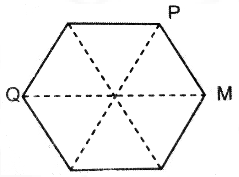
PHYSICS

61. You are provided with three similar, but slightly different tuning forks. When A and B are both struck, a beat frequency of f_{AB} is heard. When A and C are both struck, a beat frequency of f_{AC} is heard. If B and C are simultaneously struck, what will be the observed beat frequency?
1) $|f_{AB}+f_{AC}|$
2) $|f_{AB}-f_{AC}|$
3) Either $|f_{AB}+f_{AC}|$ or $|f_{AB}-f_{AC}|$ will be heard
4) $|f_{AB}+f_{AC}|$ and $|f_{AB}-f_{AC}|$ will simultaneously be heard

62. Two identical point like coherent sound sources emitting sound in same phase of wavelength 1 m are located at points P and Q as shown in figure. All sides of the polygon are equal and of length 1 m. The intensity of sound at M due to each source alone is I_0.



What will be the intensity of sound at point M when both the sources are on?

1) $4I_0$ 2) $\frac{3I_0}{2}$ 3) $\frac{9}{4}I_0$ 4) $39I_0$

63. The equation for the vibration of a string fixed at both ends vibrating in its third harmonic is given by; $y = 2cm \sin[(0.6\ cm^{-1})x] \cos[(500\pi s^{-1})t]$. The length of the string is.

1) 24.6 cm 2) 12.5 cm 3) 20.6 cm 4) 15.7 cm

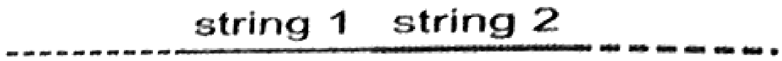
64. A sinusoidal wave travelling in the positive direction of x on a stretched string has amplitude 2.0 cm, wavelength 1 m and wave velocity 5.0 m/s. At $x = 0$ and $t = 0$, it is given that displacement $y = 0$ and $\frac{\partial y}{\partial t} < 0$. Express the wave function correctly in the form $y = f(x,t)$

1) $y = (0.02m)\sin 2\pi(x - 5t)$
2) $y = -(0.02cm)\sin 2\pi(x - 5t)$
3) $y = (0.02m)\sin 2\pi\left(x - 5t + \frac{1}{4}\right)$
4) $y = (0.02m)\cos 2\pi\left(x - 5t + \frac{1}{4}\right)$

65. The equation of a plane progressive wave is $y = 0.02\sin 8\pi\left[t - \frac{x}{20}\right]$. When it is reflected at a rarer medium (medium with higher velocity) at x = 0, its amplitude becomes 75% of its previous value. The equation of the reflected wave is :

1) $y = 0.02\sin 8\pi\left[t - \frac{x}{20}\right]$
2) $y = 0.02\sin 8\pi\left[t + \frac{x}{20}\right]$
3) $y = +0.015\sin 8\pi\left[t + \frac{x}{20}\right]$
4) $y = -0.015\sin 8\pi\left[t + \frac{x}{20}\right]$

66. String 1 is connected with string 2. The mass per unit length in string 1 is μ_1 and the mass per unit length in string 2 is $4\mu_1$. The tension in the strings is *T*. A travelling wave is coming from the left. What fraction of the energy in the incident wave goes into string 2?

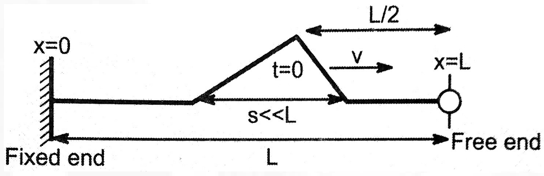


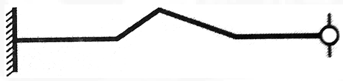
1) 1/8   2) 3/9   3) 2/3   4) 8/9

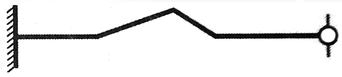
67. A string of length l is fixed at both ends. It is vibrating in its third overtone with maximum amplitude 'a'. The amplitude at a distance $\frac{l}{16}$ from one end is:

1) $\frac{a}{\sqrt{2}}$ 2) 0   3) $\frac{\sqrt{3}a}{2}$ 4) $\frac{a}{2}$

68. A very small pulse of length ‘s’ is travelling with speed v in a string of length L is shown at $t = 0$, moving towards free end. Which of these is not correctly matched:



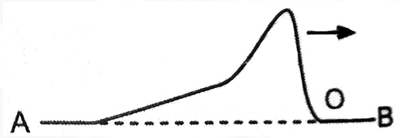
(i) $t = \frac{L}{\upsilon}$ (p) 

