PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

ARCHIVES 2 VOLUME 6

Fill In The Blank

1. A travelling wave has the frequency υ and the particle displacement amplitude A. For the wave the particle velocity amplitude is .... and the particle acceleration amplitude is ....

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2. Sound waves of frequency $600H_Z$ fall normally on perfectly reflecting wall. The distance from the wall at which the air particles have the maximum amplitude of vibration is (speed of sound in air = $330m/s$)

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3. The equations of displacement of two waves are

$y_1 = 10\sin(3\pi t + \pi/3)$

and $y_2 = 5[\sin 3\pi t + \sqrt{3}\cos 3\pi t]$

What is the ratio of their amplitude ?

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4. In a sonometer wire, the tension is maintained by suspending a $50kg$ mass from the free end of the wire. The suspended mass is completely submerged in water, the fundamental frequency will become .... Hz.

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5. The displacement of a wave disturbance propagating in the positive x-direction is given by

$y = \frac{1}{1+x^2}$ at $t = 0$ and $y = \frac{1}{1+(x-1)^2}$ at $t = 2s$

where, x and y are in meter. The shape of the wave disturbance does not change during the propagation. what is the velocity of the wave?

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6. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that

half of it is in water. The fundamental frequency of the air-column is now

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7. A bus is moving towards a huge wall with a velocity of $5m/s^{-1}$. The driver sounds a horn of frequency $200Hz$. The frequency of the beats heard by a passenger of the bus will be .... Hz (Speed of sound in air $= 342m/s^{-1}$)

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8. An object of mass 0.2 kg executes simple harmonic oscillation along the x-axis with a frequency $\frac{25}{\pi}$. At the position x = 0.04m, the object has kinetic energy 0.5J and potential energy 0.4J.

amplitude of oscillation is (potential energy is zero mean position).

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9. A plane progessive wave of frequency $25Hz$, amplitude $2.5 \times 10^{-5}m$ and initial phase zero propagates along the negative x-direction with a velocity of $300m/s$. At any instant, the phase difference between the oscillations at two points $6m$ apart the line of propagation is _____ .

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True False

1. The ratio of the velocity of sound in hydrogen $\left(\gamma = \frac{7}{5}\right)$ to that in helium $\left(\gamma = \frac{5}{3}\right)$ at the same temperature is

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2. A man stands on the ground at a fixed distance from a siren which emits sound of fixed amplitude. The man hears the sound to be louder on a clear night than on a clear day.

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3. A plane wave of sound travelling in air is incident upon a plane water surface. The angle of incidence is 60°. Assuming snell's law to be valid for sound waves, it follows that the sound wave will be refracted into water away from the normal.

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4. A source of sound with frequency $256Hz$ is moving with a velocity V towards a wall and an observer is stationary between the source and the wall. When the observer is between the source and the wall will he hear beats?

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Single Correct

1. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air-column is now

A. $f/2$

B. $3f/4$

C. f

D. $2f$

Answer: C

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2. A travelling wave is described by the equation $y = y_0 \sin 2\pi\left(\left(ft - \frac{x}{\lambda}\right)\right)$. The maximum particle velocity is equal to four times the wave velocity if

A. $\lambda = \pi \frac{y_0}{4}$

B. $\lambda = \pi \frac{y_0}{2}$

C. $\lambda = \pi y_0$

D. $\lambda = 2\pi y_0$

Answer: B

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3. A tube closed at one end and containing air produced, when excited the fundamental note of frequency $512 H_Z$. If the tube is opened at both ends, the fundamental frequency that can be exited is (in H_Z)

(a) 1024 (b) 512 (c) 256 (d) 128

A. 1024

B. 512

C. 256

D. 128

Answer: A

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4. A particle executes simple harmonic motion with a frequency v. The frequency with which the kinetic energy oscillates is

A. $f/2$

B. f

C. $2f$

D. $4f$

Answer: C

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5. A wave representing by the equation $y = A\cos(kx - \omega t)$ is suerposed with another wave to form a stationary wave such that point $x = 0$ is a node. The equation for the other wave is

A. $a\sin(kx + \omega t)$

B. $a\sin(kx - \omega t)$

C. $-a\sin(kx + \omega t)$

D. $-a\sin(kx - \omega t)$

Answer: C

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6. An organ pipe P_1 closed at one end vibrating in its first harmonic and another pipe P_2 open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of P_1 and p_2 is

(a) $8/3$ (b) $3/8$ (c) $1/6$ (d) $1/3$

A. 8//3

B. 3//8

C. 1//6

D. 1//3

Answer: C

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7. Two bodies M and N of equal masses are suspended from two separate massless springs of spring constants k_1 and k_2 respectively . If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude of vibration of M to that on N is

A. $\dfrac{k_1}{k_2}$

B. $\sqrt{k_1 / k_2}$

C. $\dfrac{k_2}{k_1}$

D. $\sqrt{k_2 / k_1}$

Answer: D

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8. A uniform cylinder of length (L) and mass (M) having cross sectional area (A) is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half - submerged in a liquid of density (rho) at equilibrium position. When the cylinder is given a small downward push and released it starts oscillating vertically with small amplitude. If the force constant of the spring is (k), the prequency of oscillation of the cylindcer is.

A. $\frac{1}{2\pi}\left(\frac{k-A\rho g}{M}\right)^{1/2}$

B. $\frac{1}{2\pi}\left(\frac{k+A\rho g}{M}\right)^{1/2}$

C. $\frac{1}{2\pi}\left(\frac{k+\rho-gL}{M}\right)^{1/2}$

D. $\frac{1}{2\pi}\left(\frac{k+A-\rho g}{M}\right)^{1/2}$

Answer: B

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9. A highly rigid cubical block A of small mass M and side L is fixed rigidly on the other cubical block of same dimensions and of modulus of rigidity η such that the lower face of A completely covers the upper face of B. The lower face of B is rigidly held on a horizontal surface . A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn , block A

executes faces of A. After the force is withdrawn , block A exceutes small oscillations , the time period of which is given by

A. $2\pi\sqrt{M\eta L}$

B. $2\pi\sqrt{\frac{M-\eta}{L}}$

C. $2\pi\sqrt{\frac{M-L}{\eta}}$

D. 2 pi sqrt((M - N)/(eta L))`

Answer: D

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10. The displacement of a particle in a periodic motion is given by $y = 4\cos^2(t/2)\sin(1000t)$. This displacement may be considered as the result superposition of n independent harmonic oscillations. Here , n is

A. two

B. three

C. four

D. five

Answer: B

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11. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to massless spring of spring constant k. A mass m hangs freely from the free end of the spring . The area of cross-section and Young's modulus of the wire are A and Y respectively . If the mass is slighty pulled down and released , it will oscillate with a time period T equal to

A. $2\pi(m/K)^{1/2}$

B. $2\pi\sqrt{\frac{m(YA+KL)}{YAK}}$

C. $2\pi[(mYA/KL)]^{1/2}$

D. $2\pi[(mL/YA)]^{1/2}$

Answer: B

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12. 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 $\left(\frac{2\rho-1}{2\rho}\right)^{\frac{1}{2}}$

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

(c)$300\left(\frac{2\rho}{2\rho-1}\right)$

(d)$300\left(\frac{2\rho-1}{2\rho}\right)$

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. $300\left(\frac{2\rho-1}{2\rho}\right)$

Answer: A

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13. The tension in a string, obeying Hooke's law, is x. The speed of sound in the stretched string is v. If the tension in the string is increased to $1.5x$, the speed of sound will be

A. $1.22v$

B. $0.61v$

C. $1.50v$

D. $0.75v$

Answer: A

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14. An open pie is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be heigth by $100H_Z$ than the fundamental frequency of the open pipe. The fundamental frequency of the open pipe is

