric potential and field at a point due to an electric dipole are proportional to

(1) r, r^{-1}
(2) r^{-1}, r^{-2}
(3) r^{-2}, r^{-3}
(4) r^{-2}, r^{-2}

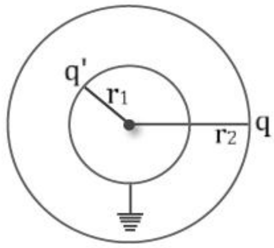
9. The force on a charge situated on the axis of a dipole is F. If the charge is shifted to double the distance, the force acting will be

(1) Zero
(2) F/2
(3) F/4
(4) F/8

10. Two conductors are of same shape and size. One of copper and the other of aluminium (less conducting) are placed in an uniform electric field. The charge induced in aluminium :–

(1) will be less than that in copper
(2) will be more than that in copper
(3) will be equal to that in copper
(4) cannot be compared with that of copper

11. Two concentric conducting spheres are of radii r1 and r2. The outer sphere is given a charge q. The charge q' on the inner sphere will be (inner sphere is grounded) :–



(1) q
(2) –q
(3) $-q\frac{r_1}{r_2}$
(4) zero

12. The capacitance C of a capacitor is :-

(1) independent of the charge and potential of the capacitor.
(2) dependent on the charge and independent of potential.
(3) independent of the geometrical configuration of the capacitor.
(4) independent of the dielectric medium between the two conducting surfaces of the capacitor,

13. A parallel plate capacitor has rectangular plates of 400 cm^2 area and are separated by a distance of 2 mm with air as the medium. What charge will appear on the plates if a 200 volt potential difference is applied across the capacitor ?

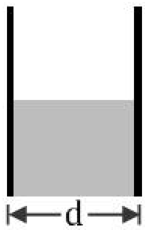
(1) $3.54 \times 10^{-6} C$
(2) $3.54 \times 10^{-8} C$
(3) $3.54 \times 10^{-10} C$
(4) $1770.8 \times 10^{-13} C$

14. The energy and capacitance of a charged parallel plate capacitor are U and C respectively. Now a dielectric slab of ϵ_r=6 is inserted in it then energy and capacitance becomes : (Assuming charge on plates remains constant)

(1) 6U, 6C
(2) U, C

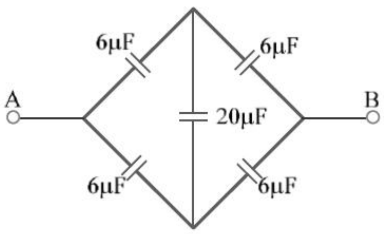
(3) U/6, 6C
(4) U, 6C

15. A parallel plate air capacitor has a capacitance C. When it is half filled with a dielectric of dielectric constant 5, the percentage increase in the capacitance will be :-



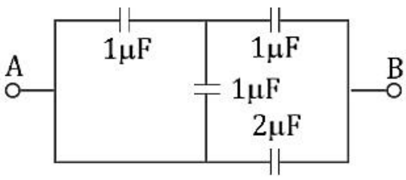
(1) 400%
(2) 66.6%
(3) 33.3%
(4) 200%

16. The effective capacitance of the network between terminals A and B is



(1) 6 μF
(2) 20 μF
(3) 3 μF
(4) 10 μF

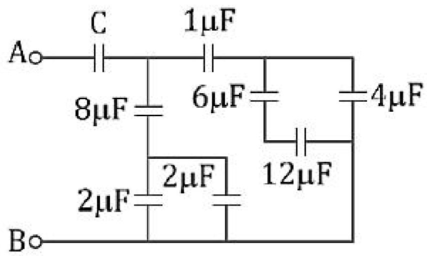
17. The equivalent capacitance between points A and B of the circuit shown will be :



(1) $\frac{2}{3}$ μF
(2) $\frac{5}{3}$ μF
(3) $\frac{7}{3}$ μF
(4) $\frac{8}{3}$ μF

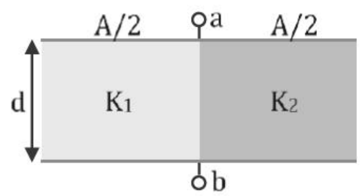
18. Half of the space between a parallel plate capacitor is filled with a medium of dielectric constant K parallel to the plates. If initially the capacitance was C, then the new capacitance will be
(1) 2KC/(1+K)
(2) C (K+1)/2
(3) CK/(1+K)
(4) KC

19. In the following circuit the resultant capacitance between A & B is . Find the value of C = 1 μF



(1) $\frac{23}{32}$ μF
(2) $\frac{32}{23}$ μF
(3) $\frac{13}{23}$ μF
(4) $\frac{23}{13}$ μF