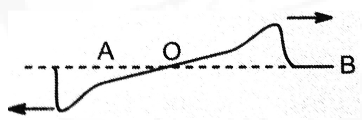
(ii) $t = \frac{2L}{\upsilon}$ (q) 

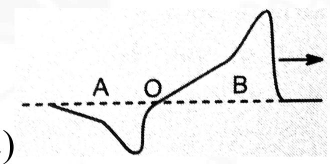
(iii) $t = \frac{3L}{\upsilon}$ (r) 

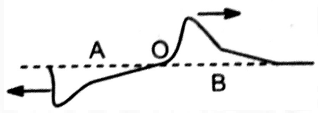
1) (i) 2) (ii) 3) (iii) 4) none of these

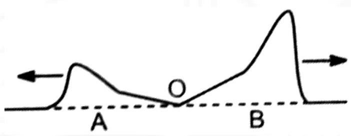
69. Two strings, A and B of lengths $4L$ and L respectively and same mass M each, are tied together to form a knot 'O' and stretched under the same tension. A transverse wave pulse is sent along the composite string from the string A, as shown towards knot 'O'. Which of the following diagrams approximately shows the reflected and transmitted wave pulses near the knot 'O'?



1) 

2) 

3) 

4) 

70. String I and II have identical lengths and linear mass densities, but string I is under greater tension than string II. The accompanying figure shows four different situations, (a) to (d), in which standing wave patterns exist on the two strings. In which situation it is possible that string I and II are oscillating at the same resonant frequency?

String I **String II**

1) 

2) 

3) 

4) 

71. A narrow steel rod of length 'L' is rigidly clamped at its mid-point only and transverse standing waves of frequency 'f' are set up in it. The speed of transverse waves in the rod is 'c'. Then:

1) The free ends of the rod must be nodes

2) The 10^{th} harmonic frequency 'f' of the rod is $\frac{33c}{7L}$

3) The second overtone frequency of the rod is $\frac{5c}{2L}$

4) 'f' can be any integral multiple of the fundamental frequency

72. A pulse is started at a time $t = 0$ along the +x direction on a long, taut string. The shape of the pulse at $t = 0$ is given by function $f(x)$ with:

$$f(x) = \begin{cases} \frac{x}{4}+1 & for\ -4 < x \le 0 \\ -x+1 & for\ \ 0 < x < 1 \\ 0 & otherwise \end{cases}$$

Here f and x are in centimeters. The linear mass density of the string is 50 gm/m and it is under a tension of 5N.

1) The shape of the string is drawn at $t = 0$ then the area of the pulse enclosed by the string and the x-axis is 7.5 cm^2.

2) The shape of the string is drawn at $t = 0$ then the area of the pulse enclosed by the string and the x-axis is 5 cm^2.

3) The transverse velocity of the particle at $x = 13$ cm and $t = 0.015$ s will be -250 cm/s

4) The transverse velocity of the particle at $x = 13$ cm and $t = 0.015$ s will be 250 cm/s

73. String of length L whose one end is at $x = 0$ vibrates according to the relations given by different equations. Choose the correct statements:

1) $y = A\sin\frac{\pi x}{L}\sin\omega t$ has 2 antinodes 4 nodes

2) $y = A\cos\frac{\pi x}{L}\sin\omega t$ has 3 antinodes, 2 nodes

3) $y = A\sin\frac{2\pi x}{L}\sin\omega t$ has 3 nodes, 2 antinodes

4) $y = A\cos\frac{2\pi x}{L}\sin\omega t$ has 3 antinodes, 3 nodes

74. In an organ pipe whose one end is at $x = 0$, the excess pressure is expressed by $P = P_0\cos\frac{3\pi x}{2}\sin 300\pi t$, where x is in meter and t in sec. The organ pipe can be:

1) Closed at one end, open at another with length = 0.5 m

2) Open at both ends, length = 1 m

3) Closed at both ends, length = 2.5 m

4) Closed at one end, open at another with length = 1/3 m

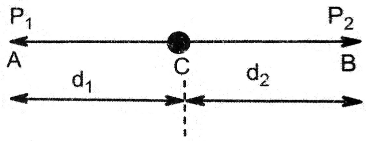
75. Three coherent sonic sources emitting sound of single wavelength 'λ'are placed on the x-axis at points $(-\lambda\sqrt{11}/6, 0), (0, 0), (\lambda\sqrt{11}/6, 0)$. The intensity reaching a point $(0, 5\lambda/6)$ from each source has the same value I_0. Then the resultant intensity at this point due to the interference of the three waves will be :

1) $6I_0$ 2) $7I_0$ 3) $5I_0$ 3) $4I_0$

76. A source when at rest in a medium produces waves with a velocity υ and a wavelength of λ. If the source is set in motion with a velocity υ_s what would be the wavelengths produced directly in front of the source?