(a) $200H_Z$ (b) $300H_Z$ (c) $240H_Z$ (d) $480H_Z$

A. 200 Hz

B. 300 Hz

C. 240 Hz

D. 480 Hz

Answer: A

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15. A whistle giving out $450H_Z$ approaches a stationary observer at a speed of $33m/s$. The frequency heard the observer (in H_Z) is (speed of sound $= 330m/s$)

A. 409

B. 429

C. 517

D. 500

Answer: D

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16. A travelling wave in a stretched string is described by the equation $y = A\sin(kx - \omega t)$ the maximum particle velocity is

A. $A\omega$

B. ω / k

C. $d\omega / dk$

D. x / t

Answer: A

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17. 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 value of Δt which allows construction tnterference betwenn successive pulses is

A. $0.05s$

B. 0.10 s`

C. $0.20s$

D. $0.40s$

Answer: B

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18. A particle of mass m is executing oscillation about the origin on X- axis Its potential energy is V(x)=kIxI Where K is a positive constant If the amplitude oscillation is a, then its time period T is proportional

A. proportional to $1/\sqrt{a}$

B. independent of a

C. proportional to $\sqrt{a}$

D. proportional to $a^{3/2}$

Answer: A

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19. A particle free to move along the (x - axis) has potential energy given by

$U(x) = k[1 - \exp(-x^2)] f$ or $-oo \leq x \leq +oo$, where (k) is a positive constant of appropriate dimensions. Then.

A. at points away from the origin, the particle is in unstable equilibrium.

B. for any finite non-zero value of x, there is a force directed away from the origin

C. if its total mehanical energy is $k/2$, it has its minimum kinetic energy at the origin

D. for small displacements from $x = 0$, the motion is simple harmonic.

Answer: D

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20. The ratio of the speed of sound in nitrogen gas to that in helium gas, at 300K is

A. $\sqrt{(2/7)}$

B. $\sqrt{(1/7)}$

C. $(\sqrt{3})/5$

D. $(\sqrt{6})/5$

Answer: B

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21. The period of oscillation of a simple pendulum of length (L) suspended from the roof of a vehicle which moves without friction down an inclined plane of inclination (prop), is given by.

A. $2\pi\sqrt{\frac{L}{g\cos\propto}}$

B. $2\pi\sqrt{\frac{L}{g\cos\propto}}$

C. $2\pi\sqrt{\frac{L}{g}}$

D. $2\pi\sqrt{\frac{L}{g\tan\propto}}$

Answer: A

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22. A train moves towards a stationary observer with speed $34m/s$. The train sound a whistle and its frequency registered by the observer by the observer is f_1. If the train's speed is reduced to $17m/s$, the frequency registered is f_2. If the speed of sound is $340m/s$, then the ratio f_1/f_2 is

A. 18//19

B. 1//2

C. 2

D. 19//18

Answer: D

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23. Two vibrating strings of the same material but lengths L and 2L have radii 2 r and r respectively. They are strectched under the same tension. Both the strings vibrate in their fundamental modes, the one of length L with frequency n_1 and the other with frequency n_2. The ratio n_1 / n_2 is given by

2

4

8

1

A. 2

B. 4

C. 8

D. 1

Answer: D

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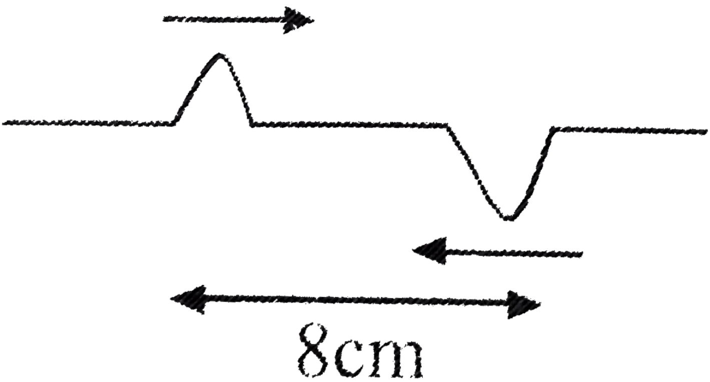
24. Two pulses in a stretched string whose centres are initially 8 cm apart are moving towards each other as shown in the figure. The speed of each pulse is 2 cm/s. After 2 second, the total energy of the pulses will be



A. zero

B. purely kinetic

C. purely potential

D. partly kinetic and partly potential

Answer: B

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25. The ends of a stretched wire of length L are fixed at x = 0 and x = L, In one experiment, the displacement of 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

A. $E_2 = E_1$

B. $E_2 = 2E_1$

C. $E_2 = 4E_1$

D. $E_2 = 16E_1$

Answer: C

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26. A particle executes S.H.M. between $x = -A$ and $x = +A$. The time taken for it to go from 0 to A/2 is T_1 and to go from A/2 to A is T_2. Then

A. $T_1 < T_2$

B. $T_1 > T_2$

C. $T_1 = T_2$

D. $T_1 = 2T_2$

Answer: A

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27. A simple pendulum has a time period T_1 when on the earth's surface and T_2 when taken to a height R above the earth's surface, where R is the radius of the earth. The value of $\frac{T_2}{T_1}$ is

A. 1

B. $\sqrt{2}$

C. 4

D. 2

Answer: D

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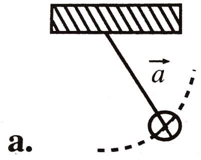
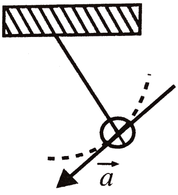
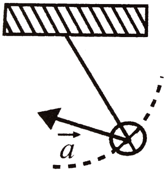
28. A simple pendulum is oscillating without damping. When the displacement of the bob is less than maximum, its acceleration vector $\overrightarrow{a}$ is correctly shown in

A. 

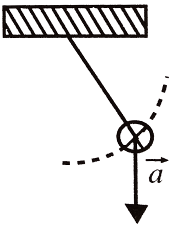
B. b.



C. c.



D. d.



Answer: C

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29. A siren placed at a railway platfrom is emitted sound of frequency $5kH_Z$, A passenger sitting in retun journey in a different train B he records a frequency of $6.0kH_Z$ while approaching the same siren. The ratio of the velocity of train B to that of train A is

A. 242//252

B. 2

C. 4

D. 6

Answer: B

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30. A somoneter wire resonates with a given tuning fork forming standing waves with five antindoes between the two bridges when a mass of 9 kg is suspended from the wire. Resonates with the same tuning fork forming three antindoes for the same postions of the bridges. the value of M is

A. 25 kg

B. 5 kg

C. 12.5 kg

D. 1/25 kg

Answer: A

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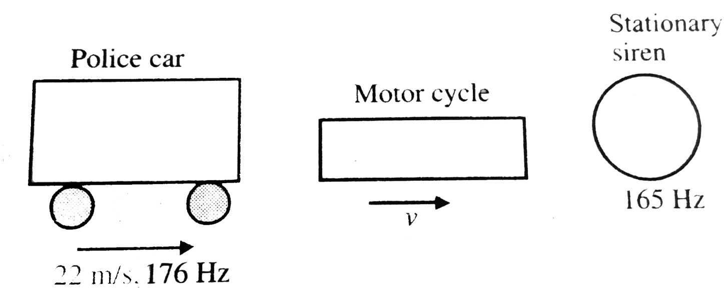
31. 

A police car moving at $22\frac{m}{s}$ chases a motorcyclist. The police man sounds his horn of frequency 176 Hz, while both of them move towards a stationary siren of frequency 165 Hz. Calculate the speed of motorcyclist if it is given that he does not hear any beat (speed of sound in air is $330\frac{m}{s}$)

A. 33 m/s

B. 22 m/s

C. zero

D. 11 m/s

Answer: B

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32. 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 tunning fork is $0.1m$. When this length is changed to $0.35m$, the same tunning fork resonates with the first overtone. calculate the end correction.

