Lorik educatinal academy –vidya nagar

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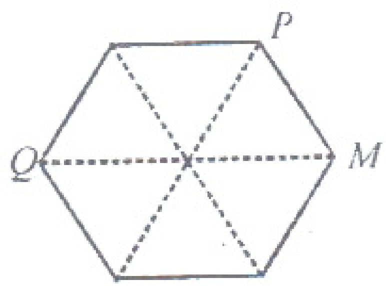
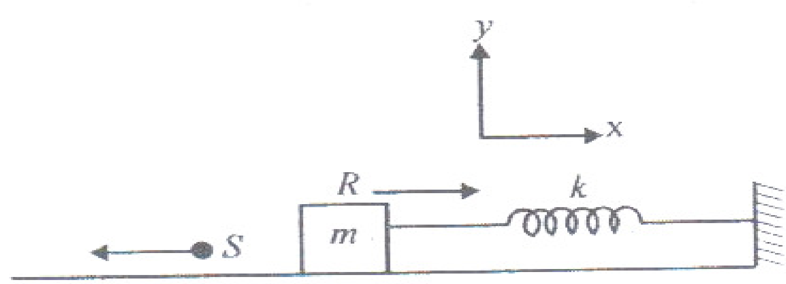
PHYSICS-Wave Motion & Sound
Assignment

1. A parachutist jumps from the top of a very high tower with a siren of frequency 800Hz on his back. Assume his initial velocity to be zero. After falling freely for 12s, he observes that the frequency of sound heard by him reflected from level ground below him is differing by 700 Hz w.r.t the original frequency. What was the height of tower. Velocity of sound in air is 330 m/s, and g = 10 m/s^2.
a) $511.5m$ b) $1057.5m$ c) $757.5m$ d) $1215.5m$
2. Two identical point like sound sources emitting sound in same phase of wavelength 1m are located at point P and Q as shown is figure. All sides of the polygon are equal and of length 1 m. The intensity of sound at M due to source P above is I_0. What will be the intensity of sound at point M when both the sources are on ?



a) $4I_0$ b) $\frac{3I_0}{2}$ c) $\frac{9}{4}I_0$ d) None of these

3. A sound source S emitting a sound of frequency 500Hz and receiver R of mass m are at the same point. R is performing SHM with the help of a spring of force constant k. At a time t = 0, R is at mean position and moving toward right as shown in figure. At the same time, source stars moving away from the R with an acceleration $18.75m/s^2$. Find the frequency (in Hz) registered by receiver at a time t = 10s.
Given that $\frac{m}{k}=\frac{100}{\pi^2}$ and amplitude of oscillation of $R=\frac{150}{\pi}m, v_{sound}=300m/s$



a) 320Hz b) 220Hz c) 420Hz d) 350Hz
4. Calculate the velocity of sound in a mixture of oxygen, nitrogen and argon at 0^0C. The mixture consists of the gases oxygen, nitrogen and argon in the mass ratio 2:7:1. (Given $R=8.3\,j\,mol^{-1}K^{-1}$. Ratio of specific heats of the gases are argon 1.67, oxygen 1.4, nitrogen 1.4. the molecular weights of the respective gases are 40,32 and 28.)
a) 329.5 m/s b) 219.0 m/s c) 422.0 m/s d) 380.2 m/s
5. A train approaching a hill at a speed of 40 km/hour sounds a whistle of frequency 580Hz when it is at distance of 1 km from the hill. Wind is blowing in the direction of the train with a speed of 40 km/h.

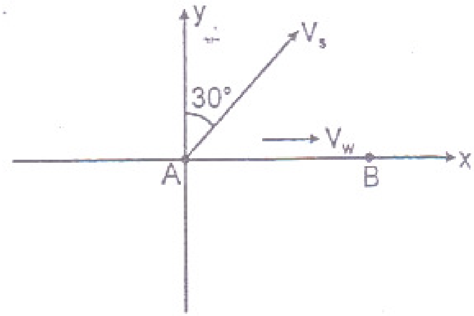
find the frequency of the whistle heard by an observer on the hill: (Velocity of sound in air = 1200 km/h)

a) 585 Hz b) 575 Hz c) 599Hz d) 589Hz

6. An object of specific gravity ρ is hung from a thin steel wire. The fundamental frequency for transverse standing waves in the wire is 300 Hz. The object is immersed in water so that one half of its volume is submerged. The new fundamental frequency in Hz is.

