PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

LINEAR AND ANGULAR SIMPLE HARMONIC MOTION

Illustration

1. What is the time - period of $x = A\sin(\omega t + \alpha)$?

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2. Find time period of the function, $y = \sin \omega t + \sin 2\omega t + \sin 3\omega t$

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3. Identify which of the following function represent simple harmonic motion.

(i) $Y = Ae^{I\omega t}$ (ii) $Y = ae^{-\omega t}$

(iii) $y = a \sin^2 \omega t$ (iv) $y = a \sin \omega t + b \cos \omega t$

(v) $y = \sin \omega t + b \cos 2\omega t$

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4. A partical excutes SHM with an angular frequency $\omega = 4\pi rad / s$. If it is at its extereme position initially, then find the transition when it is at a distance $\sqrt{2} / 2$ times its amplitude from the mean position.

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5. A particle executes SHM with an amplitude $8cm$ and a frequency $4Hz$ initially, in the positive direction , determine its displacement equation and the maximum velocity and acceleration.

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6. A particle executing SHM oscillates between two fixed points separated by $20cm$. If its maximum velocity be $30cm/s$. Find its velocity when its displacement is $5cm$ from its mean position.

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7. A particle executing SHM with time period of $2s$: Find the time taken by it to move from one amplitude to half the amplitude position.

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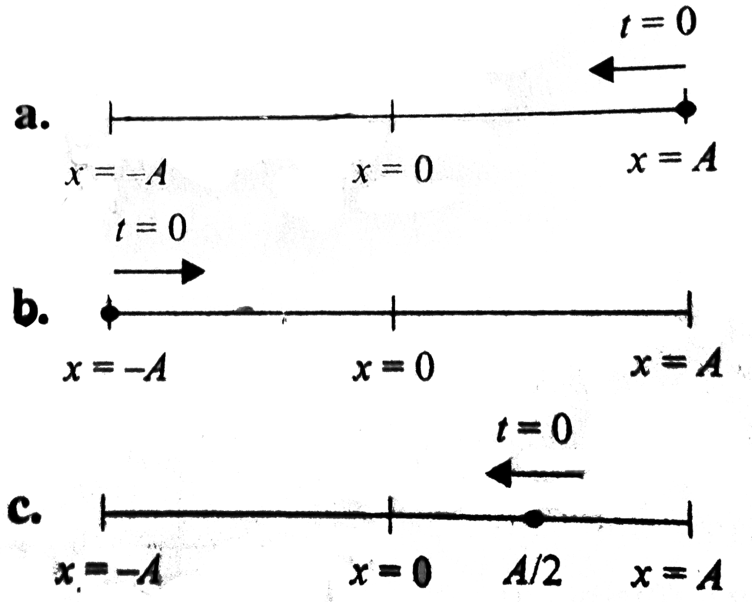
8. Write the equation of SHM for the situations show below:



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9. A particle of mass $m = 1kg$ oscillates simple harmonically with angular frequency $1rad/s$. Find the phase of the particle at $t = 1s$ and $2s$. Start calculating time when the particle moves up passing through the mean position.

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10. If $x = A/2$ at $t = 0$, Find phase constant (α) in $x = A\sin(\omega t + \alpha)$, at $t = 0$, a particle executing SHM is going along negative x axis

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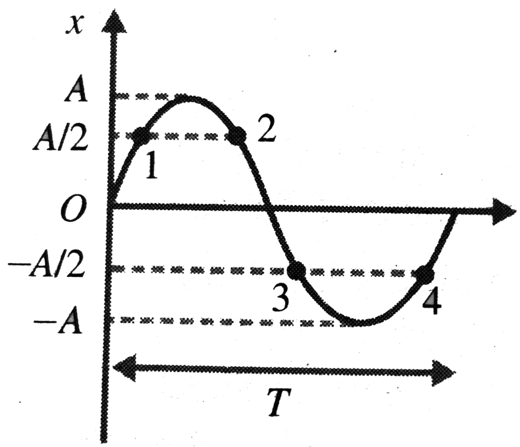
11. Shows the displacement time graph of a partical excuting SHM with a time period T. Four points $1, n2, 3$ and 4 are market on the graph where the displacement is half that of the amplitude.



a. Identify the point of same displacement but with opposite direction of motion . Find the time difference between them.

b. Identify the point where the particals move in the same difference. Find the time difference between them.

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12. A partical excutes SHM with same frequency and amplitude along the same straight line. They cross each other , at a point midway between the mean and the exterme position. Find the Phase difference between them.

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13. A partical excutes SHM with amplitude$A$ and angular frequency ω. At an instant the particle is at a distance $A/5$ from the mean position and is moving away from it. Find the time after which it will come back to this position again and also find the time after which it will pass through the mean position.

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14. two partical excuting SHM with same frequency and amplitudes A and $2A$ on same straight line with same mean position cross each other in opposite direction at a distance $A/3$ from mean possion. Find the phase difference in the two SHM s.

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15. A particle of mass 0.50 kg executes a simple harmonic motion under a force $F = -\left(50Nm^{-1}\right)x$. If it crosses the centre of oscillation with a speed of $10ms^{-1}$, find the amplitude of the motion.

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16. A $20g$ particle is oscillating simple harmonically with a period of $2 \sec$ and maximum kinetic energy $2J$. The total mechanical energy of the particle is zero , find

a Amplitude of oscillation

b. potential energy as a function of displacement x relative to mean position.

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17. A body is executing SHM under action of the a force whose maximum magnitude is $50N$. The magnitude of force acting on the particle at the time when its energy is half kinetic and half potential energy is (Assume potential energy to be zero at mean position).

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18. A point particle if mass $0.1kg$ is executing SHM of amplitude $0.1m$. When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} J$. Write down the equation of motion of this particle when the initial phase of oscillation is 45°.

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19. If a partical moves in a potential energy held $U = U_0 - ax + bx^2$, where are a and b partical constents obtian an expression for the force acting on if as a function of position. At what point does the force vanish? Is this a point of stable equilibriun ?

Calculate the force constant and friquency of the partical.

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20. A particle executes SHM with an amplitude of $10cm$ and frequency $2Hz$, at $t = 0$, the particle is at point where potential energy and kinetic energy are same. Find the equation of displacement of particle.

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21. A partical of mass $0.2kg$ undergoes SHM according to the equation $x(t) = 3\sin(\pi t + \pi/4)$.

i. What is the total energy of the partical if potential energy of zero at mean position ?

ii. What are the kinetic and potential energies of partical at time $t = 1s$?

iii. At what time instants is the particals energies purely kinetic?

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22. A partical of mass $0.2kg$ executes simple harmonic motion along a path of length $0.2m$ at the rate of 600oscillations per minute. Assum at $t = 0$. The partical start SHM in positive direction. Find the kinetic potential energies in joules when the displacement is $x = A/2$ where, A stands for the amplitude.

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23. A point particle if mass $0.1kg$ is executing SHM of amplitude $0.1m$. When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} J$. Write down the equation of motion of this particle when the initial phase of oscillation is 45°.

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24. A partical of mass m is located in a unidimensionnal potential field where potentical energy of the partical depends on the coordinates $x as : U(x) = U_0(1 - \cos Ax), U_0$ and A constants.

Find the period of small oscillation that the partical performs about the equilibrium position.

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25. Find the amplitude of the simple harmonic motion obtasined by combining the motions

$x_1 = (2.0cm)\sin \omega t$

and $x_2 = (2.0cm)\sin\left(\omega t + \frac{\pi}{3}\right)$

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26. $x_1 = 3\sin \omega t$, $x_2 = 4\cos \omega t$. Find (i) amplitude of resultant SHM, (ii) equation of the resultant SHM.

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27. Two particle A and B execute simple harmonic motion according to the equation

$y_1 = 3\sin\omega t$ and $y_2 = 4\sin[\omega t + (\pi/2)] + 3\sin\omega t$. Find the phase difference between them.

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28. If the displacement of a moving point at any time is given by an equation of the form $y(t) = a\cos\omega t + b\sin\omega t$, shown that the motion is simple harmonic . If $a = 3m, b = 4m$ and $\omega = 2$: determine the period , amplitude, maximum velocity and maximum acceleration.

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29. If two SHMs are repersented by $y_1 = 10\sin(4\pi + \pi/2)$ and $y_2 = 5\left(\sin 2\pi t + \sqrt{8}\cos 2\pi t\right)$, compare their amplitudes .

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30. A force $F = -10x + 2$ acts on a particle of mass $0.1kg$ where x is in m and F in newton. If is released from rest at $x = 0$, find:

a. Amplitude:

b. Time period:

c. Equation of motion.

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31. A person normally weighing $60kg$ stands on a platform which oscillates up and down harmonically at a frequency $2.0\sec^{-1}$ and an amplitude $5.0cm$. If a machine on the platform gives the person's weight against time deduce the maximum and minimum reading it will shown, $Take g = 10m/\sec^2$.

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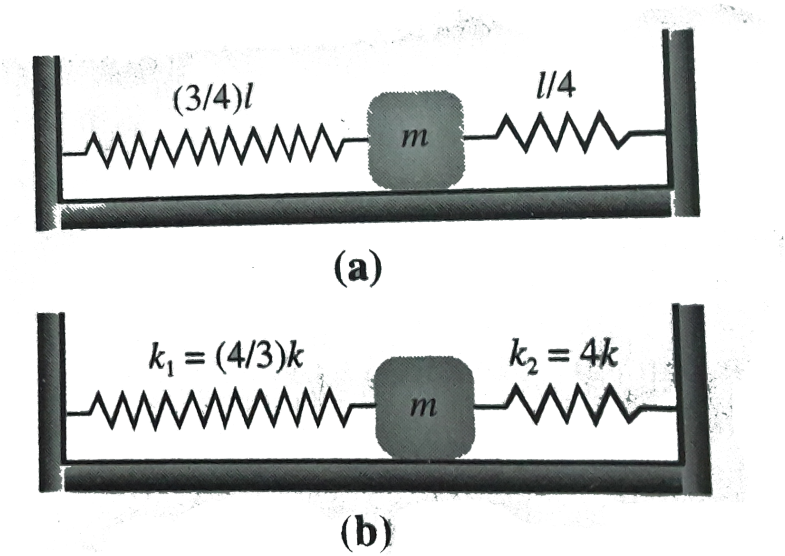
32. A spring of stiffness constant k and natural length l is cut into two parts of length $3l/4$ and $l/4$, respectively, and an arrangement is made as shown in figure . If the mass is slightly displaced , find the time period of oscillation.