(a) $0.012m$

(b) $0.025m$

(c) $0.05m$

(d) $0.024m$

A. $0.012m$

B. $0.025m$

C. $0.05m$

D. $0.024m$

Answer: B

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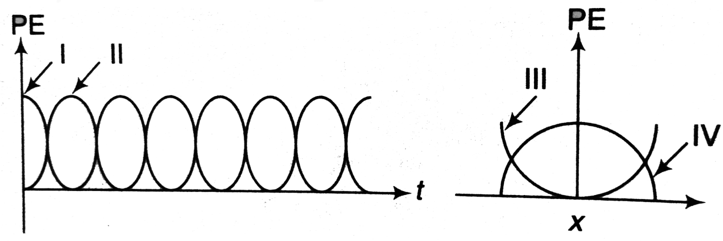
33. For a particle executing SHM, the displacement x is given by $x = A\cos\omega t$. Identify the graph which represents the variation of potential energy (PE) as a function of time t and displacement x.



(a) I, III

(b) II, IV (c) II, III

(d) I, IV

A. I,III

B. II,IV

C. II,III

D. I,IV

Answer: A

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34. A source of sound of frequency 600Hz is placed inside of water. The speed of sound is water is $1500m/s$ and air it is $300m/s$. The frequency of sound recorded by an observer who is standing in air is

A. 200 Hz

B. 3000 Hz

C. 120 Hz

D. 600 Hz

Answer: D

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35. A pipe of length l_1, closed at one end is kept in a chamber of gas of density ρ_1. A second pipe open at both ends is placed in a second chamber of gas of density ρ_2. The compressibility of both the gases is equal. Calculate the length of the second pipe if frquency of first overtone in both the cases is equal.

A. $\frac{4}{3}l_1\sqrt{\frac{\rho_2}{\rho_1}}$

B. $\frac{4}{3}l_1\frac{\sqrt{\rho_1}}{\rho_2}$

C. $l_1\sqrt{\frac{\rho_2}{\rho_1}}$

D. $l_1\frac{\sqrt{\rho_1}}{\rho_2}$

Answer: B

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36. In a resonance tube with tuning fork of frequency $512Hz$, first resonance occurs at water level equal to $30.3cm$ and second resonance ocuurs at $63.7cm$. The maximum possible error in the speed of sound is

A. $5.12cm/s$

B. $102.4cm/s$

C. $204.8cm/s$

D. $153.6cm/s$

Answer: C

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37. An open pipe is in resonance in $2nd$ harmonic with frequency f_1. Now one end of the tube is closed and frequency is increased to f_2 such that the resonance again ocuurs in nth harmonic. Choose the correct option

A. $n = 3, f_2 = \frac{3}{4} f_1$

B. $n = 3, f_2 = \frac{5}{4} f_1$

C. $n = 5, f_2 = \frac{3}{4} f_1$

D. $n = 5, f_2 = \frac{5}{4} f_1$

Answer: D

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38. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = Kt^2. (K = 1ms^{-2})$ where y is the vertical displacement. The time period now becomes T_2

The ratio of $\frac{T_1^2}{T_2^2}$(Take $g = 10ms^{-2}$)

A. $5/6$

B. $6/5$

C. 1

D. $4/5$

Answer: B

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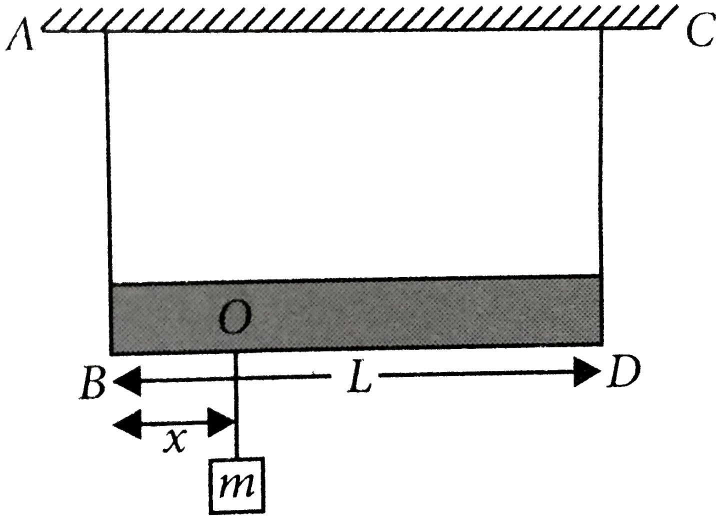
39. A massless rod of kngth L is suspended by two identical strings AB and CD of equal length. A block of mass m is suspended from point O such that BO is equal to 'x'. Further it is observed that the frequency of 1_{st} harmonic in AB is equal to 2_{nd}

harmonic frequency in CD, 'x' is



A. $\frac{L}{5}$

B. $\frac{4L}{5}$

C. $\frac{3L}{4}$

D. $\frac{L}{4}$

Answer: A

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40. In the experiment to determine the speed of sound using a resonance column,

A. prongs of the tuning fork are kept in a vertical plane

B. prongs of the tuning fork are kept in a horizontal plane

C. in one of the two resonances observed, the length of the resonating air column is close to the wavelength of sound in air

D. in one of the two resonances observed, the length of the resonating air column is close to half of the wavelength of sound in air.

Answer: A

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41. A transverse sinusoidal wave moves along a string in the positive x-direction at a speed of $10cm/s$. The wavelength of the wave is 0.5 m and its amplitude is $10cm$. At a particular time t,the snapshot of the wave is shown in figure. The velocity of point P when its displacement is 5 cm is

(a) $\frac{\sqrt{3}\pi}{50}\hat{j}m/s$

(b)$-\frac{\sqrt{3}\pi}{50}\hat{j}m/s$

(c)$\frac{\sqrt{3}\pi}{50}\hat{i}m/s$

(d) $-\frac{\sqrt{3}\pi}{50}\hat{i}m/s$

A. $\frac{\sqrt{3}\pi}{50}\hat{j}m/s$

B. $-\frac{\sqrt{3}\pi}{50}\hat{j}m/s$

C. $\frac{\sqrt{3}\pi}{50}\hat{i}m/s$

D. $-\frac{\sqrt{3}\pi}{50}\hat{i}m/s$

Answer: A

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42. A vibrating string of certain length l under a tension T resonates with a mode corresponding to the first overtone (third harmonic) of an air column of length $75cm$ inside a tube closed at one end. The string also generates $4beats/s$ with a tuning fork of frequency n . Now when the tension of the string is slightly increased the number of beats reduces to 2 per second. Assuming the velocity of sound in air to $340m/s$, the frequency n the tuning fork in H_Z is

(a) 344

(b) 336

(c) 117.3

(d) 109.3

A. 344

B. 336

C. 117.3

D. 109.3

Answer: A

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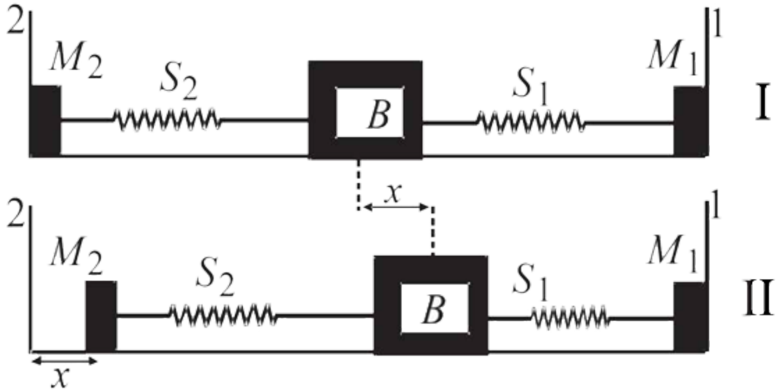
43. A block (B) is attached to two unstriched sprig S_1 and S_2 with spring constant K and $4K$, respectively (see fig 1) The other ends are atteched in identical support M_1 and M_2 not attached in the walls . The springs and supports have negligible mass . There is no friction anywhere . The block B is displaced toword wall 1 by a small distance x (figure (ii)) and released . The block return and moves a maximum distance y towards wall