1) $\lambda\left(1-\frac{\upsilon_s}{\upsilon}\right)$ 2) $\lambda\left(1+\frac{\upsilon_s}{\upsilon}\right)$ 3) $\lambda\left(1+\frac{\upsilon}{\upsilon_s}\right)$ 4) $\frac{\lambda\upsilon}{\upsilon+\upsilon_s}$

77. Two coherent loudspeakers are located at point A and B as shown. Both starts vibrating in phase at same frequency. P_1 and P_2 are their respective power status. Point C lies on a line joining the two loudspeakers at a distance of d_1 from A and d_2 from B. With both speakers switched on what is the power (in W/m^2) at point C. Take velocity of sound 300 m/s, frequency $v = 100Hz, d_1 = 1m$ *and* $d_2 = 1.5m, P_1 = 8\pi W$ and $P_2 = 18\pi W$. Also assume that loudspeakers behave like isotropic sources: (emit sound uniformly in all directions).



1) 6 W /m^2 2) 9 W/ m^2 3) 12 W/ m^2 4) 15 W/ m^2

78. A sound source is moving with uniform speed along a curve $y = A\sin kx$ in x-y plane such that its x-coordinate is increasing with time. Three detectors *A, B & C* are placed at $\left(\frac{\pi}{2k},-10A\right),\left(\frac{\pi}{2k},0\right)$ and $\left(\frac{\pi}{2k},10A\right)$ respectively. When the sound source is just going to reach the point $\left(\frac{\pi}{2k},A\right)$, the frequency registered by the detectors *A, B & C* are f_1, f_2 and f_3 respectively, then

1) $f_1 > f_2 > f_3$ 2) $f_1 < f_2 < f_3$ 3) $f_3 > f_1 > f_2$ 4) $f_3 > f_1 = f_2$

79. Two coherent radio stations that are 250 m apart emit radio waves of wavelength 100 m. Point A is 400 m from both the stations. Point B is 450 m from both stations. Point C is 400 m from one station and 450 m from the other. The radio stations were initially out of phase. Which of the following statement is true?

1) there will be constructive interference at A and B and destructive interference at C

2) there will be destructive interference at A and B and constructive interference at C

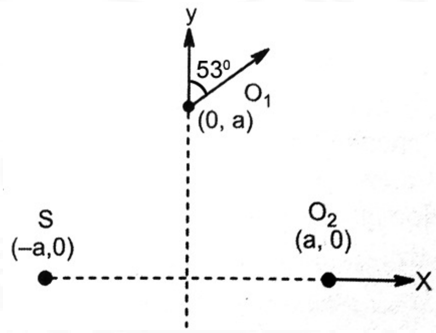
3) there will be constructive interference at A and destructive interference at B and C

4) there will be constructive interference at B and C and destructive interference at A

80. In the experiment for the determination of the speed of sound in air using the resonance column method, the length of the air column that resonates in the fundamental mode, with a tuning fork is 0.1 m. When this length is changed to 0.35 m, the same tuning fork resonates with the first overtone. The end correction is:

1) 0.025 m 2) 0.012 m 3) 0.05 m 4) 0.024 m

81. A sound source S and observers O_1, O_2 are placed as shown. S is always at rest and O_1, O_2 start moving simultaneously with constant velocity υ_0 at $t = 0$. At $t = 5$ sec, f_1 and f_2 represent apparent frequencies of sound received by O_1 and O_2 respectively. The ratio of f_1 and f_2 is:

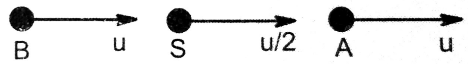


1) zero 2) between 0 and 1 3) 1 4) > 1

82. In a standing wave formed in a stretched string as a result of reflection from other end, the ratio of the amplitude at an antinode to that at node is x. The fraction of energy that is reflected is:

1) $\left[\frac{x-1}{x}\right]^2$ 2) $\left[\frac{x}{x+1}\right]^2$ 3) $\left[\frac{x-1}{x+1}\right]^2$ 4) $\left[\frac{1}{x}\right]^2$

83. A source of sound is moving with velocity $u/2$ and two observers A and B are moving with velocity 'u' as shown. Find ratio of wavelength received by A and B. Given that velocity of sound is $10u$.