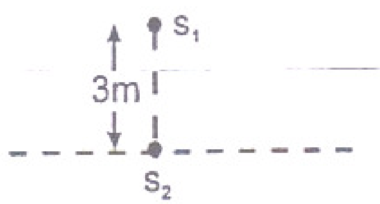
a) $300\left(\frac{2\rho-1}{2\rho}\right)^{1/2}$ b) $300\left(\frac{2\rho}{2\rho-1}\right)^{1/2}$ c) $300\left(\frac{2\rho}{2\rho-1}\right)$ d) $300\left(\frac{2\rho-1}{2\rho}\right)$

7. In the figure shown a source of sound of frequency 510 Hz moves with constant velocity $V_s = 20 m/s$ in the direction shown. The wind is blowing at a constant velocity $V_w = 20 m/s$ towards an observer who is at rest at point B. corresponding to the sound emitted by the source at initial position A, the frequency detected by the observer is equal to (speed of sound relative to air = 330 m/s)



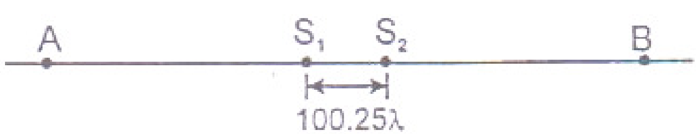
a) 510 Hz b) 500 Hz c) 525 Hz d) 550 Hz

8. s_1 & s_2 are two coherent sources of sound having no initial phase difference the velocity of sound is 330 m/s. No minima will be formed on the line passing through S_2 and perpendicular to the line joining S_1 and S_2, If the frequency of both the sources is :



a) 50 Hz b) 60 Hz c) 70 Hz d) 80 Hz

9. S_1 *and* S_2 are two coherent sources of radiation separated by distance 100.25λ, where λ is the wave length of radiation. S_1 Leads S_2 in phase by $\pi/2$ rad. A and B are two points on the line joining S_1 and S_2 as shown in figure. The ratio of amplitudes of source S_1 and S_2 are in ratio 1:2. The ratio of intensity at A to that B $\left(\frac{I_A}{I_B}\right)$ is

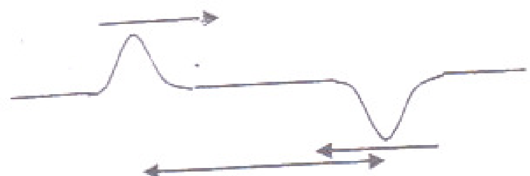


a) ∞ b) $\frac{1}{9}$ c) 0 d) 9

10. A 100m long rod of density $10.0\times10^4 kg/m^3$ and having Young's modulus $Y = 10^{11} Pa$, is clamped at one end. It is hammered at the other free end. The longitudinal pulse goes to right end, get reflected and again returns to the left end. How much time, the pulsetake to go back to initial point.

a) 0.1 sec b) 0.2 sec c) 0.3 sec d) 2 sec

11. Two pulses in a stretched string whose centers 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



a) zero b) purely kinetic c) purely potential d) partly kinetic and partly potential

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

a) $E_2 = E_1$ b) $E_2 = 2E_1$ c) $E_2 = 4E_1$ d) $E_2 = 16E_1$

13. A sound source emits frequency of 180 Hz when moving towards a rigid wall with a speed 5 m/s and an observer is moving away from wall with speed 5 m/s. Both source and observer moves on a straight line which is perpendicular to the wall. The number of beats per sec heard by the observer will be (speed of sound = 355 m/s)

a) 5 b) 10 c) 6 d) 8

14. A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between the two bridges when a mass of 9 kg is suspended from the wire. When this mass is replaced by a mass M, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value of M is

a) 25 kg b) 5 kg c) 12.5 kg d) 1/25 kg

15. A string of length 0.3 m and mass $10^{-2} kg$ is clamed at both of its ends. The tension in the string is 1.2 N. when a pulse travels along the string, the shape of the string is found to be the same at times t and $t + \Delta t$. The minimum value of Δt is

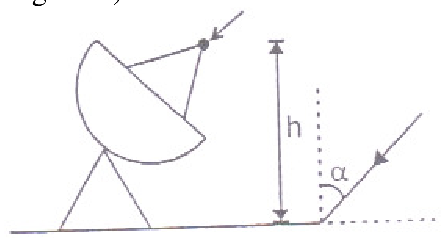
a) 0.1 sec b) 0.2 sec c) 0.3 sec d) 0.4 sec

16. Equation of a stationary and a traveling waves are as a follows $y_1 = a\sin kx \cos \omega t$ and $y_1 = a\sin(\omega t - kx)$.