2.Displacements x and y are measured w.r.to the equalibrum of the block B and the ratio y / x is



A. 4

B. 2

C. 1//2

D. 1//4

Answer: C

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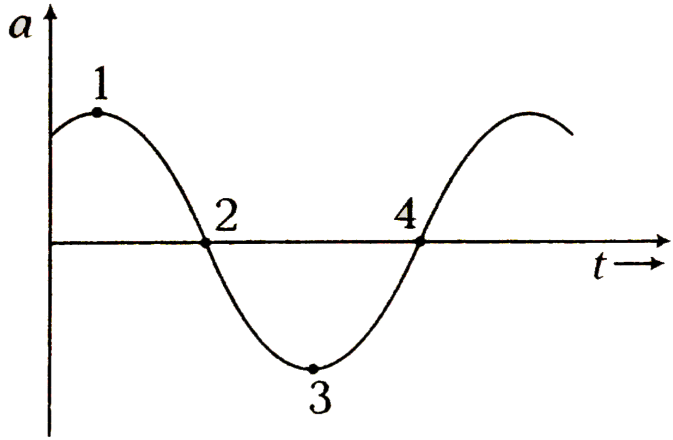
44. The acceleration a of a particle undergoing SHM is shown in the figure. Which of the labelled points corresponds to the particle being at $-x_{\max}$



A. $\frac{\sqrt{3}}{32}\pi^2 cm / s^2$

B. $\frac{-\pi^2}{32} cm / s^2$

C. $\frac{\pi^2}{32} cm / s^2$

D. $-\frac{\sqrt{3}}{32}\pi^2 cm / s^2$

Answer: D

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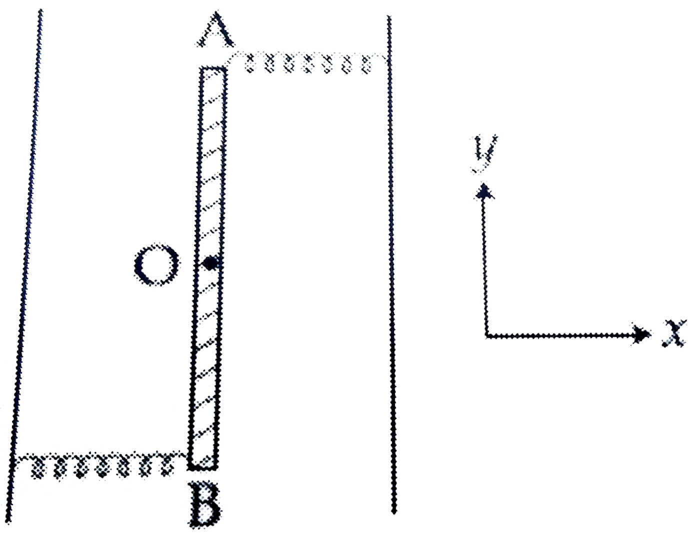
45. two light identical springs of spring constant K are attached horizontally at the two ends of a uniform horizontal rod AB of length l and mass m. the rod is pivoted at its centre 'o' and can rotate freely in horizontal plane . The other ends of the two springs are fixed to rigid supportss as shown in figure . the rod is gently pushed through a small angle and released , the frequency of resulting oscillation is :



A. $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$

B. $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$

C. $\frac{1}{2\pi}\sqrt{\frac{6k}{M}}$

D. $\frac{1}{2\pi}\sqrt{\frac{24k}{M}}$

Answer: C

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46. A hollow pipe of length $0.8m$ is closed at one end. At its open end a $0.5m$ long uniform string is vibrating in its second harmonic and it resonates with the fundamental frequency of the pipe. If the tension in the wire is $50N$ and the speed of sound is $320ms^{-1}$, the mass of the string is

A. 5 g

B. 10 g

C. 20 g

D. 40 g

Answer: B

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47. Two monatomic ideal gas 1 and 2 of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at same temperature. The ratio of the speed of sound in gas 1 to that in gas 2 is given by

A. $\sqrt{\frac{m_1}{m_2}}$

B. $\sqrt{\frac{m_2}{m_1}}$

C. $\frac{m_1}{m_2}$

D. $\frac{m_2}{m_1}$

Answer: B

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48. A police car with a siren of frequency $8KHz$ is moving with uniform velocity $36Km/hr$ towards a ball building which reflects the sound waves. The speed of sound in air is $320m/s$. The frequency of the siren heard by the car driver is

A. $8.50kHz$

B. $8.25kHz$

C. $7.25kHz$

D. $7.50kHz$

Answer: A

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49. A point mass is subjected to two simultaneous sinusoidal displacements in $x - direction, x_1(t) = A\sin(\omega)t$ and $x_2(t) = A\sin\left(\left(\omega t + \frac{2\pi}{3}\right)\right)$. Adding a third sinusoidal displacement $x_3(t) = B\sin(\omega t + \phi)$ brings the mas to a complete rest. The values of (B) and (phi) are.

A. $\sqrt{2}A, \frac{3\pi}{4}$

B. $A, \frac{4\pi}{3}$

C. $\sqrt{3}A, \frac{5\pi}{6}$

D. $A, \frac{\pi}{3}$

Answer: B

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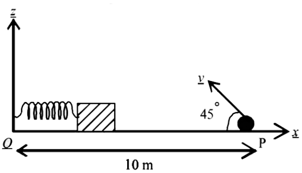
50. A small block is connected to one end of a massless spring of un - stretched length $4.9m$. The other end of the spring (see the figure) is fixed. The system lies on a horizontal frictionless surface. The block is stretched by $0.2m$ and released from rest at $t = 0$. It then executes simple harmonic motion with angular frequency $(\omega) = (\pi / 3) rad / s$. Simultaneously at $t = 0$, a small pebble is projected with speed (v) from point (P) at an angle of 45° as shown in the figure. Point (P) is at a horizontal distance of $10m \circ m O$. If the pebble hits the block at $t = 1s$, the value of (v) is $(take g = 10m / s^2)$.



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A. $\sqrt{50} m / s$

B. $\sqrt{51} m / s$

C. $\sqrt{52} m / s$

D. $\sqrt{53}m/s$

Answer: A

Watch Video Solution

51. A student is performing the experiment of resonance column. The diameter of the column tube is $4cm$. The frequency of the tuning fork is $512Hz$ The air temperature is $38.^\circ C$ in which the speed of sound is $336m/s$. The zero of the meter scale coincides with the top end of the resonance column tube. When the first resonance occurs, the reading of the water level in the column is.

(a) $14.0cm$

(b) $15.2cm$

(c) $6.4cm$ (d) $17.6cm$.