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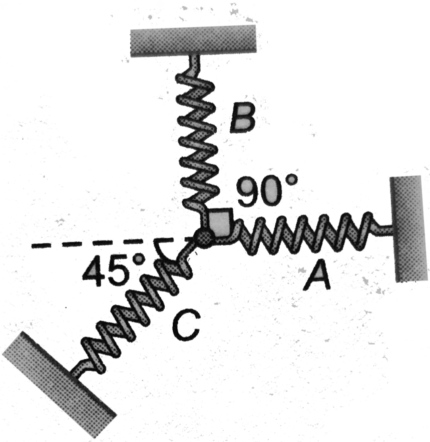
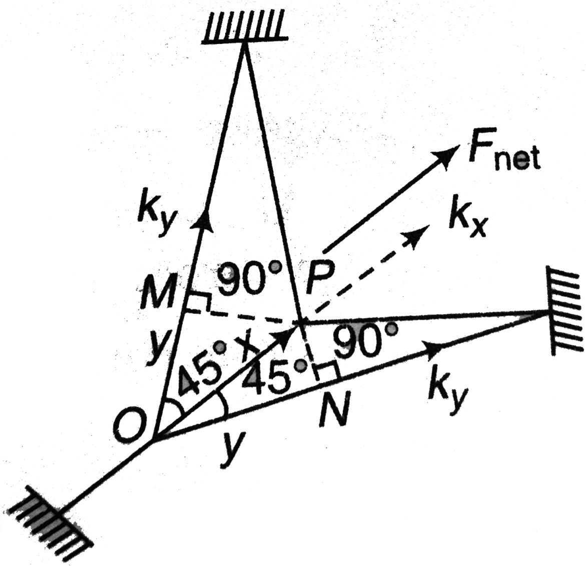
33. A particle of mass m is attached with three springs A, B and C of equal force constancts k as shown in figure. The particle is pushed slightly against the spring C and released. Find the time period of oscillation.





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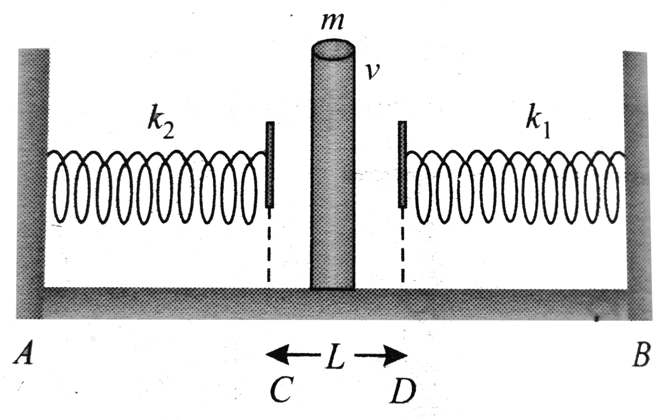
34. Two light spring of force constants k_1 and k_2 and a block of mass m are in the line AB on a smooth horizontal table such that one end of each spring is fixed on right supports and the other end is free as shown in figure



The distance CD between the free ends of the spring is $60cm.$ If the block

$(k_1 = 1.8N/m, k_2 = 3.2N/m \text{ and } m = 200g)$.

Is the motion simple harmonic?

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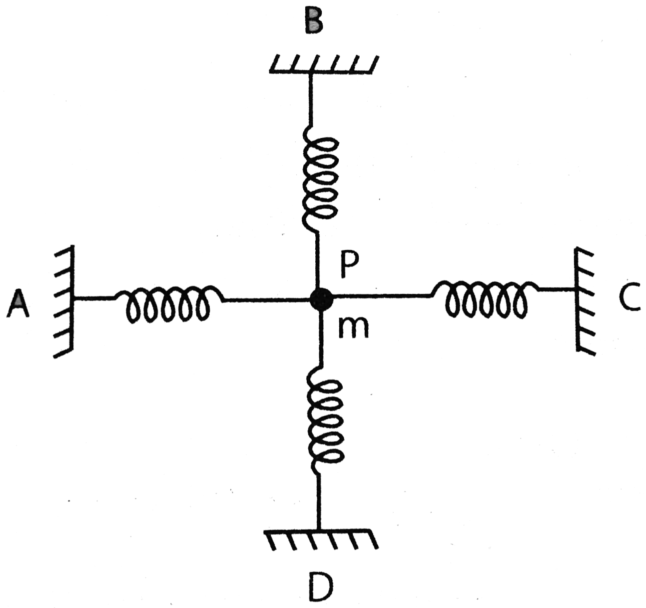
35. figure shown a partical mass $m = 100g$ attaches with four identical spring , each of length $l = 10cm$. Initial tension in each spring is $F_0 = 25N$. Neglecting gravity , Calculate the period of small oscillation of the article along a line perpendicular to the plane of the figure .



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36. Find the time period of m if pulley P is light and small.

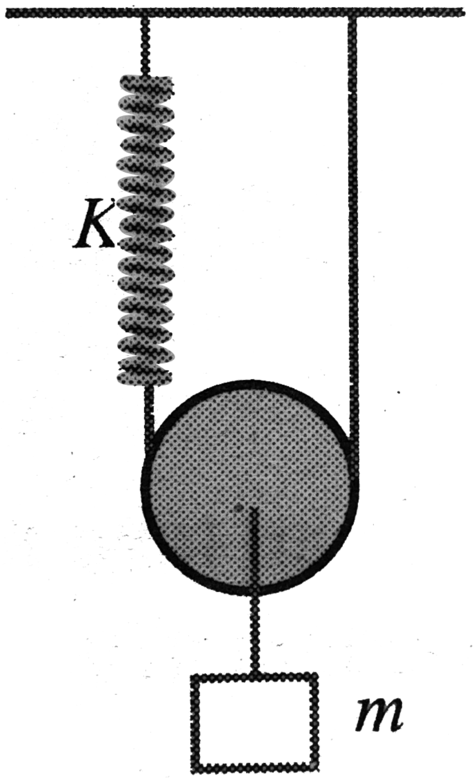

Fig. 4.43

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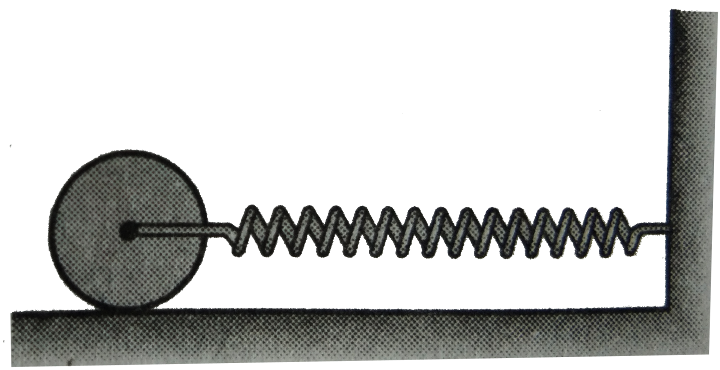
37. A solid cylinder of mass m is attached to a horizontal spring with force constant k. The cylinder can roll without slipping along the horizontal plane. (See the accompanying figure.) Show that the center of mass of the cylinder executes simple harmonic motion with a period $T = 2\pi\sqrt{\frac{3m}{2k}}$, if displaced from mean position.



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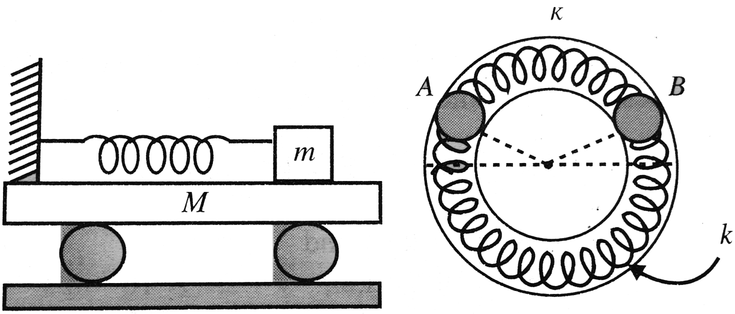
38. figure (a) and (b) represent spring- block system. If m is displacement slightly , find the time period of ascillation of the system.



(a) (b)

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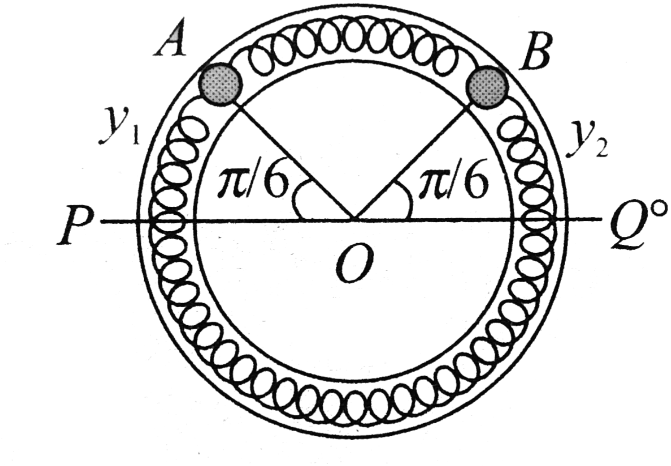
39. Two identical balls A and B eavh of mass $0.1 kg$ are attached to two identical mass less is springs. The spring-mass system is consetrained to move inside a right smooth pipe bent in the form of a circle as shown in figure . The pipe is fixed in a horigental plane. The center of the balls can move in a circle of radius $0.06m$. Each spring has a natural length of $0.06\pi m$ and force constant $0.1N/m$. Initially, both the balls are displaced bu an angle $\theta = \pi/6$ dadius withrespect to diameter PQ of the circle and released from rest.

a. Calculate the frequency of oscillation of the ball

B.

b. What is the total energy of the system ?

c. Find the speed of the bal A when A and B are at the two ends of the diameter PQ.



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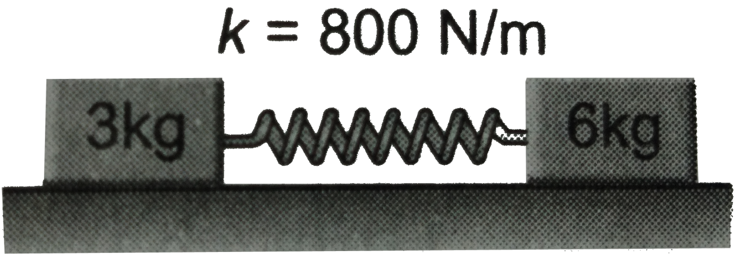
40. The system shown in the figure can move on a smooth surface. They are initially compressed by $6cm$ and then released, then choose the correct options.