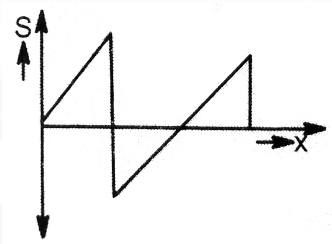


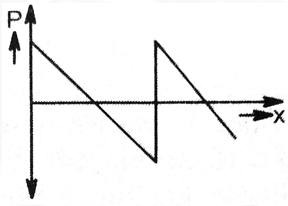
1) 19/21 2) 21/23 3) 17/23 4) 17/21

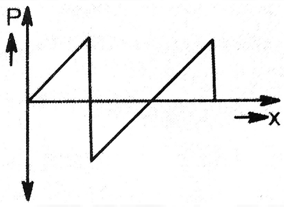
84. The ends of a stretched wire of length L are fixed at $x = 0$ and $x = L$. In one experiment, the displacement of the wire is $y_1 = A\sin(\pi x/L)\sin\omega t$ and energy is E_1 and in another experiment its displacement is $y_2 = A\sin(2\pi x/L)\sin 2\omega t$ and energy is E_2. Then:

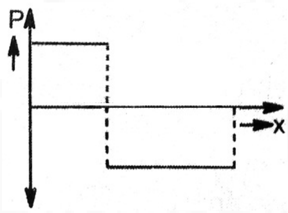
1) $E_2 = E_1$ 2) $E_2 = 2E_1$ 3) $E_2 = 4E_1$ 4) $E_2 = 16E_1$

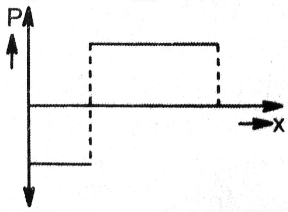
85. A sound wave is propagating through a medium whose displacement (S) *vs* x-graph shown in the figure. Its pressure (P) *vs* x-graph is:



1) 

2) 

3) 

4) 

86. A sound wave of frequency f travels horizontally to the right due to some distant stationary sound source. It is reflected from a large vertical plane surface moving to left with a speed υ. The speed of sound in medium is c then select incorrect option

1) The number of waves striking the surface per second is $f\dfrac{(c+\upsilon)}{c}$

2) The wavelength of reflected wave is $\dfrac{(c-\upsilon)}{f(c+\upsilon)}$

3) The frequency of the reflected wave is $f\dfrac{(c+\upsilon)}{(c-\upsilon)}$

4) The number of beats heard by a stationary listener to the left of the reflecting surface is $\dfrac{\upsilon f}{c-\upsilon}$

87. Standing waves are produced on a stretched string of length L with fixed ends. When there is a node at a distance $L/3$ from one end, then:

1) minimum and next higher number of nodes excluding the ends are 2, 5 respectively

2) minimum and next higher number of nodes excluding the ends are 2, 4 respectively

3) minimum and next higher number of nodes excluding the ends are 2, 3 respectively

4) minimum and next higher number of nodes excluding the ends are 2, 7 respectively

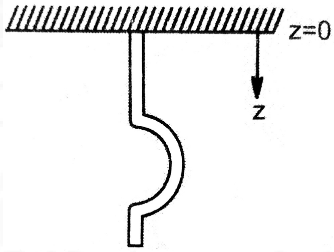
88. Equations of two progressive waves at a certain point in a medium are given by $y_1 = a\sin(\omega t + \phi_1)$ and $y_2 = a\sin(\omega t + \phi_2)$. If amplitude and time period of resultant wave formed by the superposition of these two waves is same as that of both the waves, then $\phi_1 - \phi_2$ is:

1) $\frac{\pi}{3}$ 2) $\frac{2\pi}{3}$ 3) $\frac{\pi}{6}$ 4) $\frac{\pi}{4}$

89. A standing wave is maintained in a homogeneous string of cross-sectional area a and density ρ. It is formed by the superposition of two waves travelling in opposite directions given by the equation; $y_1 = a\sin(\omega t - kx)$ and $y_2 = a\sin(\omega t + kx)$. The total mechanical energy confined between the sections corresponding to the adjacent antinode is:

1) $\frac{3\pi s\rho\omega^2 a^2}{2k}$ 2) $\frac{\pi s\rho\omega^2 a^2}{2k}$ 3) $\frac{5\pi s\rho\omega^2 a^2}{2k}$ 4) $\frac{\pi s\rho\omega^2 a^2}{k}$

90. A rope hangs from a rigid support. A very short pulse is set by jiggling the bottom end. We want to design a rope in which velocity υ of pulse is independent of z, the distance of the pulse from fixed end of the rope. If the rope is very long, then desired function for mass per unit length $\mu(z)$ in terms of μ_0 [mass per unit length of the rope at the top $(z=0)$] g, υ and z is :



1) $\mu(z) = \mu_0 e^{-[g/\upsilon^2]z}$ 2) $\mu(z) = \mu_0 e^{+[g/\upsilon^2]z}$

3) $\mu(z) = \mu_0 \log_e\left(\frac{g}{\upsilon^2}\right)z$ 4) $\mu(z) = \mu_0 e^{-\left(g^2/\upsilon^3\right)z^2}$