A. 14.0 cm

B. 15.2 cm

C. 16.4 cm

D. 17.6 cm

Answer: B

Watch Video Solution

Multiple Correct

1. A wave equation which given the dispplacement along the y-direction is given by ,

$y = 10^{-4} \sin(60t + 2x)$

where x and y are in matre and t is time in second. This represents a wave

A. travelling with a velocity of $30m/s$ in the negative x-direction.

B. of wavelength πm

C. of frequency $30/\pi Hz$

D. of amplitude $10^{-4}m$ travelling along the negative x-direction.

Answer: A::B::C::D

Watch Video Solution

2. An air column in a pipe, which is closed at one end, will be in resonance with a vibaring tuning fork of frequency 264 Hz, if the length of the column in cm is (Speed of sound = 330 m/s)

A. 31.25

B. 62.5

C. 93.75

D. 125

Answer: A::C

Watch Video Solution

3. The displacement of particles in a string stretched in the x-direction is represented by y.among the following expressions for y, those describing wave motion are

A. $\cos kx \sin \omega t$

B. $k^2x^2 - \omega^2t^2$

C. $\cos^2(kx + \omega t)$

D. $\cos\left(k^2x^2 - \omega^2t^2\right)$

Answer: A::C

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4. velocity of sound in air is 320 m/s. A pipe closed at one end has a length of 1 m. Neglecting end corrections, the air column in the pipe can resonates for sound of frequency

A. 80 Hz

B. 240 Hz

C. 320 Hz

D. 400 Hz

Answer: A::B::D

Watch Video Solution

5. A linear harmonic oscillator of force constant $2 \times 10^{6} N/m$ and amplitude $0.01m$ has a total mechanical energy of $160J$. Its

A. maximum potential energy is $100J$

B. maximum kinetic energy of $100J$

C. maximum potential energy is $160J$

D. minimum potential energy of zero

Answer: B::C

Watch Video Solution

6. A wave is represented by the equation

$y = A\sin(10\pi x + 15\pi t + \pi/3)$

Where x is in metre and t is in second.

a wave travelling in the positive x-direction with a velocity of 1.5

m/s

a wave travelling in the negative x-direction with a velocity 1.5

m/s

a wave travelling in the negative x-direction with a wavelength of

0.2 m

a wave travelling in the positive x-direction with a wavelength 0.2

m

A. a wave travelling in the positive x-direction with a velocity

$1.5m/s$

B. a wave travelling in the negative x-direction with a

wavelength $1.5m/s$

C. a wave travelling in the negative x-direction having a

wavelength $0.2m$

D. a wave travelling in the positive x-direction having a

wavelength $0.2m$.

Answer: B::C

Watch Video Solution

7. Two identical straight wires are stretched so as to products $6beats/s$ when vibrating simultaneously. On changing the tension slightly in one of them, the beat frequency remains unchanged. Denoting by , T_1 the higher and T_2 the lower, initial tensions in the strings, then it could be said that that while making the above changes in tension

A. T_2 was decreased

B. T_2 was increased

C. T_1 was increased

D. T_1 was decreased

Answer: B::D

Watch Video Solution

8. A sound wave of frequency f travels horizontally to the right . It is teflected from a larger vertical plane surface moving to left with a speed v. the speed of sound in medium is c

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

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

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

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

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

B. The wavelength of reflected wave is $\dfrac{f(c-v)}{c+v}$

C. The frequency of the reflected wave is $\dfrac{f(c+v)}{c-v}$

D. The number of beats heard by a stationary listener to the left of the reflecting surface is $\dfrac{vf}{c-v}$

Answer: A::B::C

Watch Video Solution

9. The equation of a wave disturbance is given as $y = 0.02\cos\left(\frac{\pi}{2} + 50\pi t\right)\cos(10\pi x)$, where x an y are in metre and t in second. Choose the wrong statement.

A. A node occurs at $x = 0.15m$

B. An antinode occurs at $x = 0.3m$

C. The speed of wave is $5m/s$

D. The wave length is $0.2m$

Answer: A::B::C::D

Watch Video Solution

10. The (x, y) co-ordinates of the corners of a square plate are $(0, 0)$,$(L, 0)$, (L, L) and $(0, L)$. The edges of the plate are clamped and transverse standing waves are set up in it. If $u(x, y)$ denotes the displacement of the plate at the point (x, y) at some instant of time, the possible expression (s) for u is (are) $(a = positivecons\tan t)$

A. $a\cos(\pi r/2L)\cos(\pi y/2L)$

B. $a\sin(\pi x/L)\sin(\pi y/L)$

C. $a\sin(\pi x/L)\sin(2\pi y/L)$

D. $a \cos(2\pi x / L)\sin(\pi y / L)$

Answer: B::C

Watch Video Solution

11. A transverse sinusoidal wave of amplitude a, wavelength λ and frequency f is travelling on a stretched string. The maximum speed of any point in the string is $v/10$, where v is the speed of propagation of the wave. If $a = 10^{-3}m$ and $v = 10ms^{-1}$, then λ and f are given by

A. $\lambda = 2\pi \times 10^{-2}m$

B. $\lambda = 10^{-3}m$

C. $f = \frac{10^3}{2\pi}Hz$

D. $f = 10^4 Hz$

Answer: A::C

Watch Video Solution

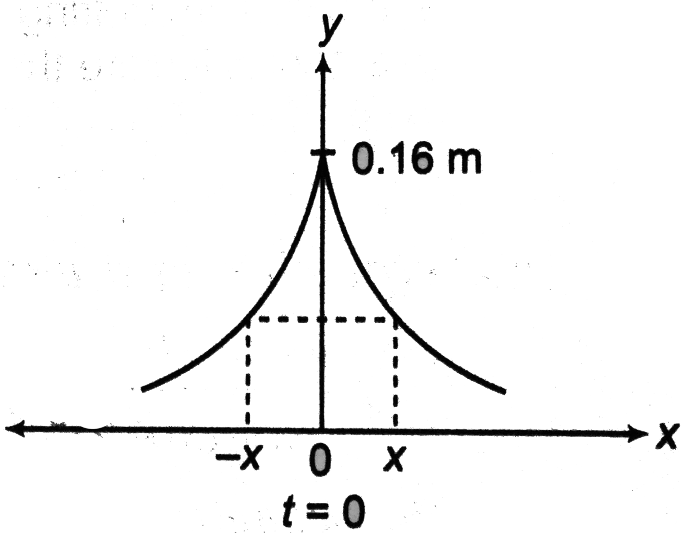
12. $y(x,t)=\frac{0.8}{\left[(4x+5t)^2+5\right]}$ represents a moving pulse where x and y are in metre and t in second. Then,choose the correct alternative(s):

(a) pules is moving in positive x- direction

(b) in $2s$ it will travel a distance of $2.5m$

(c) its maximum displacement is $0.16m$

(d) it is a sysmmetric pulse



A. pulse is moving in + x-direction

B. in $2s$ it will travel a distance of $2.5m$

C. its maximum displacement is $0.16m$

D. it is a symmetric pulse

Answer: B::C::D

Watch Video Solution

13. In a wave motion $y = a\sin(kx - \omega t)$, y can represent

A. electric field

B. magnetic field

C. displacement

D. pressure

Answer: A::B::C::D

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14. Standing waves can be produced

A. on a string clamped at both the ends.

B. on a string clamped at one end and free at the other

C. when incident wave gets reflected from a wall.

D. when two identical waves with a phase difference of are moving in the same direction.

Answer: A::B::C

Watch Video Solution

15. As a wave propagates

A. the wave intensity remains constant for a plane wave.

B. the wave intensity decrease as the inverse of the distance from the source for a spherical wave.

C. the wave intensity decreases as the inverse square of the distance from the source for a spherical wave.

D. total intensity of the spherical wave over the spherical surface centred at the source remains constant at all times.

Answer: A::C::D

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16. Three simple harmonic motions in the same direction having the same amplitude and same period are superposed. If each differ in phase from the next by 45°, then

A. the resultant amplitude is $(1+\sqrt{2})a$

B. the phase of the resultant motion relative to the first is 90°

C. the energy associated with the resulting motionis $(3+2\sqrt{2})$ times the energy associated any single motion.

D. the resulting motion is not simple harmonic.

Answer: A::C

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17. The function $x = A\sin^2(\omega)t + B\cos^2(\omega)t + C\sin(\omega)t\cos(\omega)t$ represent (SHM) for which of the option(s).