(a) The system performs, SHM with time period $\frac{\pi}{10}s$

(b) The block of mass $3kg$ perform SHM with amplitude $4cm$

(c) The block of mass $6kg$ will have maximum momentum of $2.40kg - m/s$

(d) The time periods of two blocks are in the ratio of $1 : \sqrt{2}$

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41. A simple pendulum of length 40 cm oscillates with an angular amplitude of 0.04 rad. Find a. the time period b. the linear amplitude of the bob, c. The speed of the bob when the string makes 0.02 rad with the vertical and d. the angular acceleration when the bob is in momentarily rest. Take $g = 10ms^{-2}$.

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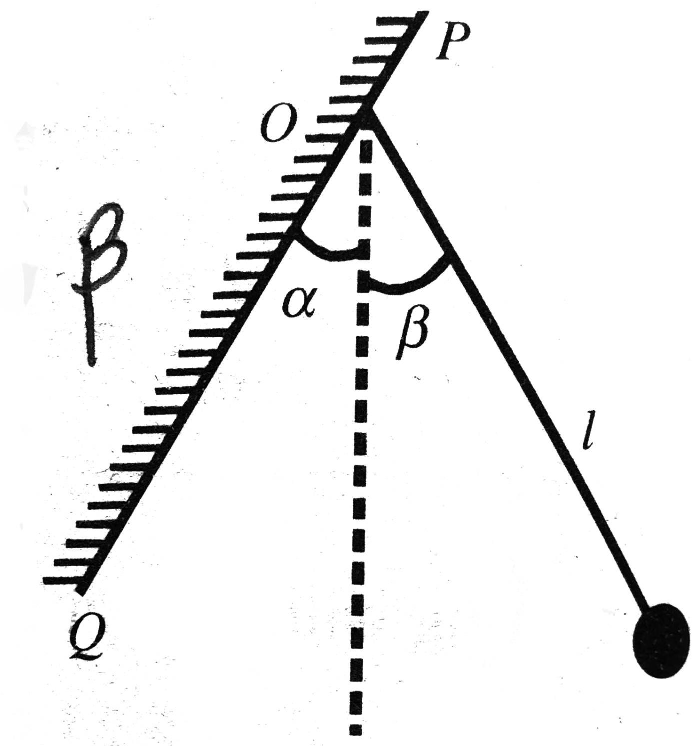
42. A ball is suspended by a thread of length l at the point O on an incline wall as shown. The inclination of the wall with the vertical is (a)the thread is displacement througha small angle away from the vertical and (b) the ball is released. Find the period of obcillation of pendulum. Consider both cases



a. $\alpha > \beta$

b. $\alpha < \beta$

Assuming that any impact between the wall and the ball is elastic.

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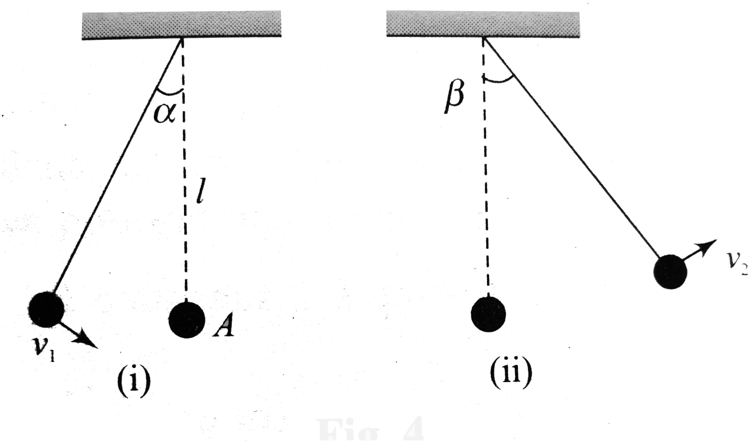
43. figure show the identical simple pan-delums of length. One is tilled at an angle α and imparted an initial velocity v_1 towards mean possition and at a velocity v_2 at an initial angular displacement β. Find the phase difference in oscillations of these two pendulums



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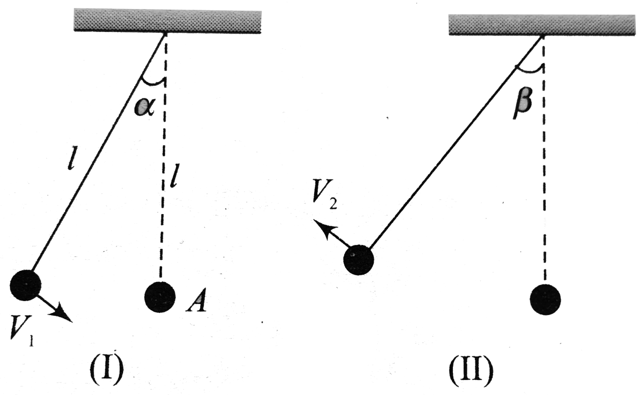
44. If the second pendulum bob is thrown at velocity v_2 at an angle β from mean position, but on other side of mean position , find the phase diffrence in the two SHMs now as show in the figure.



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45. Derive an expression for the angular frequency of small oscillation of the bob of a simple pendulum when it is immerased in a liquid of density ρ. Assume the density of the bob as σ and length of the string as l.

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46. What is the period of a pendulum formed by pivoting a metre stick so that is free to rotate about a horizontal axis passing through the $75cm$ mark?

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47. A uniform disc of radius 5.0 cm and mass 200g is fixed at its centre to a metal wire, the other end of which is fixed with a clamp. The hanging disc is rotated about the wire through an angle and is released. If the disc makes torsional oscillations with time period 0.20s, find the torsional constant of the wire.

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48. Assume that a tunnel is dug across the earth (radius=R) passing through its centre. Find the time a particle takes to cover the length of the tunnel if (a) it is projected into the tunnel with a speed of $\sqrt{(gR)}$ (b) it is relased from a height R above the tunnel (c) it is thrown vertically upward along the length of tunnel with a speed of $\sqrt{gR}$.

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49. Consider a solid cylinder of the density ρ_s cross section area A and h ploating in a liquid of density ρ_l as shown in figure $(\rho_l > \rho_s)$. It is depressed sligtly and allowed to oscillation.

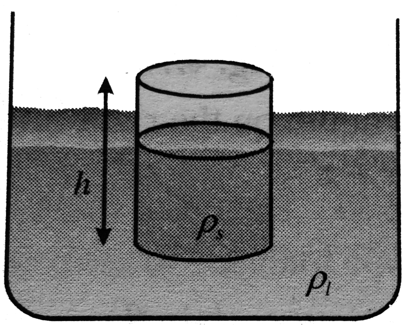

Fig. 4.76

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50. A V-shaped glass tube of uniform cross section is kept in a vertical plane as shown. A liquid is poured in the tube. In equilibrum the level of liquid in both limds of tube. Find the angular frequency of small oscillation of liquid.

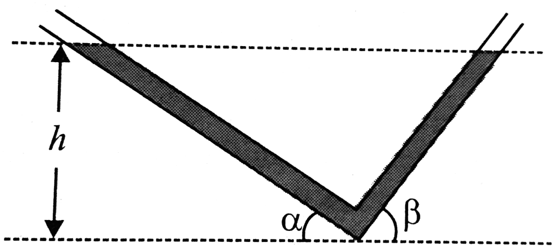

Fig. 4.77

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51. Find the amplitude and initial phase of a partical in SHM, whose motion equation is given as

$y = A \sin \omega t + B \cos \omega t$

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52. Two simple harmonic motion are represent by the following equations

$y_1 = 10 \sin(\pi / 4)(12t + 1)$

$y_2 = 5\left(\sin 3\theta t + \sqrt{3} \cos 3\theta t\right)$

Here t is in seconds.

Find out the ratio of their amplitudes.What are the time period of the two motion?

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Solved Example

1. A uniform horizontal plank is resting symmetrically in a horizontal position on two cylindrical droms , which are apinning in in opposite direction about their horizontal axes with equal angular velocity . The distance between the axes with equal angular velocity. The distance between the axes is $2L$ and the coefficient of friction between the plank and cylender is μ . If the plank is displaced slightly from the equilibrium position along its length and released, show that it performs simple horizontal motion. Caculate also the time period of motion.

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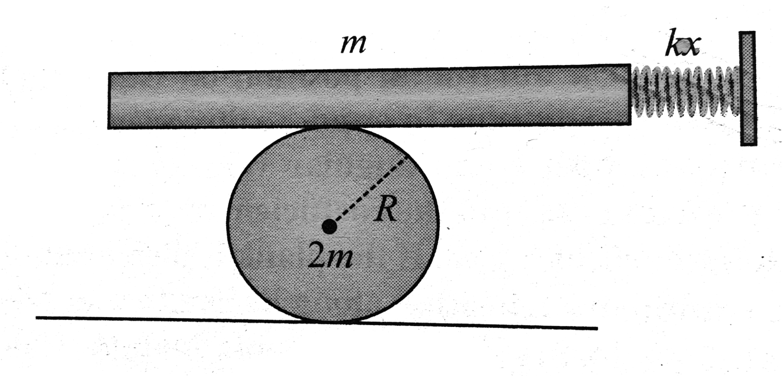
2. A uniform plank of mass m, free to move in the horizontal direction only , is placed at the top of a solid cylinder of mass $2m$ and radius R. The plank is attached to a fixed wall by mean of a light spring constant k. There is no slipping between the cylinder and the planck , and between the cylinder and the ground. Find the time period of small oscillation of the system.



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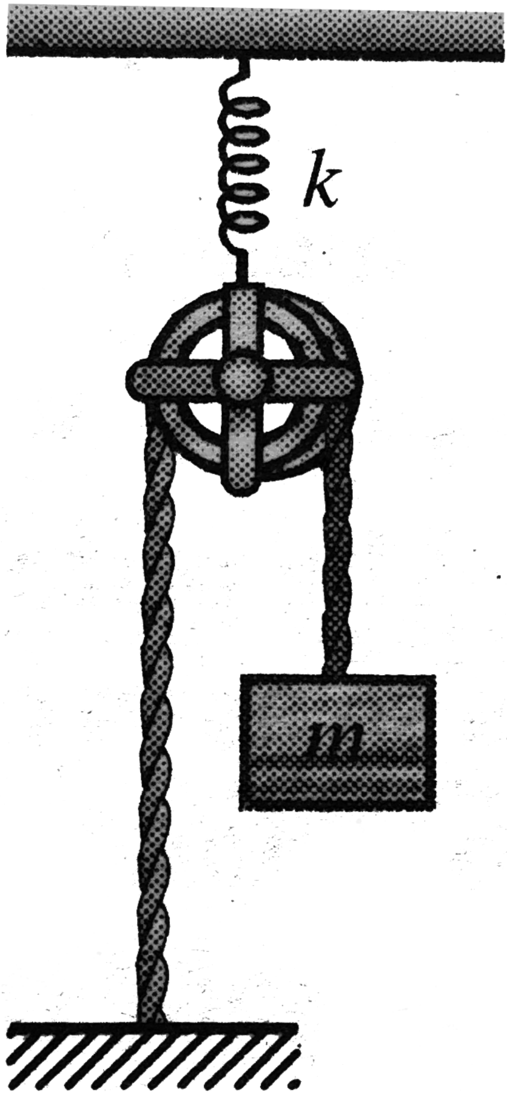
3. A block of mass m hangs by means of a string which goes over a pulley of mass m and moment of inertia I, as shown in the diagram. The string does not realtive to the pulley. Find the frequency of small oscillations.



