9. A string of length 0.4 m and mass 10^{-2} kg is tightly clamped at its ends. The tension in the string is 1.6 N. Identical wave pulses are produced at one end at equal intervals of time Δt. The minimum value of Δt which allows constructive interference between successive pulses is **[IIT 1998]**

(a) 0.05 s (b) 0.10 s

(c) 0.20 s (d) 0.40 s

10. Two identical stringed instruments have frequency 100 Hz. If tension in one of them is increased by 4% and they are sounded together then the number of beats in one second is **[EAMCET (Engg.) 1995]**

(a) 1 (b) 8

(c) 4 (d) 2

11. The difference between the apparent frequency of a source of sound as perceived by an observer during its approach and recession is 2% of the natural frequency of the source. If the velocity of sound in air is 300 m/sec, the velocity of the source is (It is given that velocity of source << velocity of sound) **[CPMT 1982; RPET 1998]**

(a) 6 m/sec (b) 3 m/sec

(c) 1.5 m/sec (d) 12 m/sec

12. A sound wave of frequency ν travels horizontally to the right. It is reflected from a large vertical plane surface moving to the left with a speed v. The speed of sound in the medium is c, then **[IIT 1995; BCECE 2005]**

(a) The frequency of the reflected wave is $\frac{\nu(c+v)}{c-v}$

(b) The wavelength of the reflected wave is $\frac{d(c-v)}{\nu(c+v)}$

(c) The number of waves striking the surface per second is $\frac{\nu(c+v)}{c}$

(d) The number of beats heard by a stationary listener to the left of the reflecting surface is $\frac{v\,\nu}{c-v}$

13. Two cars are moving on two perpendicular roads towards a crossing with uniform speeds of 72 km/hr and 36 km/hr. If first car blows horn of frequency 280 Hz, then the frequency of horn heard by the driver of second car when line joining the cars make 45° angle with the roads; will be **[RPET 1997]**

(a) 321 Hz (b) 298 Hz

(c) 289 Hz (d) 280 Hz

14. Two whistles A and B produces notes of frequencies 660 Hz and 596 Hz respectively. There is a listener at the mid-point of the line joining them. Now the whistle B and the listener start moving with speed 30 m/s away from the whistle A. If speed of sound be 330 m/s, how many beats will be heard by the listener **[RPET 1996]**

(a) 2 (b) 4

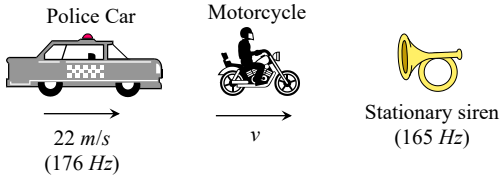
(c) 6 (d) 8

15. A source producing sound of frequency 170 Hz is approaching a stationary observer with a velocity 17 ms^{-1}. The apparent change in the wavelength of sound heard by the observer is (speed of sound in air = 340 ms^{-1}) **[EAMCET (Engg.) 2000]**

(a) 0.1m (b) 0.2m

(c) 0.4m (d) 0.5m

16. A police car moving at 22 m/s, chases a motorcyclist. The police man sounds his horn at 176 Hz, while both of them move towards a stationary siren of frequency 165 Hz. Calculate the speed of the motorcycle, if it is given that he does not observes any beats **[IIT-JEE (Screening) 2003]**



(a) 33 m/s (b) 22 m/s

(c) Zero (d) 11 m/s

17. An observer moves towards a stationary source of sound with a speed 1/5th of the speed of

sound. The wavelength and frequency of the source emitted are λ and f respectively. The apparent frequency and wavelength recorded by the observer are respectively [CBSE PMT 2003]

(a) $1.2\ f, \lambda$ (b) $f, 1.2\lambda$

(c) $0.8\ f, 0.8\lambda$ (d) $1.2\ f, 1.2\lambda$

18. A light pointer fixed to one prong of a tuning fork touches a vertical plate. The fork is set vibrating and the plate is allowed to fall freely. If eight oscillations are counted when the plate falls through 10 *cm*, the frequency of the tuning fork is [IIT 1977; KCET 2002]

(a) 360 *Hz* (b) 280 *Hz*

(c) 560 *Hz* (d) 56 *Hz*

19. Oxygen is 16 times heavier than hydrogen. Equal volumes of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is [KCET 2004]

(a) $\sqrt{\frac{1}{8}}$ (2) $\sqrt{\frac{32}{17}}$

(c) $\sqrt{8}$ (d) $\sqrt{\frac{2}{17}}$

20. The equation of displacement of two waves are given as $y_1 = 10\sin\left(3\pi t + \frac{\pi}{3}\right)$; $y_2 = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$. Then what is the ratio of their amplitudes [AIIMS 1997; Haryana PMT 2000]