A. For all value of A, B and C (except C = 0)

B. $A = -B, C = 2B, amplitude = |B\sqrt{2}|$

C. $A = B, C = 0$

D. $A = B, C = 2B, amplitude = |B|$

Answer: B::D

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18. A student performed the experiment to measure the speed of sound in air using resonance air-column method. Two resonances in the air-column were obtained by lowering the water level. The resonance with the shorter air-column is the first resonance and that with the longer air-column is the second resonance. Then,

A. (a)the intensity of the sound heard at the first reson was more than that at the second resonance.

B. (b)the prongs of the tuning fork were kept in a horizontal plane above the resonance tube.

C. (c)the amplitude of vibration of the ends of the prongs is typically around $1cm$

D. (d)the length of the air-column at the first resonance somewhat shorter than $1/4th$ of the wavelength sound in air.

Answer: A::D

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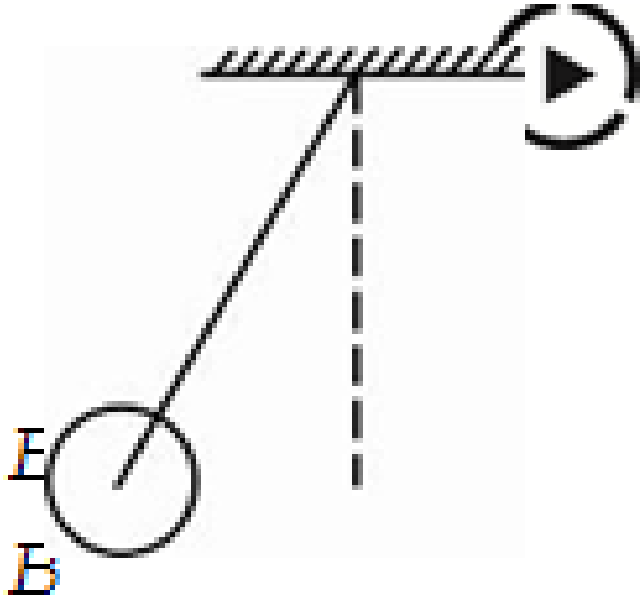
19. A metal rod of length 'L' and mass 'm' is pivoted at one end. A thin disk of mass 'M' and radius 'R' (< L) is attached at its centre to the free end of the rod. Consider two ways the disc is attached: (case A) - The disc is not free to rotate about its centre and (case B) - the disc is free to rotate about its centre. The rod-disc system after being released from the same displaced position. Which of the following statement(s) is(are) true?



A. (a)Restoring torque in case A = Resorting torque in case B

B. (b)Restoring torque in case A lt Restoring torque in case B

C. (c)Angular frequency for case A gt Angular frequency for case B

D. (d)Angular frequency for case A lt Angular frequency for case B.

Answer: A::D

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20. A person blows into open- end of a long pipe. As a result,a high pressure pulse of air travel down the pipe. When this pulse reaches the other end of the pipe,

A. a high-pressure pulse starts travelling up the pipe, if the other end of the pipe is open

B. a low-pressure pulse starts travelling up the pipe, if the other end of the pipe is open

C. a low-pressure pulse starts traveling up the pipe, if the other end of the pipe is closed.

D. a high-pressure pulse starts travelling up the pipe, if the other end of the pipe is closed.

Answer: B::D

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21. A particle of mass m is attached to one end of a mass-less spring of force constant k, lying on a frictionless horizontal plane. The other end of the spring is fixed. The particle starts moving horizontally from its equilibrium position at time $t = 0$ with an initial velocity u_0. when the speed of the particle is $0.5u_0$, it collides elastically with a rigid wall. After this collision

A. the speed of the particle when it returns to its equilibrium position is u_0.

B. the time at which the particle passes through the equilibrium position for the first time is $t = \pi\sqrt{\frac{m}{k}}$

C. the time at which the maximum compression of the spring occurs is $t = \frac{4\pi}{3}\sqrt{\frac{m}{k}}$

D. the time at which the particle passes through the equilibrium position for the second time is $t = \frac{5\pi}{3}\sqrt{\frac{m}{k}}$.

Answer: A::D

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22. Two vehicles, each moving with speed u on the same horizontal straight road, are approaching each other. Wind blows along the road with velocity w. One of these vehicles blows a whistle of frequency f_1. An observer in the other vehicle hears the frequency of the whistle to be f_2. the speed of sound in still air is V_C. The correct statement (s) is (are)

A. If the wind blows from the source to the observer, $f_2 > f_1$

B. If the wind blows from the observer to the source, $f_2 > f_1$

C. If the wind blows from observer to the source, $f_2 < f_1$

D. If the wind blows from the source to the observer, $f_2 < f_1$

Answer: A::B

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Comprehension

1. Waves $y_1 = A\cos(0.5\pi x - 100\pi t)$ and $y_2 = A\cos(0.46\pi x - 92\pi t)$ are travelling along x-axis. (Here x is in m and t is in second)

(1) Find the number of times intensity is maximum in time interval of 1 sec.

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2. Waves $y_1 = A\cos(0.5\pi x - 100\pi t)$ and $y_2 = A\cos(0.46\pi x - 92\pi t)$ are travelling along x-axis. (Here x is in m and t is in second)

(2) The wave velocity of louder sound is

A. 100 m//s

B. 192 m//s

C. 200 m//s

D. 96 m//s

Answer: C

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3. Waves $y_1 = A\cos(0.5\pi x - 100\pi t)$ and $y_2 = A\cos(0.46\pi x - 92\pi t)$ are travelling along x-axis. (Here x is in m and t is in second)

(3) The number of times $y_1 + y_2 = 0$ at $x = 0$ in $1\sec$ is

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4. Two trains A and B moving with speeds $20m/s$ and $30m/s$ respectively in the same direction on the same straight track, with B ahead of A. The engines are at the front ends. The engine of train A blows a long whistle.

Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800Hz$ to $f_2 = 1120Hz$, as shown in the figure. The spread in the frequency (highest frequency - lowest frequency) is thus $320Hz$.

The speed of sound in still air is $340 m / s$.

(4) The speed of sound of the whistle is

A. $340 m / s$ for passengers in A and $310 m / s$ for passengers in B

B. $360 m / s$ for passengers in A and $310 m / s$ for passengers in B

C. $310 m / s$ for passengers in A and $360 m / s$ for passengers in B

D. $340 m / s$ for passengers in both the trains.

Answer: B

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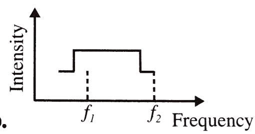
5. Two trains A and B moving with speeds $20 m / s$ and $30 m / s$ respectively in the same direction on the same straight track, with B ahead of A. The engines are at the front ends. The engine of train A blows a long whistle.

Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800 Hz$ to $f_2 = 1120 Hz$, as shown in the figure. the spread in the frequency (highest frequency - lowest frequency) is thus $320 Hz$. the speed of sound in still air is $340 m / s$.

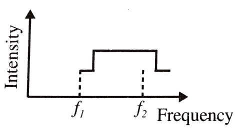
(5) The distribution of the sound intensity of the whistle as observed by the passengers in train A is best represented by

A.

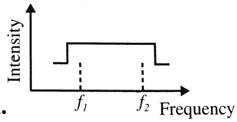
B. b.



C. c.



D. d.



Answer: A

View Text Solution

6. Two trains A and B moving with speeds $20m/s$ and $30m/s$ respectively in the same direction on the same straight track, with B ahead of A. The engines are at the front ends. The engine of train A blows a long whistle.

Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800Hz$ to $f_2 = 1120Hz$, as shown in the figure. the spread in the frequency (highest frequency - lowest frequency) is thus $320Hz$. the speed of sound in still air is $340m/s$.