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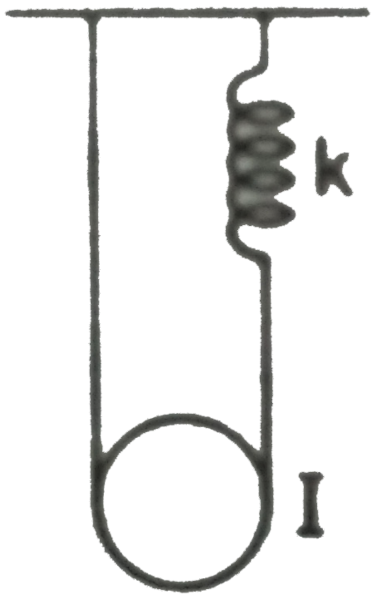
4. The pulley shown in figure has a moment of inertias I about its xis and mss m. find the tikme period of vertical oscillastion of its centre of mass. The spring has spring constant k and the string does not slip over the pulley.



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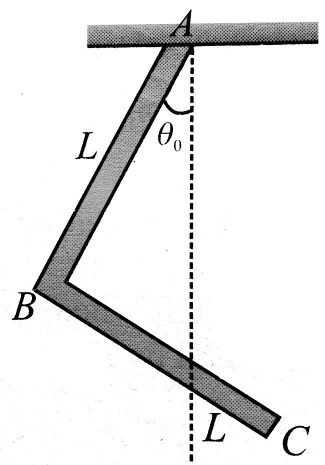
5. An L-shaped bar of mass M is pivoted at one of its end so that it can freely rotate in a vertical plane, as shown in the figure

a. Find the value of θ_0 at equilibrum

b. If it is slighly displacement from its equilibrum position, find the frequency of oscillation.



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6. A certain of a perfect gas is enclosed in a cylinder of volume V_0 fitted with a smooth heavy piostion of mass m and area a. The piston is displaced through a small distance downwards so as to compress the gas isother mally , and then it is left free to go show that it performs SHM and also find its period . Take the atmospheric pressure as $P_{a \to m}$.

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7. A spherical ball of mass m and radius r rolls without slipping on a rough concave surface of large radius R. It makes small oscillations about the lowest point. Find the time period.

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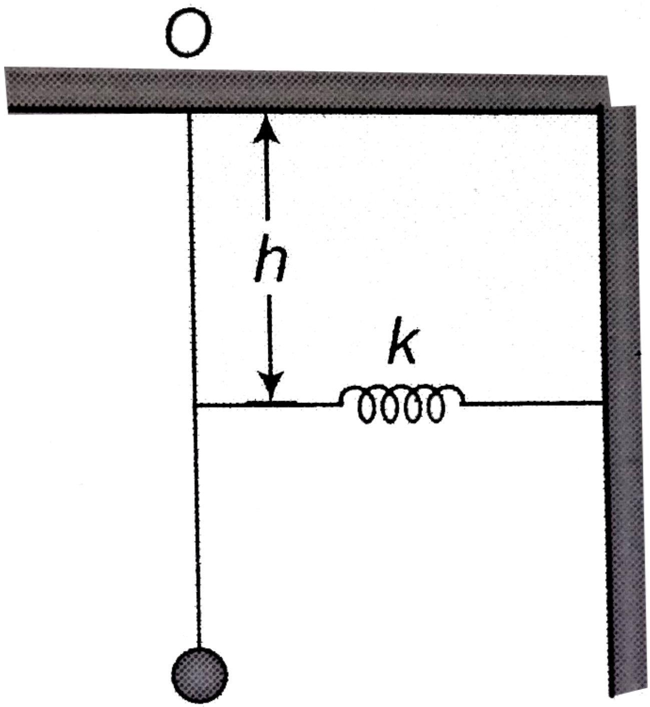
8. A simple pendulum of length L and mass m has a spring of force constant k connected to it at a distance h below its point of suspension. Find the frequency of vibrations of the system for small values of amplitude.



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9. One end of an ideal spring is fixed to a wall at origin O and axis of spring is parallel to x-axis. A block of mass $m = 1kg$ is attached to free end of the spring and it is performing SHM. Equation of position of the block in co-ordinate system shown in figure is $x = 10 + 3\sin(10t)$. Here, t is in second and x in cm. Another block of mass $M = 3kg$, moving towards the origin with velocity $30cm / s$ collides with the block performing SHM at $t = 0$ and gets stuck to it. Calculate

(a) new amplitude of oscillations,

(b) neweqution for position of the combined body,

(c) loss of energy during collision. Neglect friction.

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10. A circular spring of natural length l_0 is cut and weided with two beads of masses m_1 and m_2 such that the ratio of the lengths of the springs between the beads is 4:1 if the stiffness of the spring is k. find the frequency of oscillation of the beads in a smooth horizontal rigid tube. Assume m_(1) = m and m_(2) = 3 m`.

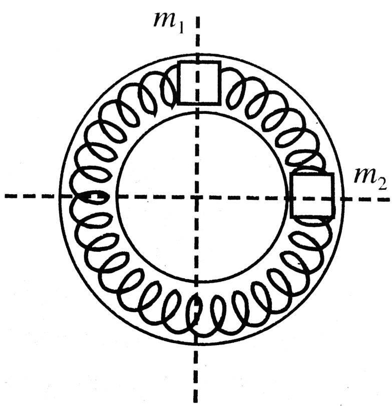

Fig. 4.110

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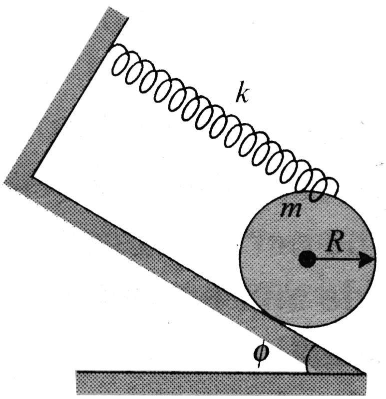
11. A uniform cylinder of mass m and radius R is in equilibrium on an inclined by the action of a light spring of stiffnesk, gravity and reaction force acting on it .If the angle of inclination of the plane is ϕ , find the angular frequency of small oscillation of the cylinder



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12. A $2kg$ mass is attached to a spring of force constant $600N/m$ and rests on a smooth horizontal surface. A second mass of $1kg$ slides along the surface toward the first at $6m/s$.

(a) Find the amplitude of oscillation if the masses make a perfectly inelastic collision and remain together on the spring. what is the period of oscillation ?

(b) Find the amplitude and period of oscillation if the collision is perfectly elastic.

(c) For each case , write down the position x as a function of time t for the mass attached to the spring, assuming that the collision occurs at time $t = 0$. What is the impulse given to the `2kg mass in each case ?

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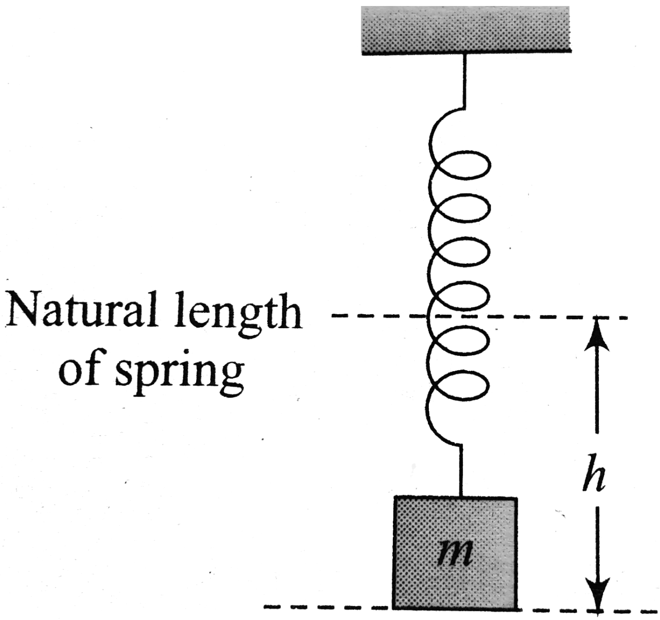
13. A spring block pendulum is shown in figure . The system is hanging in equilibrium. A bullet of mass $m/2$ moving at a speed u bites the block from downwards direction and gets embedded in it. Find the amplitude of oscillation of the block now.



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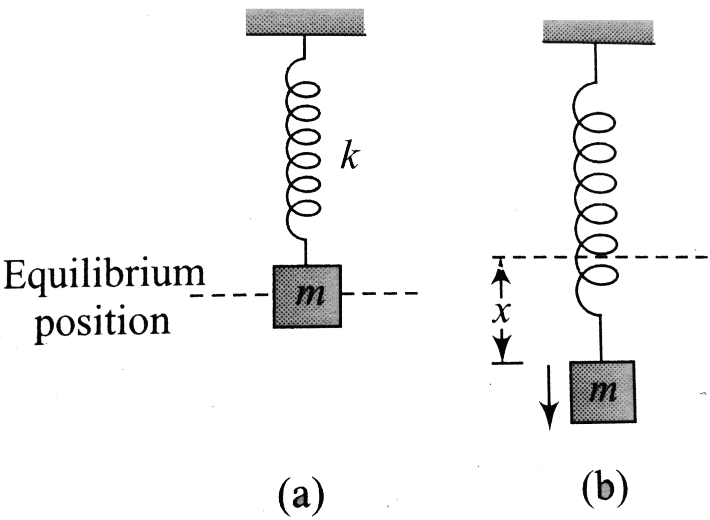
14. Figure shown a spring block system hanging in equilibrium. The block of system is pulled down by the distance x and imparted a velocity v in downward direction as shown in figure. Find the time it will take to reach its mean position. Also find the maximum distance to which if will move before returning back towards mean position.