(a) 1 : 2 (b) 2 : 1

(c) 1 : 1 (d) None of these

21. The equation $y = A\cos^2\left(2\pi\ nt - 2\pi\frac{x}{\lambda}\right)$ represents a wave with

(a) Amplitude $A/2$, frequency $2n$ and wavelength $\lambda/2$

(b) Amplitude $A/2$, frequency $2n$ and wavelength λ

(c) Amplitude A, frequency $2n$ and wavelength 2λ

(d) Amplitude A, frequency n and wavelength λ

22. In a wave motion $y = a\sin(kx - \omega t)$, y can represent [IIT-JEE 1999]

(a) Electric field (b) Magnetic field

(c) Displacement (d) Pressure

23. Consider ten identical sources of sound all giving the same frequency but having phase angles which are random. If the average intensity of each source is I_0, the average of resultant intensity I due to all these ten sources will be [MP PMT 1990]

(a) $I = 100\ I_0$ (b) $I = 10\ I_0$

(c) $I = I_0$ (d) $I = \sqrt{10}\ I_0$

24. Ten tuning forks are arranged in increasing order of frequency in such a way that any two nearest tuning forks produce 4 *beats*/*sec*. The highest frequency is twice of the lowest. Possible highest and the lowest frequencies are [MP PMT 1990; MHCET 2002]

(a) 80 and 40 (b) 100 and 50

(c) 44 and 22 (d) 72 and 36

25. 41 forks are so arranged that each produces 5 *beats per sec* when sounded with its near fork. If the frequency of last fork is double the frequency of first fork, then the frequencies of the first and last fork are respectively [MP PET 1997; KCET 2002]

(a) 200, 400 (b) 205, 410

(c) 195, 390 (d) 100, 200

26. Two identical wires have the same fundamental frequency of 400 *Hz*. when kept under the same tension. If the tension in one wire is increased by 2% the number of beats produced will be [KCET 2002]

(a) 4 (b) 2

(c) 8 (d) 1

27. 25 tunning forks are arranged in series in the order of decreasing frequency. Any two successive forks produce 3 beats/sec. If the frequency of the first turning fork is the octave of the last fork, then the frequency of the 21st fork is [Kerala (Engg.) 2001]

(a) 72 *Hz* (b) 288 *Hz*

(c) 84 *Hz* (d) 87 *Hz*

28. 16 tunning forks are arranged in the order of increasing frequencies. Any two successive forks give 8 beats per sec when sounded together. If the frequency of the last fork is twice the first, then the frequency of the first fork is

[CBSE PMT 2000; MP PET 2001]

(a) 120 (b) 160

(c) 180 (d) 220

29. Two identical straight wires are stretched so as to produce 6 beats per second when vibrating simultaneously. On changing the tension in one of them, the beat frequency remains unchanged. Denoting by T_1, T_2, the higher and the lower initial tensions in the strings, then it could be said that while making the above change in tension **[IIT 1991]**

(a) T_2 was decreased (b) T_2 was increased

(c) T_1 was increased (d) T_1 was kept constant

30. The frequency of a stretched uniform wire under tension is in resonance with the fundamental frequency of a closed tube. If the tension in the wire is increased by 8 *N*, it is in resonance with the first overtone of the closed tube. The initial tension in the wire is

(a) 1 *N* (b) 4 *N*

(c) 8 *N* (d) 16 *N*

31. A metal wire of linear mass density of 9.8 *g/m* is stretched with a tension of 10 *kg* weight between two rigid supports 1 *metre* apart. The wire passes at its middle point between the poles of a permanent magnet, and it vibrates in resonance when carrying an alternating current of frequency *n*. The frequency *n* of the alternating source is

[AIEEE 2003]

(a) 25 *Hz* (b) 50 *Hz*

(c) 100 *Hz* (d) 200 *Hz*

32. A wire of density 9×10^3 kg /m^3 is stretched between two clamps 1 m apart and is subjected to an extension of 4.9×10^{-4} m. The lowest frequency of transverse vibration in the wire is ($Y = 9 \times 10^{10}$ N / m^2) **[UPSEAT 2000; Pb. PET 2004]**

(a) 40 *Hz* (b) 35 *Hz*

(c) 30 *Hz* (d) 25 *Hz*

33. A man is watching two trains, one leaving and the other coming in with equal speeds of 4 *m*/sec. If they sound their whistles, each of frequency 240 *Hz*, the number of beats heard by the man (velocity of sound in air = 320 *m*/*sec*) will be equal to **[NCERT 1984; CPMT 1997; MP PET 1999; RPMT 2000; BHU 2004, 05]**