The spread of frequency as observed by the passenger in train B is

A. 310 Hz

B. 330 Hz

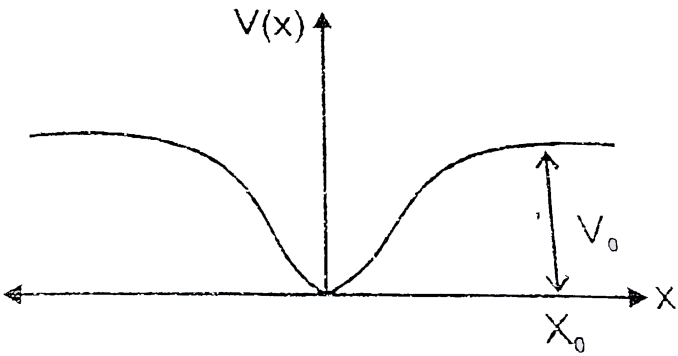
C. 350 Hz

D. 290 Hz

Answer: A

Watch Video Solution

7. When a particle is mass m moves on the $x-$ axis in a potential of the from $V(x) = kx^2$, it performs simple harmonic motion. The corresponding thime periond is proportional to $\sqrt{\frac{m}{k}}$, as can be seen easily asing dimensional analysis. However, the motion of a pariticle can be periodic even when its potential enem increases on both sides $x = 0$ in a way different from kx^2 and its total energy is such that the particel does not escape to infinity. consider a particle of mass m moving onthe $x -$ axis . Its potential energy is $V(x) = \omega(\alpha > 0)$ for $|x|$ near the origin and becomes a constant equal to V_0 for $|x| \geq X_0$ (see figure)



If the total energy of the particle is E, it will perform is periodic motion why if :

A. E lt 0

B. E gt 0

C. $V_0 > E > 0$

D. $E > V_0$

Answer: C

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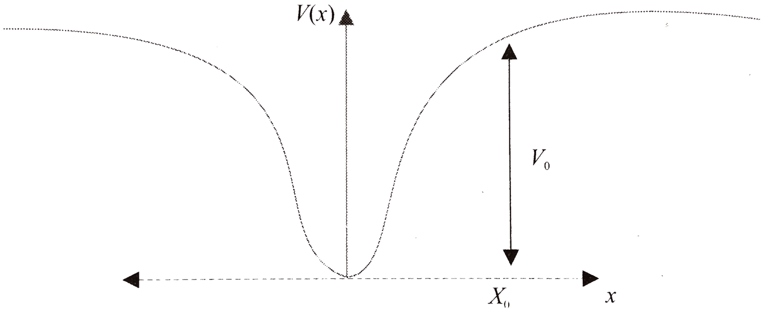
8. When a particle of mass m moves on the x-axis in potential of the from $V(x) = kx^2$ it performs simple harmonic motion. The corresponding time period is proportional to m, k as can be seen easily using dimensional analysis. However, the motion of a particle can be periodic even when its potential energy increases on both sides of $x = 0$ in a way different from kx^2 and its total energy is such that the particle does not escape to infinity. Consider a particle of mass m moving on the x-axis. Its potential energy is $V(x) = \propto x^4 (\propto > 0)ø|x|$ near the origin and becomes a constant equal to $V_0 f$ or $|x| \geq X_0$ (see Fig. 8.12).



If the total energy of the particle is E. it will perform periodic motion only if.

A. $A\sqrt{\frac{m}{\propto}}$

B. $\frac{1}{A}\sqrt{\frac{m}{\propto}}$

C. $A\sqrt{\frac{\propto}{m}}$

D. $A\sqrt{\frac{2\propto}{m}}$

Answer: B

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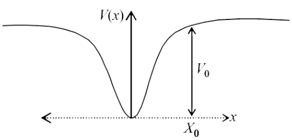
9. When a particle of mass m moves on the x-axis in a potential of the form $V(x) = kx^2$ it performs simple harmonic motion. The correspondubing time period is proprtional to $\frac{\sqrt{m}}{h}$, as can be seen easily using dimensional analusis. However, the motion of a particle can be periodic even when its potential energy increases on both sides of $x = 0$ in a way different from kx^2 and its total energy is such that the particle does not escape toin finity. Consider a particle of mass m moving on the x-axis. Its potential energy is $V(x) = ax^4 (a > 0)$ for |x| neat the origin and becomes a constant equal to V_0 for |x|impliesX_(0)` (see figure).



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The acceleration of this partile for $|x| > X_0$ is

(a) proprtional to V_0

(b) proportional to.

A. proportional to V_0

B. proportional to $\frac{V_0}{mX_0}$

C. proportional to $\sqrt{\frac{V_0}{mX_0}}$

D. zero

Answer: D

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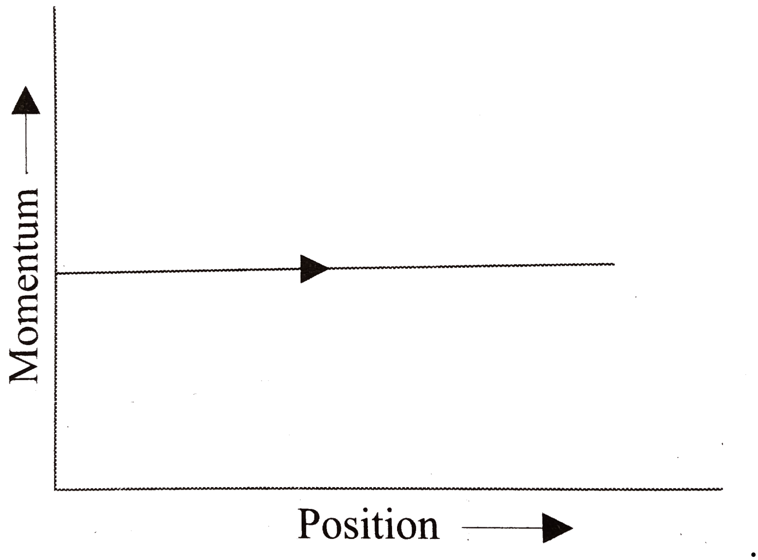
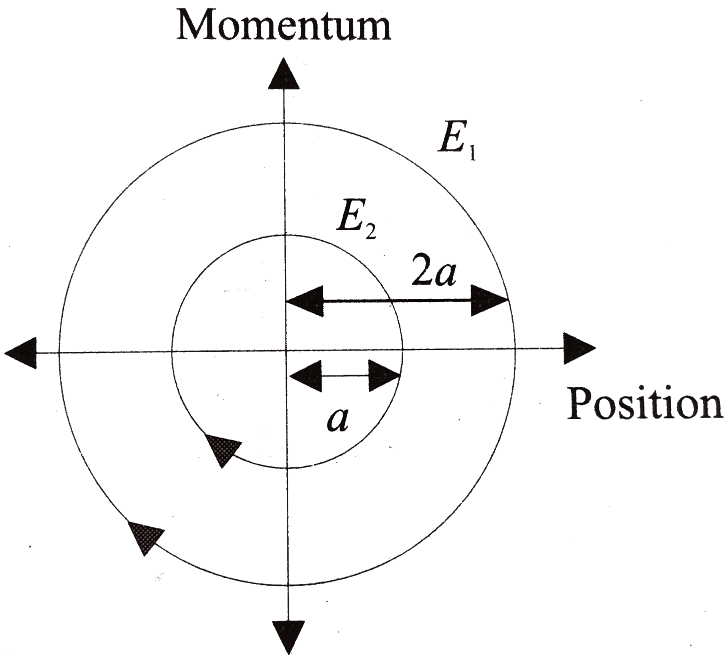
10. Phase space diagrams are useful tools in analysing all kinds of dynamical problems. They are especially useful in studying the changes in motion as initial position and momentum are changed. Here we consider some simple dynamical systems in one dimension. For such systems, phase space is a plane in which position is plotted along horizontal axis and momentum in plotted along vertical the axis.

The phase space diagram is $x(t)$ vsersus $p(t)$ curve in this plane. The arrow on the curve indicates the time flow. For example, the phase space space diagram for a particle moving with constant velocity is a straight line as shown in (Fig. 8.13). We use the sign convention in which position or momentum upwards (or to right) is positive and downwards (or to left) is negative.



The phase space diagram for simple harmonic motion is a circle centred at the origin. In (Fig. 8.14), the two circles represent the same oscillator but for different initial conditions, and

E_1 and E_2 are the total mechanical energies respectively. Then.