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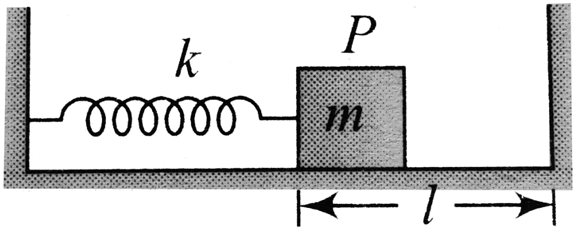
15. Figure shown a block P of mass m resting on a smooth horizontal surface, attached to a spring of force constant k which is rigidly fixed on the wall on left side, shown in the figure . At a distance l to the right of the block there is a rigid wall. If block is pushed towards left so that spring is compressed by a distance $5l/3$ and when released, if will starts its oscillations. If collision of block with the wall is considered to be perfectly elastic.

Find the time period of oscillation of the block.



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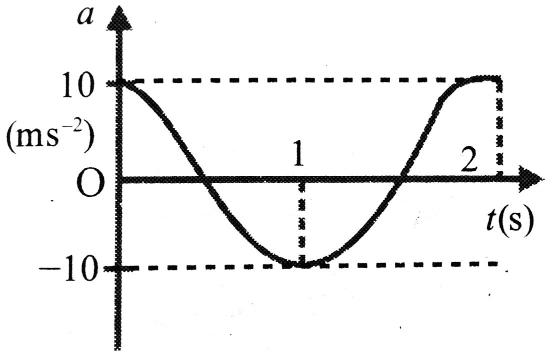
Exercise 4.1

1. i.The acceleration versus time graph of a partical SHM is shown in the figure . Plot the displacement versus time graph



(A)

ii. The frequency of oscillation is........

iii. The displacement amplitude is ....

iv. At $t = 0$, the velocity of the partical is ......

v. The kinetic energy of the partical is maximum at $t =$ .... and t = ...

vi. The potential energy is maximum at t = ... : t = ... ans t = ...

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2. A partical slides back and forth between two inclined friction lessplanes.

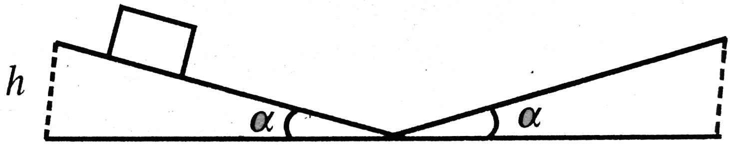

Fig. 4.28

a. If h is the initial height of the partical, the period of oscillation......

b. Is the motion oscillatory? Is it SHM?

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3. The equation of displacement of two waves are given as

$$y_1 = 10\sin\left(3\pi t + \frac{\pi}{3}\right), y_2 = 5\left[\sin 3\pi t + \sqrt{3}\cos 3\pi t\right]$$

Then what is the ratio of their amplitudes

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4. Suppose a tunnel is dug along a diameter of the earth. A particle is dropped from a point at a distance h directly above the tunnel. The motion of the particle as seen from the earth is

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5. The equation of motion of a particle started at t=0 is given by $x = 5\sin\left(20t + \frac{\pi}{3}\right)$, where x is in centimetre and t in second. When does the particle

a. first come rest

b. first have zero acceleration

c. first have maximum speed?

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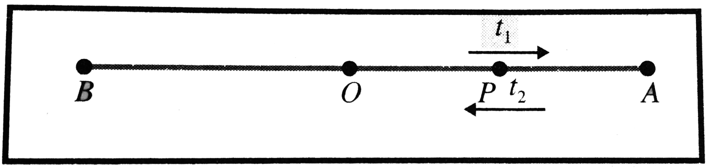
6. A particle starts SHM from mean position O executing SHM A and B are the two point at which its velocity is zero . It passes through a certain point P at time $t_1 = 0.5$ and $t_2 = 1.5 s$ with a speed of $3 m / s$.

i. The maximum speed ....

ii. ratio AP / PB ....



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7. If the maximum speed and acceleration of a particle executing SHM is

$20 cm / s$ and $100\pi cm / s^2$, find the time period od oscillation.

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8. A particle is performing SHM of amplitude 'A' and time period 'T'. Find the time taken by the particle to go from $0 \rightarrow A / 2$.

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9. A particle of mass $2kg$ is moving of a straight line under the action of force $F = (8 - 2x)N$. It is released at rest from $x = 6m$.

a. Is the particle moving simple harmonically.

b. Find the equilibrium position of the particle.

c. Write the equation of motion of the particle.

d. Find the time period of SHM.

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10. A particle executing simple harmonic motion has amplitude of $1m$ and time period $2s$. At $t = 0$, net force on the particle is zero. Find the equation of displacement of the particle.

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11. In the previous question, find maximum velocity and maximum acceleration.

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12. A partical in SHM ha a period of 4s .It takes time t_1 to start from mean position and reach half the amplitude. In another case it taken a time t_2 to start from extreme position and reach half the amplitude. Find the ratio t_1 / t_2

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13. A particle is subjected to two simple harmonic motion in the same direction having equal amplitudes and equal frequency. If the resultant amplitude is equal to the amplitude of the individual motions. Find the phase difference between the individual motions.

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14. A particle executes SHM of period $1.2s$ and amplitude $8cm$. Find the time it takes to travel

$3cm$ from the positive extremity of its oscillation.

$[\cos^{-1}(5/8) = 0.9rad]$

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15. A cylinder of mass M and radius R is resting on a horizontal platform (which is parallel to the $x-y$ plane) with its axis fixed along the y-axis and free to rotate about its axis. The platform is given a motion in the x-direction given by $x = A\cos(\omega t)$ There is no slipping between the cylinder and the platform. The maximum torque acting on the cylinder during its motion is ___.

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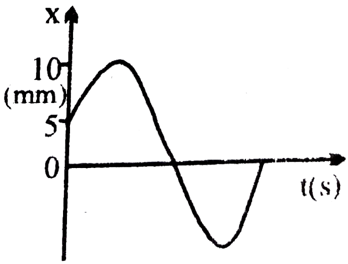
16. The figure shows the displacement-time graph of a particle executing SHM. If the time period of oscillation is $2s$, then the equation of motion is given by

X = ________



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17. A body executing SHM has its velocity its $10cm/\sec$ and$7cm/\sec$ when its displacement from the mean position are $3cm$ and $4cm$, respectively. Calculate the length of the path.

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18. A body undergoing SHM about the origin has its equation is given by $X = 0.2 \cos 5\pi t$. Find its average speed from $t = 0 \rightarrow t = 0.7 \sec$.

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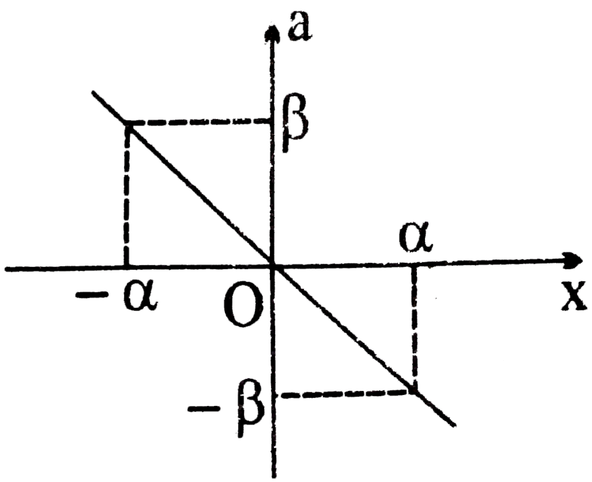
19. The acceleration-displacement $(a - X)$ graph of a particle executing simple harmonic motion is shown in the figure. Find the frequency of oscillation.



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20. A block is kept on a horizontal table. The stable is undergoing simple harmonic motion of frequency $3Hz$ in a horizontal plane. The coefficient of static friciton between block and the table surface is 0.72. find the maximum amplitude of the table at which the block does not slip on the surface.

A. 3

B. 1

C. 2

D. 7

Answer: c

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21. A linear harmonic oscillator has a total mechanical energy of 200 J . Potential energy of it at mean position is 50 J. Find,

(i) the minimum potential energy,

(ii) the maximum kinetic energy ,

(iii) the potential energy at extreme positions.

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22. The potential energy of a particle oscillating along x-axis is given as

$U = 20 + (x - 2)^2$

Here, U is in joules and x in meters. Total mechanical energy of the particle is $36J$.

(a) State whether the motion of the particle is simple harmonic or not.

(b) Find the mean position.

(c) Find the maximum kinetic energy of the particle.

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23. $x_1 = 5\sin\omega t$

$x_2 = 5\sin(\omega t + 53^\circ)$

$x_3 = -10\cos\omega t$

Find amplitude of resultant SHM.

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Exercise 4.2

1. A block of mass m is suspended from the ceiling of a stationary standig elevator through a spring of spring constant k. Suddenly, the cable breaks and the elevator starts falling freely. Show that the bklock now executes a simple harmonic motion of amplitude $m\frac{g}{k}$ in the elevator

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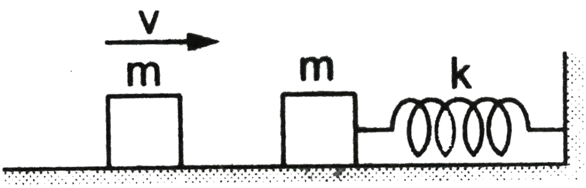
2. The left block in filgure collides inelastically with the right block and sticks to it. Find the amplitude of the resulting simple harmonic motion.



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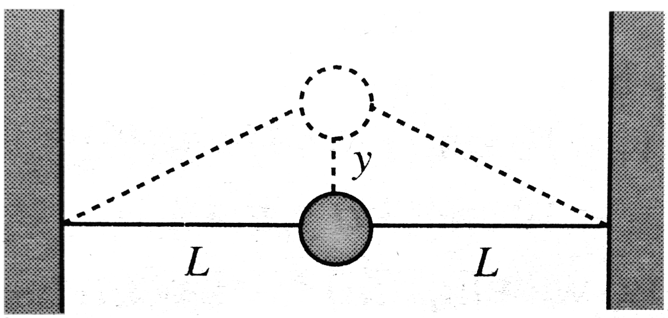
3. A ball of amss m is connected to two rubber bands of length L, each under tension T as shown in figure . The ball is diplaced by a small distance y perpendicular to the length of the rubber band. Assuming the tension does not change , shown that

(a) the restoring force is $-(2T/L)y$

(b) the sysytem exbibites simple harmonic motion with an angular frequency $\omega = \sqrt{2T/mL}$s.



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4. A mass M attached to a spring oscillation with a period of $2s$. If the mass is increased by $2kg$, the period increases by 1s, find the initial mass m assuming that Hooke's law is obeyed.