(a) 6 (b) 3

(c) 0 (d) 12

34. An open pipe is in resonance in its 2nd harmonic with tuning fork of frequency f_1. Now it is closed at one end. If the frequency of the tuning fork is increased slowly from f_1 then again a resonance is obtained with a frequency f_2. If in this case the pipe vibrates n^{th} harmonics then

[IIT-JEE (Screening) 2005]

(a) $n = 3,\ f_2 = \frac{3}{4} f_1$ (b) $n = 3,\ f_2 = \frac{5}{4} f_1$

[EAMCET (Engg.) 2000]

(c) $n = 5,\ f_2 = \frac{5}{4} f_1$ (d) $n = 5,\ f_2 = \frac{3}{4} f_1$

35. Two speakers connected to the same source of fixed frequency are placed 2.0 *m* apart in a box. A sensitive microphone placed at a distance of 4.0*m* from their midpoint along the perpendicular bisector shows maximum response. The box is slowly rotated until the speakers are in line with the microphone. The distance between the midpoint of the speakers and the microphone remains unchanged. Exactly five maximum responses are observed in the microphone in doing this. The wavelength of the sound wave is

(a) 0.2 *m* (b) 0.4 *m*

(c) 0.6 m (d) 0.8 m

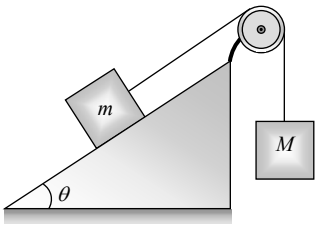
36. A wire of $9.8\times10^{-3}\,kgm^{-1}$ passes over a frictionless light pulley fixed on the top of a frictionless inclined plane which makes an angle of 30° with the horizontal. Masses m and M are tied at the two ends of wire such that m rests on the plane and M hangs freely vertically downwards. The entire system is in equilibrium and a transverse wave propagates along the wire with a velocity of 100 ms^{-1}. Chose the correct option

(a) $m=20\,kg$

(b) $m=5\,kg$

(c) $m=2\,kg$

(d) $m=7\,kg$

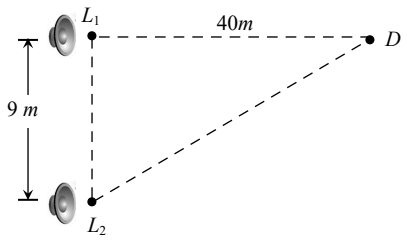


37. A man standing in front of a mountain beats a drum at regular intervals. The rate of drumming is generally increased and he finds that the echo is not heard distinctly when the rate becomes 40 per minute. He then moves nearer to the mountain by 90 m and finds that echo is again not heard when the drumming rate becomes 60 per minute. The distance between the mountain and the initial position of the man is

(a) 205 m (b) 300 m

(c) 180 m (d) 270 m

38. Two loudspeakers L_1 and L_2 driven by a common oscillator and amplifier, are arranged as shown. The frequency of the oscillator is gradually increased from zero and the detector at D records a series of maxima and minima. If the speed of sound is 330 ms^{-1} then the frequency at which the first maximum is observed is



(a) 165 Hz (b) 330 Hz

(c) 496 Hz (d) 660 Hz

39. The displacement due to a wave moving in the positive x-direction is given by $y=\frac{1}{(1+x^2)}$ at time $t=0$ and by $y=\frac{1}{[1+(x-1)^2]}$ at $t=2$ seconds, where x and y are in *metres*. The velocity of the wave in *m/s* is

(a) 0.5 (b) 1

(c) 2 (d) 4

40. A person speaking normally produces a sound intensity of 40 dB at a distance of 1 m. If the threshold intensity for reasonable audibility is 20 dB, the maximum distance at which he can be heard clearly is

(a) 4 m (b) 5 m

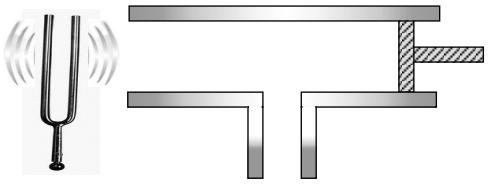
(c) 10 m (d) 20 m

41. A string of length L and mass M hangs freely from a fixed point. Then the velocity of transverse waves along the string at a distance x from the free end is

(a) $\sqrt{gL}$ (b) $\sqrt{gx}$

(c) gL (d) gx

42. Vibrating tuning fork of frequency n is placed near the open end of a long cylindrical tube. The tube has a side opening and is fitted with a movable reflecting piston. As the piston is moved through 8.75 *cm,* the intensity of sound changes from a maximum to minimum. If the speed of sound is 350 *m/s*. Then n is