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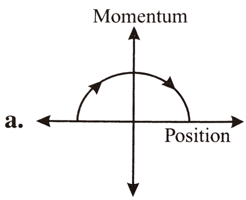

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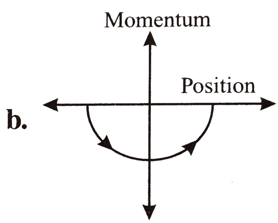
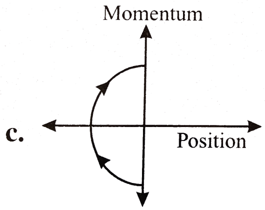
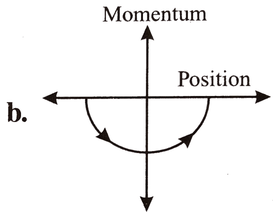




C.



D.

Answer: D

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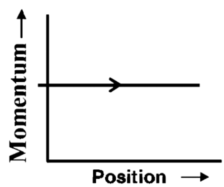
11. Phase space deagrams are useful tools 

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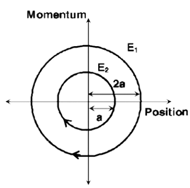
in analyzing all kinds of dynamical problems. They are especially usrful in studying the changes in motion as initial position and momenum are changed. Here we conseder some simple dynamical systems in one dimension. For such systems, phase space is a plane in which position is plotted along horizontal axis and momentum is plotted along vertical axis. The phase space diagram is `x(t) vs. p(t) curve in this plane. The arrow on the curve indicates the time flow. For example, the phase space diagram for a particle moving with constant velocity is a straight line as shown in the figure. We use the sign convention in which positon or momentum upwards (or to right) is poitive and downwards (or to left) is negative.

The plase space deagram for simple harmonic motion is a circle centered at the origin. In the figure, the two circles represent the same oscillator but for different initial condetions, and E_(1) and E_(2) the total mechanical energies respectivey.



.

A. $E_1 = \sqrt{2} E_2$

B. $E_1 = 2E_2$

C. $E_1 = 4E_2$

D. $E_1 = 16E_2$

Answer: C

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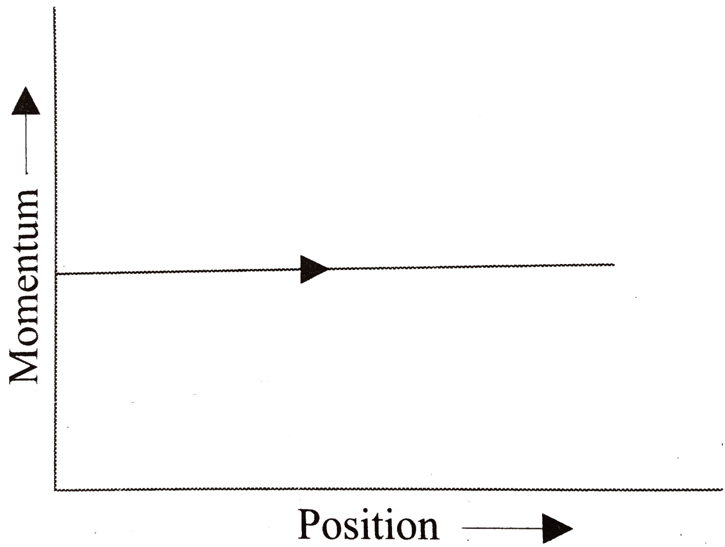
12. Phase space diagrams are useful tools in analysing all kinds of dynamical problems. They are especially useful in studying the changes in motion as initial position and momentum are changed. Here we consider some simple dynamical systems in one dimension. For such systems, phase space is a plane in which position is plotted along horizontal axis and momentum in plotted along vertical the axis.

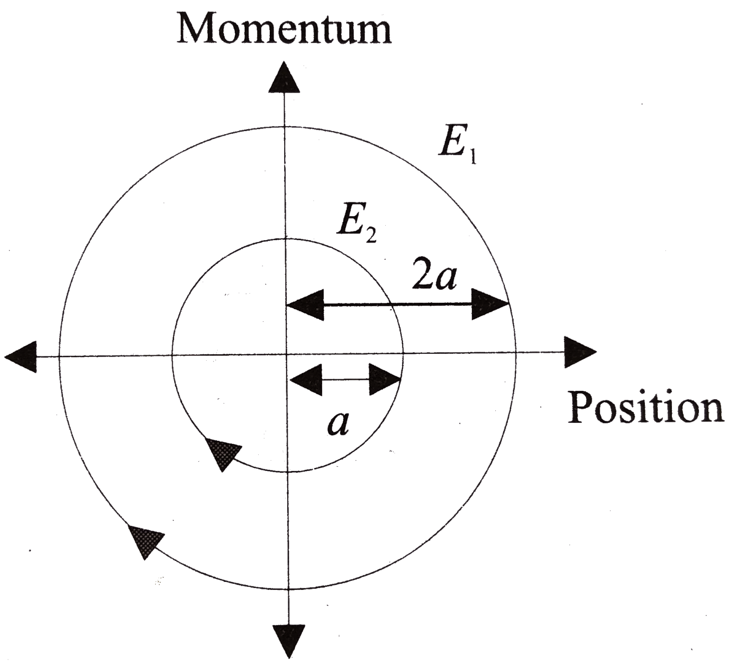
The phase space diagram is $x(t)$ vsersus $p(t)$ curve in this plane.

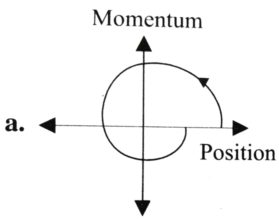
The arrow on the curve indicates the time flow. For example, the phase space space diagram for a particle moving with constant velocity is a straight line as shown in (Fig. 8.13). We use the sign convention in which position or momentum upwards (or to right) is positive and downwards (or to left) is negative.



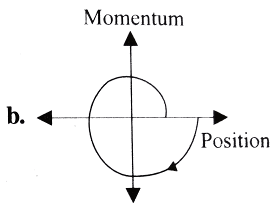
The phase space diagram for simple harmonic motion is a circle centred at the origin. In (Fig. 8.14), the two circles represent the same oscillator but for different initial conditions, and

E_1 and E_2 are the total mechanical energies respectively. Then.

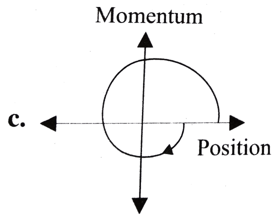


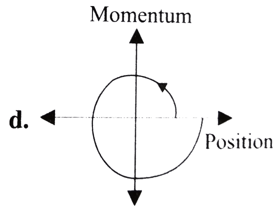


A.



B.

C. 

D. 

Answer: B

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Integer

1. A $20cm$ long string, having a mass of $1.0g$, is fixed at both the ends. The tension in the string is $0.5N$. The string is into vibrations using an external vibrator of frequency $100Hz$. Find the separation (in cm) between the successive nodes on the string.

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2. A stationary source is emitting sound at a fixed frequency f_o, which is reflected by two cars approaching the source. The difference between the frequencies of sound reflected from the cars is 1.2 % of f_o. What is the difference in the speeds of the cars (in km per hour) to the nearest integer? Thee cars are moving at constant speeds much smaller than the speed of sound which is 330 ms^{-1}

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3. When two progressive waves $y_1 = 4\sin(2x - 6t)$ and $y_2 = 3\sin\left(2x - 6t - \frac{\pi}{2}\right)$ are superimposed, the amplitude of the resultant wave is

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4. A $0.1kg$ mass is suspended from a wire of negligible mass. The length of the wire is $1m$ and its cross - sectional area is $4.9 \times 10^{-7} m^2$. If the mass is pulled a little in the vertically downward direction and released , it performs SHM with angular frequency $140 rad s^{-1}$. If the young's modulus of the material of the wire is $p \times 10^9 Nm^{-2}$, find the value of p.

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