20. The capacitance of a parallel plate air capacitor is 10 μF. As shown in the figure this capacitor is divided into two equal parts; these parts are filled by media of dielectric constants K_1 =2 and K_2 = 4. Capacitance of this arrangement will be :



(1) 20 μF
(2) 30 μF
(3) 10 μF
(4) 40 μF

21. Energy per unit volume for a capacitor having area A and separation d kept at potential difference V is given by :

(1) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$

(2) $\frac{1}{2}\frac{V^2}{d^2}\frac{1}{\varepsilon_0}$

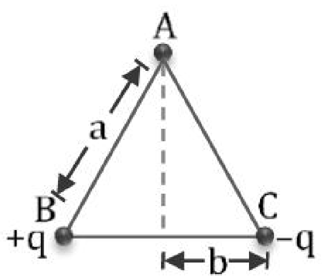
(3) $\frac{1}{2}\varepsilon_0\frac{V^2A^2}{d^2}$

(4) $\frac{1}{2}\frac{V^2}{d^2}\frac{A^2}{\varepsilon_0}$

22. Three capacitors each of capacitance 4 μF are to be connected in such a way that the effective capacitance is 6 μF. This can be done by :-

(1) connecting all of them in series
(2) connecting all of them in parallel
(3) connecting two in series and one in parallel
(4) connecting two in parallel and one in series

23. As shown in the fig. charges +q and –q are placed at the vertices B and C of an isosceles triangle. The potential at the vertex A is :–



(1) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{\sqrt{a^2+b^2}}$

(2) Zero

(3) $\frac{1}{4\pi\varepsilon_0}\frac{q}{\sqrt{a^2+b^2}}$

(4)) $\frac{1}{4\pi\varepsilon_0}\frac{-q}{\sqrt{a^2+b^2}}$

24. Four charges 2C, –3C, –4C and 5C respectively are placed at the four corners of a square. Which of the following statements is true for the point of intersection of the diagonals ?

(1) E = 0, V = 0
(2) E $\neq$ 0, V = 0
(3) E = 0, V $\neq$ 0
(4) E $\neq$ 0, V $\neq$ 0

25. The electric potential V is given as a function of distance x (metre) by V = ($5x^2$ – 10x – 9) volts. The value of eletric field at x = 1 m is :

(1) 20 V/m
(2) 6 V/m
(3) 11 V/m
(4) Zero

26. A charged hollow metal sphere has a radius r. If the potential difference between its surface and a point at distance 3r from the centre is V then the electric intensity at a distance 3r from the centre is :–

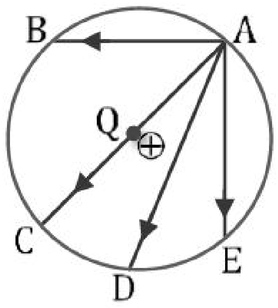
(1) $\frac{V}{6r}$

(2) $\frac{V}{4r}$

(3) $\frac{V}{3r}$

(4) $\frac{V}{2r}$

27. In the electric field of charge Q, another charge is carried from A to B, A to C, A to D and A to E, then work done will be :–



(1) minimum along the path AB
(2) minimum along the path AD
(3) minimum along the path AE
(4) zero along each path

28. A charge of 10 esu is placed at a distance of 2 cm from a charge of 40 esu and 4 cm from another charge of –20 esu. The potential energy of the charge 10 esu is :– (in ergs)
(1) 87.5
(2) 112.5
(3) 150
(4) zero

29. 15 joule of work has to be done against an existing electric field to take a charge of 0.01 C from A to B. Then the potential difference (VB – VA) is :–
(1) 1500 volts
(2) –1500 volts
(3) 0.15 volts
(4) None of these

30. A particle of mass m and charge q is released from rest in an electric field E. Then the K.E. after time t will be :–

(1) $\frac{2E^2t^2}{mq}$

(2) $\frac{E^2t^2q^2}{2m}$

(3) $\frac{Emq^2}{2t^2}$

(4) $\frac{Emq}{2t}$

31. Two particles each of mass M is attached to the two ends of a massless rigid non-conducting rod of length L. The two particles carry charges +q and –q respectively. This arrangement is held in a region of uniform electric field E such that the rod makes a small angle θ (<5°) with the field direction. The time period of rod is (rod oscillates about its centre of mass) :–

(1) $2\pi\sqrt{\frac{ML}{2qE}}$

(2) $\pi\sqrt{\frac{ML}{2qE}}$

(3) $\frac{\pi}{2}\sqrt{\frac{ML}{2qE}}$

(4) $4\pi\sqrt{\frac{ML}{2qE}}$

32. A small electric dipole is of dipole moment p. The electric potential at a distance 'r' from its centre and making an angle θ from the axis of dipole will be :–