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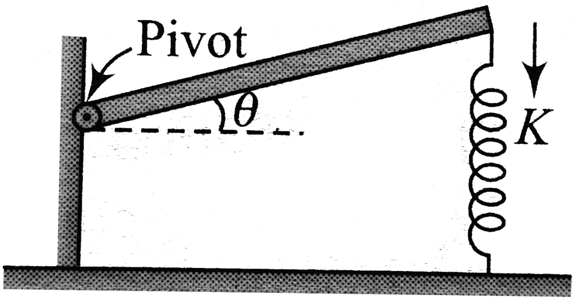
5.



A horizontal rod of mass m and length L is pivoted at one end The rod's other end is supported by a spring of force constant k. The rod is displaced by a small angle θ from its horizontal equilibrium position and released. The angular frequency of the subsequent simple harmonic motion is

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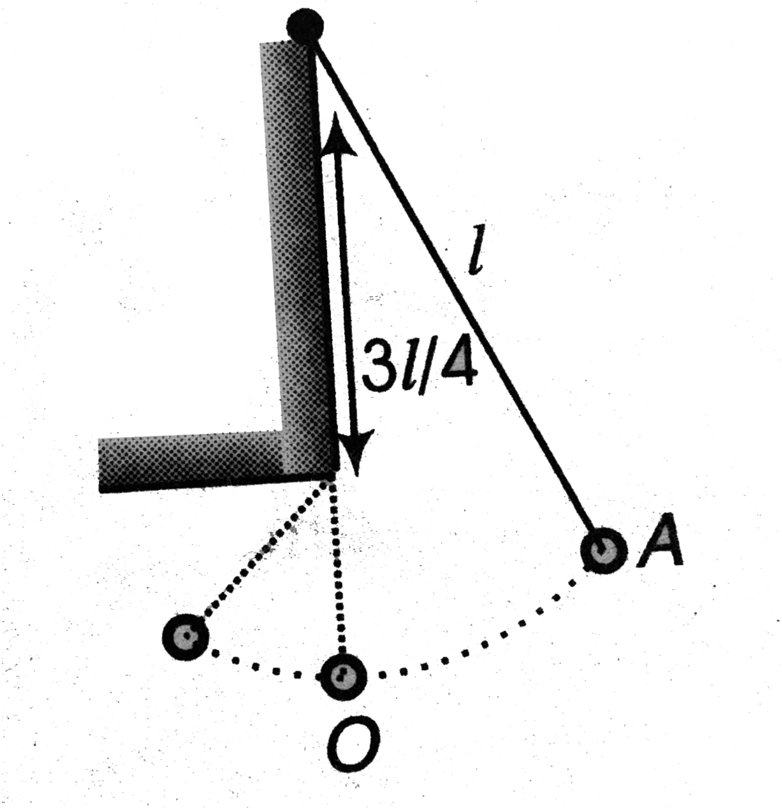
6. A pendulum has a period T for small oscillations. An obstacle is placed directly beneath the pivot, so that only the lowest one - quarter of the string can follow the pendulum bob when it swings to the left of its resting position. The pendulum is released from rest at a certain point. How long will it take to return to that point again ? In answering this question, you may assume that the angle between the moving string and the vertical stays small throughout the motion.



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7. A horizontal spring block system of mass M executes simple harmonic motion. When the block is passing through its equilibrium position, an object of mass m is put on it and the two move together. Find the new amplitude and frequency of vibration. Given, k is the spring constant of the system.

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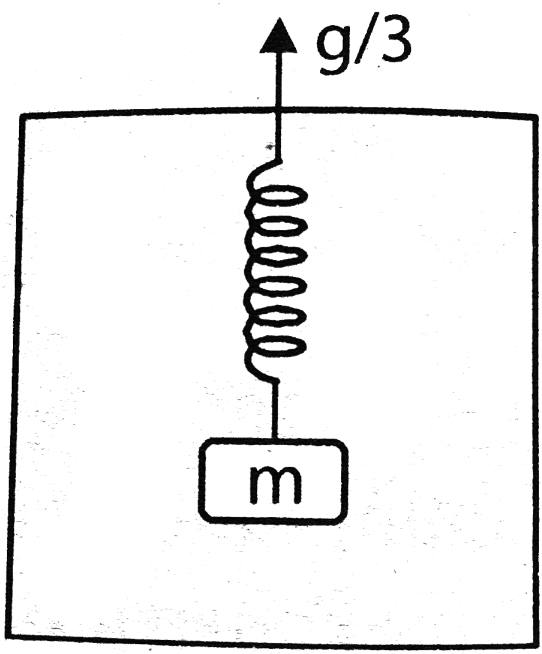
8. A spring of spring constant $200 N/m$ has a block of mass $1 kg$ hanging at its one end and form the other and the spring is attached to a celling of an elevator. The elevator rises upwards with an acceleration of $g/3$.

When acceleration is suddenly ceased , then what should be the angular frequency and elongationduring the time when the elevator is accelerating?



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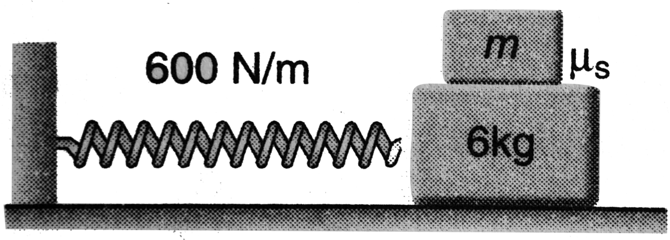
9. With the assumption of no slipping, determine the mass m of the block which must be placed on the top of a $6kg$ cart in order that the system period is $0.75s$. What is the minimum coefficient of static friction μ_s for which the block will not slip relative to the cart is displaced $50mm$ from the equilibrium position and released? Take

$(g = 9.8 m / s^2)$.



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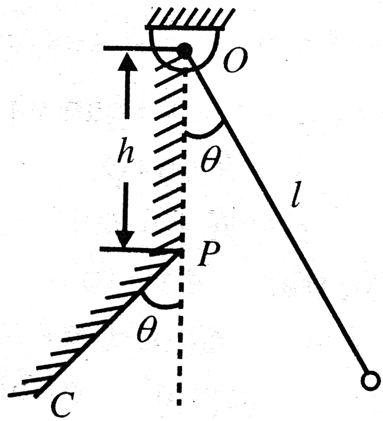
10. A simple pendulum of length l swimings from a small angle θ . Its swinging is constrained by the smooth inclined planes OP and PC. Assuming elastic collision of the bob with the plane PC, find angular amplitude for the motion of the bob in the left hand side of its mean possition.

.



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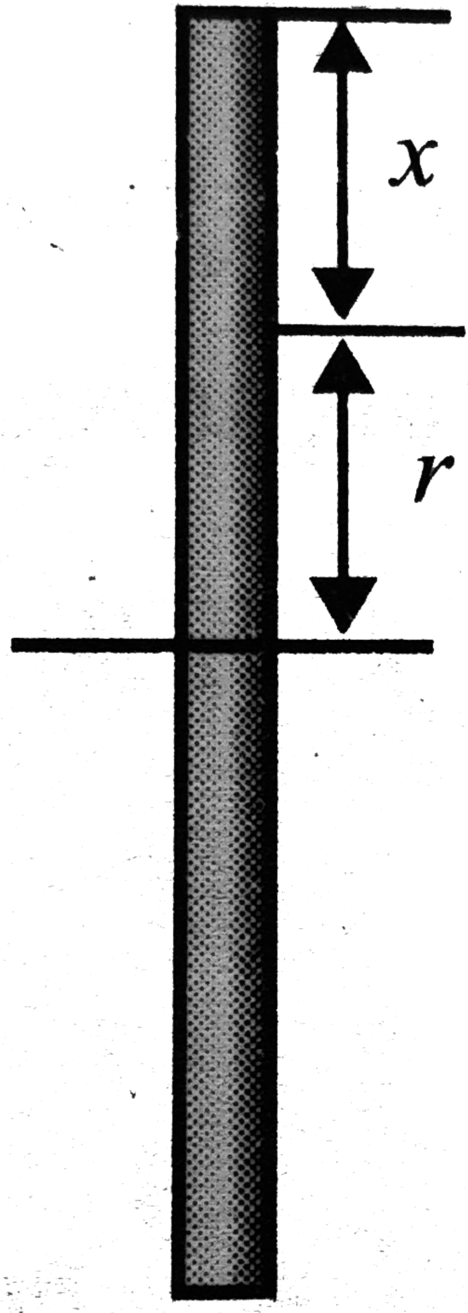
11. A uniform rod of length l is pivoted distance x from the top of the rod . Neglecting friction find the (a) value of x for minimum period of oscillation, (b) minimum period of oscillation of the rod.


x
r

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12. The period of oscillation of a spring pendulum is T. If the spring is cut into four equal parts, then find the time period corresponding to each part.

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13. A uniform stick of length l is hinged so as to rotated about a harmonic axis perpendicular to the stick, at a distance from the center . Find the value of x, for which the time period is minimum.

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14. A ball is released in a smooth dimetrical tunnel of earth

a. After how much time will it pass through the center of earth?

b. With what speeed will the ball pass the center earth?

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15. A body is in SHM with period T when oscillated from a freely suspended spring. If this spring is cut in two parts of length ratio $1:3$& again oscillated from the two the two parts separatedly, then the periods are $T_1 \& T_2$ then find T_1 / T_2.

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16. A point mass m is supended at the end of a massless wire of length Land cross sectional are A, If Y is the Youmg's modulus of the wire. Then the frequency of the oscillation for the simple harmonic oscillation along the vertical direction is

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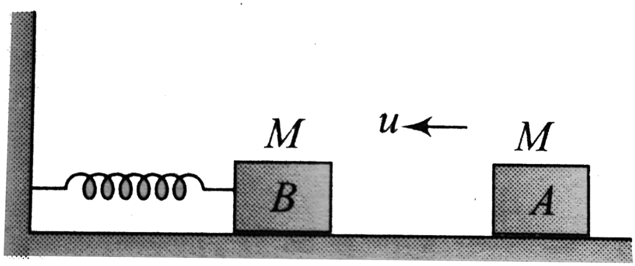
17. In the figure shown, the block A of mass m collides with the identical block B and after collision they stick together. Calculate the amplitude of resulatant vibration.