(a) 500 Hz (b) 1000 Hz

(c) 2000 Hz (d) 4000 Hz

43. A stone is hung in air from a wire which is stretched over a sonometer. The bridges of the

sonometer are L *cm* apart when the wire is in unison with a tuning fork of frequency N. When the stone is completely immersed in water, the length between the bridges is l *cm* for re-establishing unison, the specific gravity of the material of the stone is

(a) $\frac{L^2}{L^2+l^2}$ (b) $\frac{L^2-l^2}{L^2}$

(c) $\frac{L^2}{L^2-l^2}$ (d) $\frac{L^2-l^2}{L^2}$

44. The displacement of a particle in string stretched in X direction is represented by y. Among the following expressions for y, those describing wave motions are

[IIT 1987]

(a) $\cos kx \sin \omega t$ (b) $k^2x^2-\omega^2t^2$

(c) $\cos(kx+\omega t)$ (d) $\cos(k^2x^2-\omega^2t^2)$

45. Three waves of equal frequency having amplitudes 10 μm, 4 μm and 7 μm arrive at a given point with successive phase difference of $\frac{\pi}{2}$. The amplitude of the resulting wave in μm is given by **[AIIMS 1995]**

(a) 7 (b) 6

(c) 5 (d) 4

46. There are three sources of sound of equal intensity with frequencies 400, 401 and 402 *vib*/*sec*. The number of beats heard per second is

[MNR 1980; J & K CET 2005]

(a) 0 (b) 1

(c) 2 (d) 3

47. A tuning fork of frequency 340*Hz* is vibrated just above the tube of 120 *cm* height. Water is poured slowly in the tube. What is the minimum height of water necessary for the resonance (speed of sound in the air = 340 *m*/*sec*)

[CBSE PMT 1999; UPSEAT 1999]

(a) 15 *cm* (b) 25 *cm*

(c) 30 *cm* (d) 45 *cm*

48. An organ pipe is closed at one end has fundamental frequency of 1500 *Hz*. The maximum number of overtones generated by this pipe which a normal person can hear is :

[AIIMS 2004]

(a) 14 (b) 13

(c) 6 (d) 9

49. In Melde's experiment, the string vibrates in 4 loops when a 50 *gram* weight is placed in the pan of weight 15 *gram*. To make the string to vibrates in 6 loops the weight that has to be removed from the pan is

[MH CET 2004]

(a) 0.0007 *kg wt* (b) 0.0021 *kg wt*

(c) 0.036 *kg wt* (d) 0.0029 *kg wt*

50. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v is the velocity of sound, then the velocity of the car is

[KCET 2002; CBSE PMT 2004]

(a) $v/\sqrt{2}$ (b) $v/2$

(c) $v/3$ (d) $v/4$

51. An earthquake generates both transverse (S) and longitudinal (P) sound waves in the earth. The speed of S waves is about 4.5 *km*/s and that of P waves is about 8.0 *km/s*. A seismograph records P and S waves from an earthquake. The first P wave arrives 4.0 *min* before the first S wave. The epicenter of the earthquake is located at a distance about

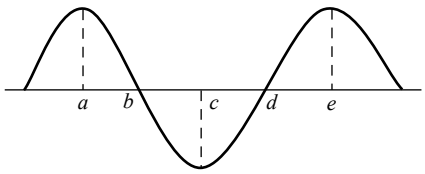
[AIIMS 2003]

(a) 25 *km* (b) 250 *km*

(c) 2500 *km* (d) 5000 *km*

Graphical Questions

1. The rope shown at an instant is carrying a wave travelling towards right, created by a source vibrating at a frequency n. Consider the following statements



I. The speed of the wave is $4n \times ab$

II. The medium at a will be in the same phase as d after $\frac{4}{3n}s$

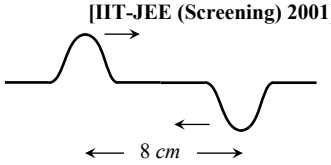
III. The phase difference between b and e is $\frac{3\pi}{2}$

Which of these statements are correct **[AMU 2001]**

(a) I, II and III (b) II only

(c) I and III (d) III only

2. Two pulses in a stretched string whose centres are initially 8 *cm* apart are moving towards each other as shown in the figure. The speed of each pulse is 2 *cm/s*. After 2 seconds, the total energy of the pulses will be **[IIT-JEE (Screening) 2001]**



(a) Zero

(b) Purely kinetic

(c) Purely potential

(d) Partly kinetic and partly potential