(1) $\frac{K\,p\,\sin\theta}{r^2}$

(2) $\frac{K\,p\,\cos\theta}{r^2}$

(3) $\frac{K\,p}{r^3}\sqrt{1 + 3\cos^2\theta}$

(4) $\frac{K\,p}{r^3}\sqrt{1 + 3\sin^2\theta}$

33. A big hollow metal sphere A is charged to 100 volts and another smaller hollow sphere B is charged to 50 volts. If B is

put inside A and joined with a metallic wire, then the direction of charge flow :–

(1) is from A to B

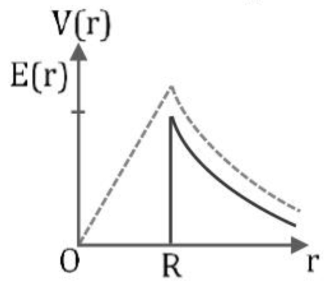
(2) is from B to A

(3) no charge flows

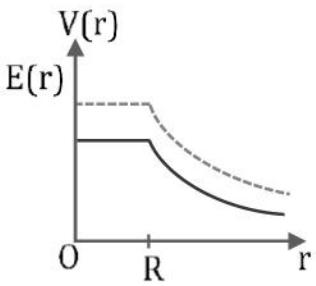
(4) depends on the radii of spheres.

34. Consider a conducting spherical shell of radius R with its centre at the origin, carrying uniform positive surface charge density. The variation of the magnitude of the electric field and the electric potential V(r) with the distance r from the centre, is best represented by the graph (Here dotted line represents potential curve and bold line represents electric field curve) :– |E(r)|

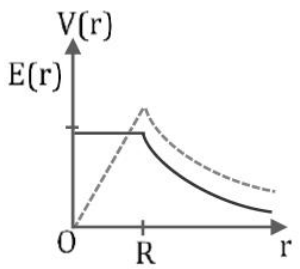
(1)



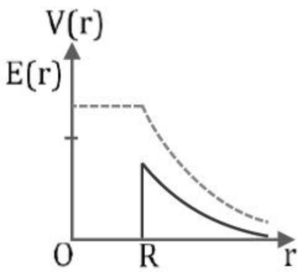
(2)



(3)



(4)



35. An uncharged capacitor is connected to a battery. On charging the capacitor :-

(1) all the energy supplied is stored in the capacitor.

(2) half the energy supplied is stored in the capacitor.

(3) the energy stored depends upon the capacitance of the capacitor only.

(4) the energy stored depends upon the time for which the capacitor is charged.

SECTION B

36. A charged parallel plate capacitor of distance (d) has energy U_0. A slab of dielectric constant (K) and thickness (d) is then introduced between the plates of the capacitor. The new energy of the system is given

(1) KU_0

(2) K^2

(3) U_0/K

(4) U_0/K^2

37. Distance between the plates of a parallel plate capacitor is 'd' and area of each plate is A. When a slab of dielectric constant K and thickness t is placed between the plates, its capacitance becomes:

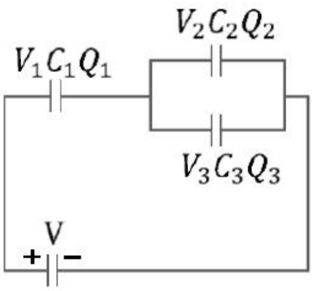
(1) $\frac{\varepsilon_0 A}{\left[d+t\left\{1-\frac{1}{K}\right\}\right]}$

(2) $\frac{\varepsilon_0 A}{\left[d+t\left\{1+\frac{1}{K}\right\}\right]}$

(3) $\frac{\varepsilon_0 A}{\left[d-t\left\{1+\frac{1}{K}\right\}\right]}$

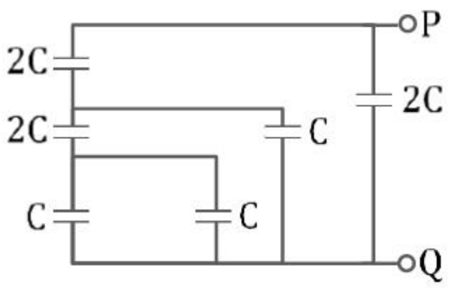
(4) $\frac{\varepsilon_0 A}{\left[d-t\left\{1-\frac{1}{K}\right\}\right]}$

38. In an adjoining figure three capacitors C1, C2 and C3 are joined to a battery. The correct condition will be :



(1) Q1= Q2 = Q3 and V1 = V2 = V3
(2) Q1= Q2 + Q3 and V = V1 + V2 + V3
(3) Q1= Q2 + Q3 and V = V1 + V2
(4) Q2 = Q3 and V2 = V3