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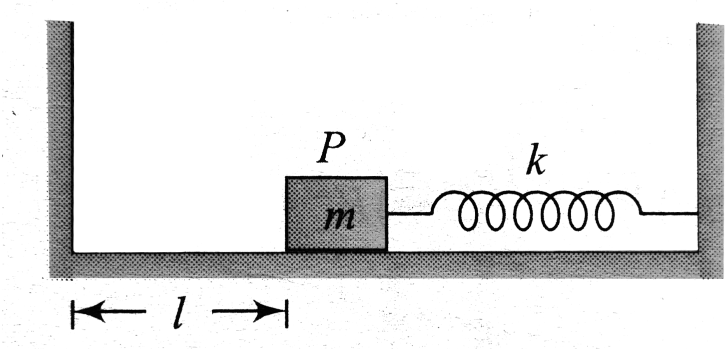
18. Figure shown a block P of mass m resting on a smooth floor at a distance l from a regid wall. Block is pushed towards right by a distance $3/2$ and released. When block passes from its mean position another block of mass m_1 so that the combined block just collides with the left wall.



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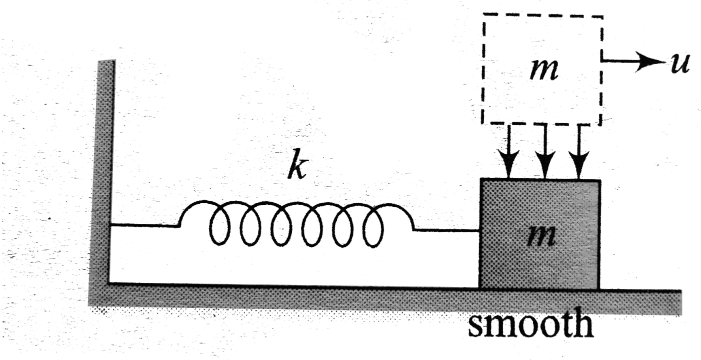
19. Figure shown a block P of mass m resting on a smooth horizontal ground, attached to one and a spring of force constant k in netural length. If another block od same mass and moving with a velocity u towards right is placed on the block on which stick to it due to friction ,find the time it will take to reach its exterme position. Also find the amplitude of oscillation of the combined mass $2m$.



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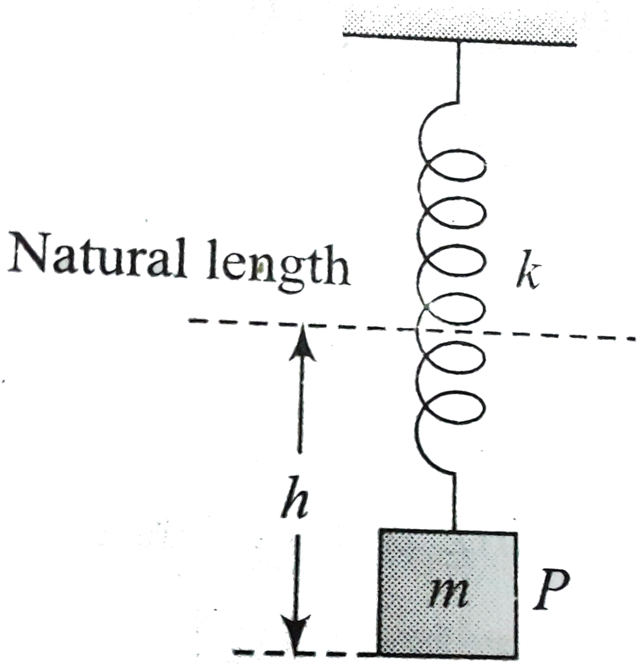
20. Figure shown a spring block system hanging in equilibrium. If a velocity v_0 is imparted to the block in downwards direction . Find the amplitude of SHM of the block and the time after which it will reach a point at half the amplitude of block



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21. Find the amplitude of the simple harmonic motion obtasined by combining the motions

$x_1 = (2.0cm)\sin\omega t$

and $x_2 = (2.0cm)\sin\left(\omega t + \frac{\pi}{3}\right)$

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22. $x_1 = 3\sin\omega t, x_2 = 4\cos\omega t$

Find (i) amplitude of resultant SHM, (ii) equation of the resultant SHM.

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23. A partical is subjucted to two simple harmonic motions

$x_1 = A_1 \sin \omega t$

and $x_2 = A_2 \sin(\omega t + \pi / 3)$

Find(a) the displacement at $t = 0$, (b) the maximum speed of the partical and (c) the maximum acceleration of the partical.

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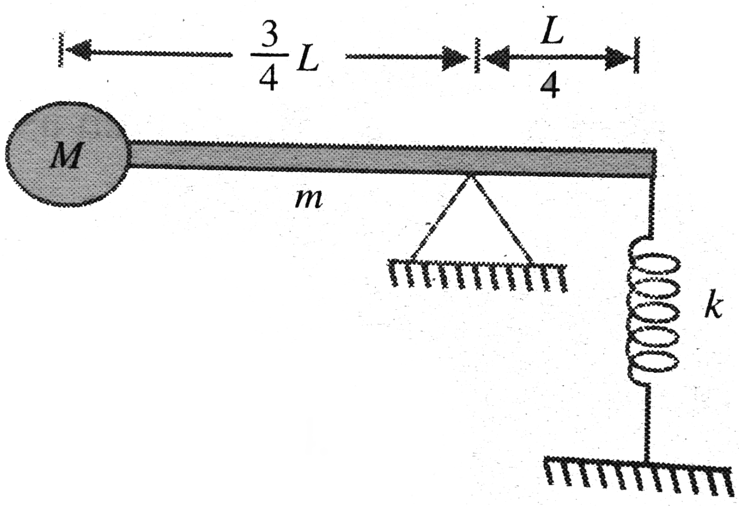
Subjective

1. A rigid rod of mass m with a ball of mass M attached to the free end is restrained to oscillate in a vertical plane as shown in the figure. Find the natural frequency of oscillation.



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2. A rectangular tank having base $15cm \times 20cm$ is filled with water (density $\rho = 1000kg/m^3$) up to $20cm$ and force constant $K = 280N/m$ is fixed to the bottom of the tank so that the spring remains vertical.

This system is in an elevator moving downwards with acceleration $a = 2m/s^2$. A cubical block of side $l = 10cm$ and mass $m = 2kg$ is gently placed over the spring and released gradually, as shown in the figure.

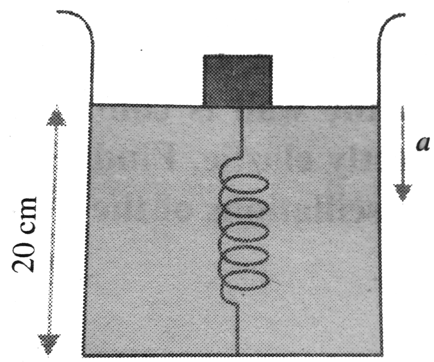

Fig. 4.124

a. Calculate compression of the spring in equilibrium position.

b. If the block is slightly pushed down from equilibrium position and released, calculate frequency of its vertical oscillations.

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3. A body A mass $m_1 = 1kg$ and body B of mass $m_2 = 4.1kg$. The body A perform free vertical harmonic oscillations with the amplitude $1.6cm$ and frequency $25Hz$. Neglecting the mass of the spring , find the maximum and m inimum value of force that the system exerts on the hearing surface.

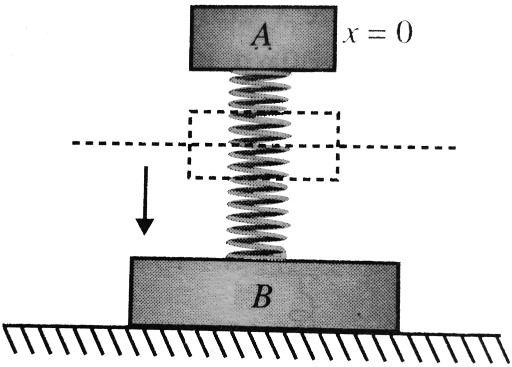

Fig. 4.125

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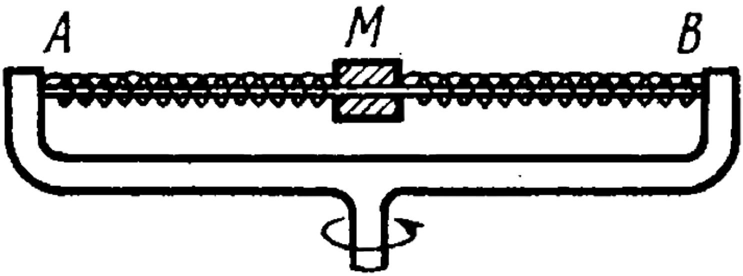
4. In the arrangement shown in figure the sleeve M of mass $m = 0.20 kg$ is fixed between two identical springs whose combined stiffness is equal to $x = 20 N/m$. The sleeve can slide without friction over a horizontal bar AB. The arrrangement rotates with a constant angular velocity $\omega = 4.4 rad/s$ about a vertical axis passing through the middle of the bar . Find the period of small oscillations of the sleeve. At what values of ω will there be no oscillations of the sleeve ?



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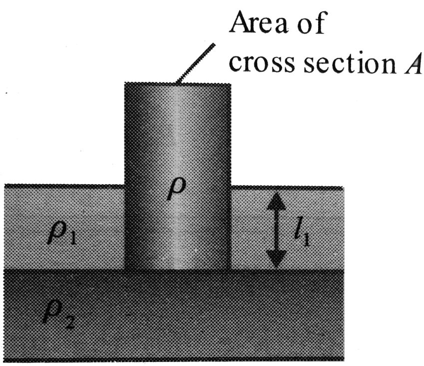
5. A vertical pole of length l , density ρ , area of cross section A floats in two immiscible liquids of densities $\rho_1$and ρ_2. In equuilibrium possition the bottom end is at the interface of the liquids. When the cylinder is displaced vertically, find the time period of oscillation.



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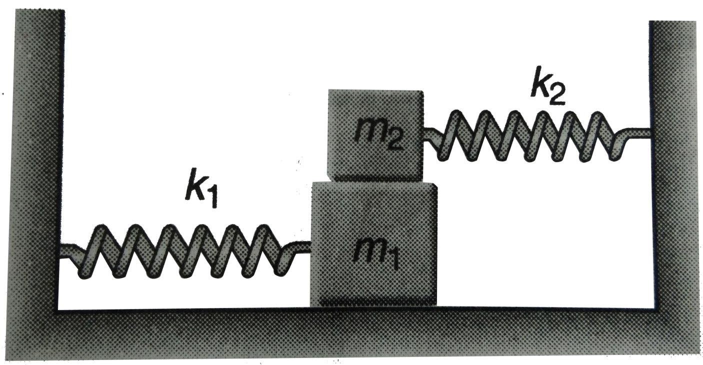
6. In the shown arrangement, both the spring are in their natural lengths. The coefficient of friction between m_2 and m_1 is μ. There is no friction between m_1 and the surface. If the blocks are displaced slightly, they together perform simple harmonic motion. Obtain



(a) Frequency of such oscillations.