The phase difference between two points $X_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$ is ϕ_1 in the standing wave (y_1) and is ϕ_2 in travelling wave (y_2) then ratio $\frac{\phi_1}{\phi_2}$ is

a) 1 b)5/6 c)3/4 d)6/7

17. Radio waves coming at $\angle\ \alpha$ to vertical are received by a radar after reflection from a nearby water surface & directly. What can be height of antenna from water surface so that it records a maximum intensity (a maxima). (wavelength=λ)



a) $\dfrac{\lambda}{2\cos\alpha}$ b) $\dfrac{\lambda}{4\sin\alpha}$ c) $\dfrac{\lambda}{4\sin\alpha}$ d) $\dfrac{\lambda}{4\cos\alpha}$

18. Microwaves from a transmitter are directed normally towards a plane reflector. A detector moves along the normal to the reflector. Between positions of 14 successive maxima, the detector travels a distance 0.14 m. If the velocity of light is 3 x 10^8 m/s, find the frequency of the transmitter.
a) 1.5 x 10^{10} Hz b)10^{10} Hz c)3 x 10^{10}Hz d)

19. A man standing in front of a mountain at a certain distance beats a drum at regular intervals. The drumming rate is gradually increase and he finds that the echo is not heard distinctly when the rate becomes 40 per minute. He then moves near to the mountain by 90 meters and finds that the echo is again not heard when the drumming rate becomes 60 per minute. Then the distance between the mountain and the initial position of the man is:
(A) 330m (B) 300m (C) 240m (D) 270m

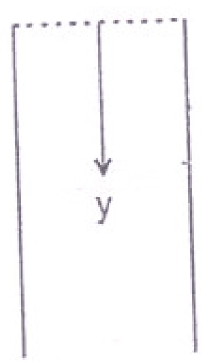
20. In Quincke's tube a detector detects minimum intensity. Now one of the tubes is displaced by 5 cm. During displacement detector detects maximum intensity 10 times, then finally a minimum intensity(when displacement is complete). The wave length of sound is
(A) $\frac{10}{9}$ cm (B) 1 cm (C) $\frac{1}{2}$ cm (D) $\frac{5}{9}$ cm

Comprehension

In an organ pipe (may be closed or open) of 99 cm length standing wave is setup, whose equation is given by longitudinal displacement

$$\xi = (0.1mm)\cos\frac{2\pi}{0.8}(y+1cm)\cos 2\pi(400)t$$

Where y is measured from the top of the tude in meters and t in second. Here 1 cm is the end correction.



21. The upper end and the lower end of the tube are respectively:
a) open-closed b) closed-open c)open-open d)closed-closed

22. The air column is vibrating in
a) First overtone b) Second overtone c) Third harmonic d) Fundamental mode

23. Equation of the standing wave in TERMS OF EXCESS PRESSURE IS –
(Bulk modulus of air B= 5 x 10^5 N/m^2)

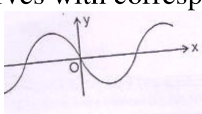
a) $P_{ex} = (125\ \pi N/m^2)\ \sin\frac{2\pi}{0.8}(y + 1\ cm)\ \cos\ 2\pi\ (400t)$

b) $P_{ex} = (125\ \pi N/m^2)\ \cos\frac{2\pi}{0.8}(y + 1\ cm)\ \sin\ 2\pi\ (400t)$

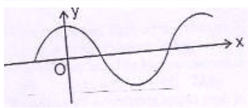
c) $P_{ex} = (225\ \pi N/m^2)\ \sin\frac{2\pi}{0.8}(y + 1\ cm)\ \cos\ 2\pi\ (200t)$

d) $P_{ex} = (225\ \pi N/m^2)\ \cos\frac{2\pi}{0.8}(y + 1\ cm)\ \sin\ 2\pi\ (200t)$

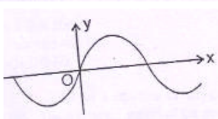
24. For four sine waves, moving on a string along positive x direction, displacement-distance curves (y-x curves) are shown at time t=0. In the right column, expressions for y as function of distance x and time t for sinusoidal waves are given. All terms in the equations have general meaning. Correctly match y-x curves with corresponding equations.

a) 

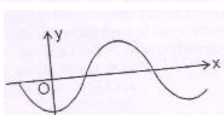
(p) $y = A\cos(\omega t - kx)$

b) 

(q) $y = -A\cos(kx - \omega t)$

c) 

(r) $y = A\sin(\omega t - kx)$

d) 

(s) $y = -A\sin(kx - \omega t)$

25. Match the statements in column-I with the statements in column-II.

Column-I	Column=II
a) A tight string is fixed at both ends and sustaining standing wave	p) At the middle, antinode is formed in odd harmonic
b) A tight string is fixed at one end and free at the other end	q) At the middle, node is formed in even harmonic
c) A tight string is fixed at both ends and Vibrating in four loops	r) The frequency of vibration is 300% more than its fundamental frequency
d) A tight string is fixed at one end and free At the other end, vibrating in 2^{nd} mode of Vibration.	s) Phase difference between SHMS of any two particles will be either π or zero.
	t) The frequency of vibration is 400% more

than fundamental frequency.

KEY

1) B 2) C 3) D 4) A 5) C 6) A 7) C

8) A 9) B 10) B 11) B 12) C 13) A 14) A

15) A 16) D 17) D 18) A 19) D 20) B 21) A

22) B 23) A 24) $a \to r, b \to p, c \to s, d \to q$

25) $a \to p, q, s : b \to r, s : c \to q, r, s, : d \to r, s, t$