39. The value of equivalent capacitance of the combination shown in figure, between the points P and Q is :



(1) 3C
(2) 2C
(3) C
(4) C/3

40. Two spheres of radii R_1 and R_2 having equal charges are joined together with a copper wire. If V is the potential of each sphere after they are separated from each other, then the initial charge on both spheres was

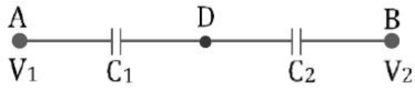
(1) $\frac{V}{K}[R_1 + R_2]$

(2) $\frac{V}{2K}[R_1 + R_2]$

(3) $\frac{V}{3K}[R_1 + R_2]$

(4) $\frac{V}{K}\frac{[R_1 R_2]}{[R_1 + R_2]}$

41. Two capacitances C_1 and C_2 in a circuit are joined as shown in figure The potential of point A is V_1 and that of B is V_2. The potential of point D will be :



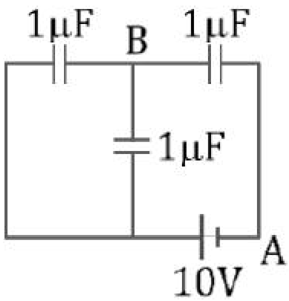
(1) $\frac{1}{2}(V_1 + V_2)$

(2) $(C_2V_1 + C_1V_2)/ C_1 + C_2$

(3) $(C_1V_1 + C_2V_2)/ C_1 + C_2$

(4) $(C_2V_1 - C_1V_2)/ C_1 + C_2$

42. If potential of A is 10 V, then potential of B is :



(1) 25/3 V
(2) 50/3 V
(3) 100/3 V
(4) 50 V

43. Two spherical conductors A and B of radius a and b (b > a) are placed in air concentrically. B is given a charge + Q coulombs and A is grounded. The equivalent capacitance of these is :

(1) $4\pi\epsilon_0\frac{ab}{b-a}$

(2) $4\pi\epsilon_0(a+b)$

(3) $4\pi\epsilon_0 b$

(4) $4\pi\epsilon_0\frac{b^2}{b-a}$

44. Two capacitors of capacitances 3 μF and 6 μF are charged to a potential of 12 V each. They are now connected to each other with the positive plate of one joined to the negative plate of the other. The potential difference across each will be

(1) 3V
(2) Zero
(3) 6V
(4) 4V

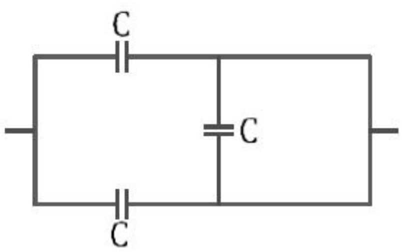
45. A 40 μF capacitor in a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of duration 2ms. The power delivered to the patient is :

(1) 45 kW
(2) 90 kW
(3) 180 kW
(4) 360 kW

46. Twenty seven drops of same size are charged at 220V each. They combine to form a bigger drop. Calculate the potential of the bigger drop.

(1) 660V
(2) 1320V
(3) 1520V
(4) 1980V

47. The equivalent capacitance of the combination shown in the figure is :

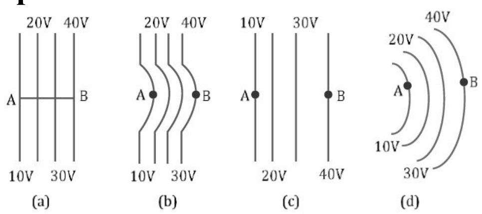


(1) 3C
(2) 2C
(3) C/2
(4) -3C/2

48. In a certain region of space with volume 0.2 m^3 the electric potential is found to be 5 V throughout. The magnitude of electric field in this region is :

(1) 5 N/C
(2) Zero
(3) 0.5 N/C
(4) 1 N/C

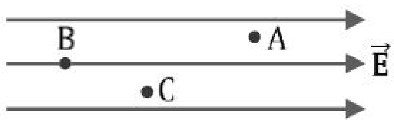
49. The diagrams below show regions of equipotentials:



A positive charge is moved from A to B in each diagram.

(1) In all the four cases the work done is the same
(2) Minimum work is required to move q in figure (a)
(3) Maximum work is required to move q in figure (b)
(4) Maximum work is required to move q in figure (c)

50. A, B and C are three points in a uniform electric field. The electric potential is :-



(1) same at all the three points A,B and C
(2) maximum at A
(3) maximum at B
(4) maximum at C

ANSWER KEY

Q	A	Q	A	Q	
1	1	2	1	3	
6	2	7	1	8	
11	3	12	1	13	
16	1	17	3	18	
21	1	22	3	23	
26	1	27	4	28	
31	1	32	2	33	
36	3	37	4	38	
41	3	42	2	43	
46	4	47	2	48	