(b) The condition if the friction force on clock m_2 is to act in the direction of its displacement from mean position.

(c) If the condition obtained in (b) is met, what can be maximum of their oscillations ?

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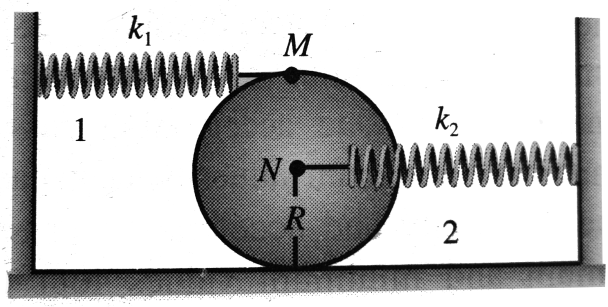
7. A uniform dise of mass m and radius R is connected with two light springs 1 and 2. The springs are connected at the highest point M and the CM 'N' of the dise. The other ends of the springs are rigidly attached with vertical walls. If we shift the CM in horizontalby a small distance , the discoscillates simple harmonically. Assuming a perfect rolling of the dise on the horizontal surface , find the angular frequency of oscillation.



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8. Consider a liquid which fills a uniform U - tube uniform U- tube, as shown in figure , up to a height h. Find angular the frequency of small oscillation of th eliquid in the U - tube.

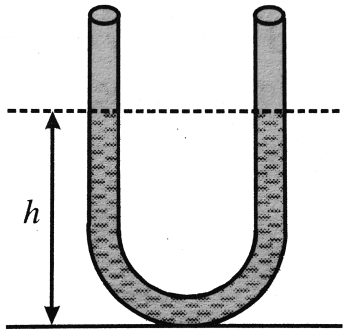

Fig. 4.130

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9. A partical of mass m is located in a unidimensionnal potential field where potentical energy of the partical depends on the coordinates $xasU(x) = \frac{A}{x^2} - \frac{B}{x}$ where A and B are positive constant.

Find the time period of small oscillation that the partical perform about equilibrium possition.

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10. A particle of mass $2kg$ is moving of a straight line under the actin force $F = (8 - 2x)N$. It is released at rest from $x = 6m$.

a. Is the partical moving simple harmonically.

b.Find the equilibrium position of the particle.

c. Write the equation of motion of the partical.

d. Find the time period of SHM.

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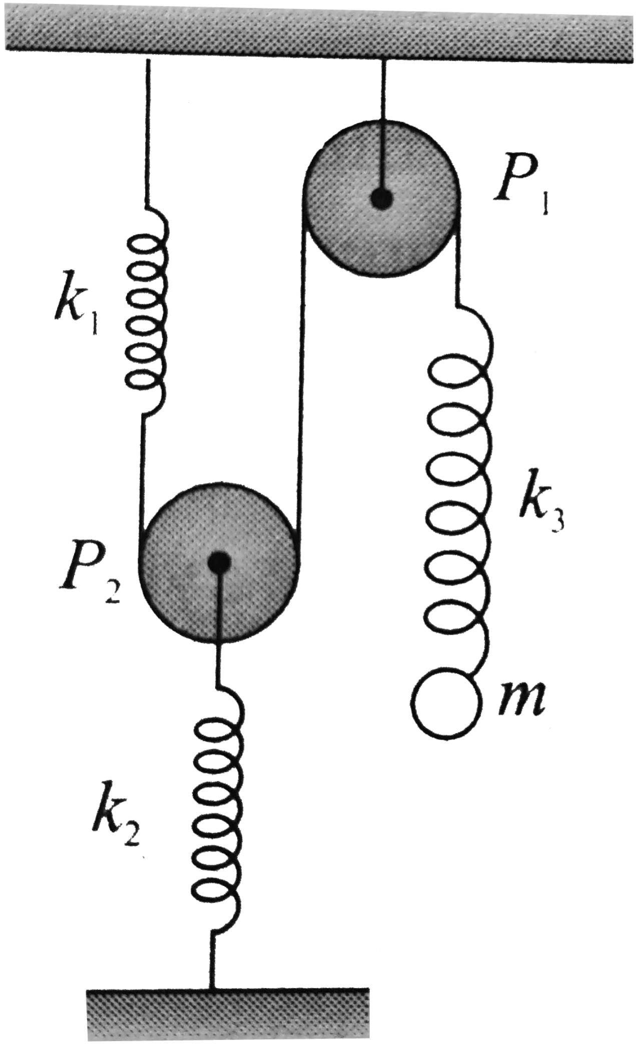
11. A body of mass m hangs from a smooth fixed pulley P_1 by the inextensible string fitted with the springs of stiffness k_1 and k_2 . The string passes over the smooth light pulley P_2 which is connected with another ideal spring of stiffness k_2

. Find the period of oscillation of the body.



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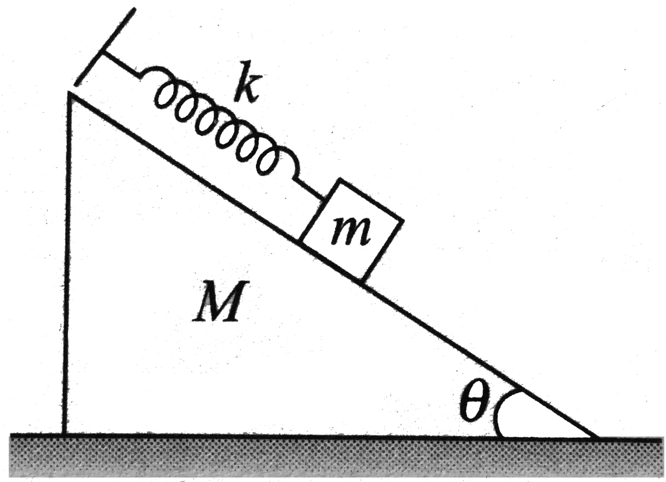
12. A block of mass m connected with a smooth prismatic wedge of mass M is released from rest when the spring is relaxed. Find the angular frequency of oscillation.



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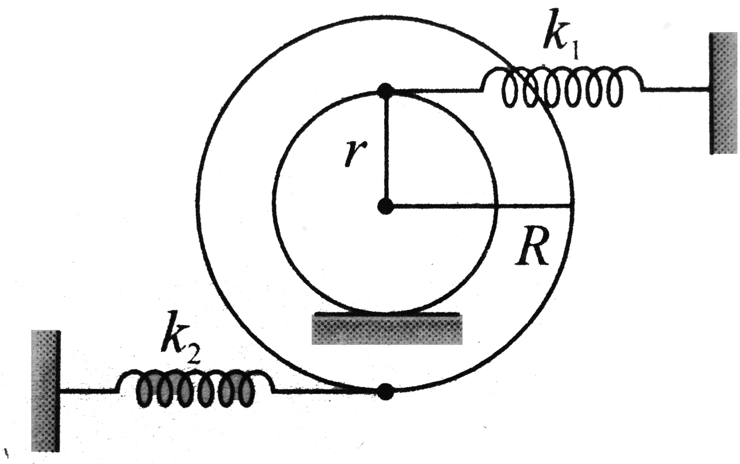
13. A stepped pulley having mass m radius of gyration k is connected with two ideal springs of stiffness k_1 and k_2 as shown in figure. If the pulley shown in the figure rolls without sliding, find the angular frequency of its oscillation.



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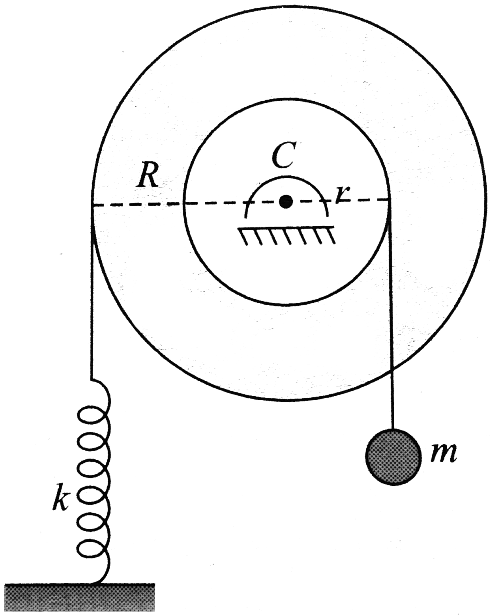
14. A stepped dies of mass M and radius R is pivoted at its center C smoothly. An inextensible string connected with a light spring of stiffness k passes over the pulley. One end of the string is rigidly connected with the ground and the other end is attached to a body of mass m . If the string does not slide on the pulley, find the angularfrequency of oscillation of the syytem



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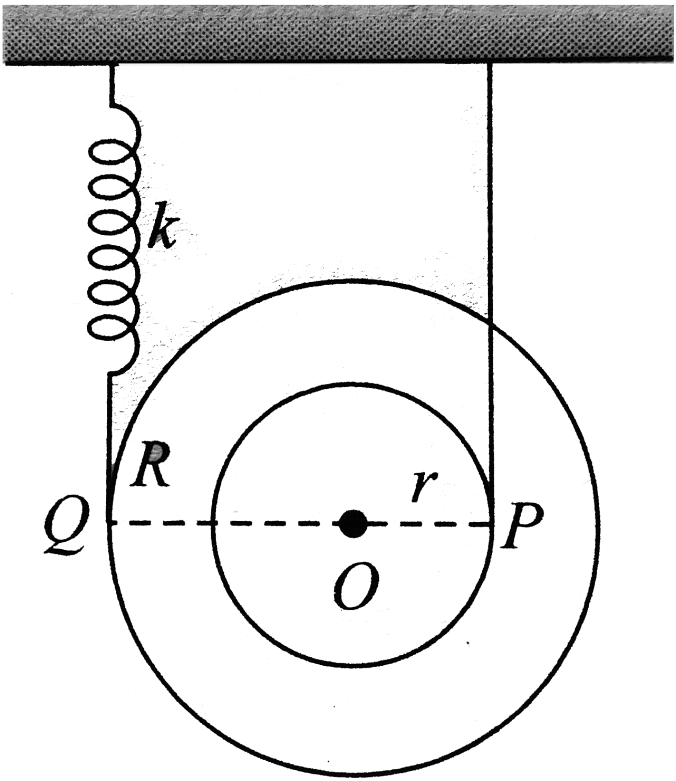
15. A disc of mass m hanged by a string is attached at P and a spring of stiffness k is attached at Q. Find the frequency of small angular oscillation of the disc if the string does not slide over the pulley.

Assume $l_0 = Ml$ of the dise about O.



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16. 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 (ρ) 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 frequency of oscillation of the cylinder is.

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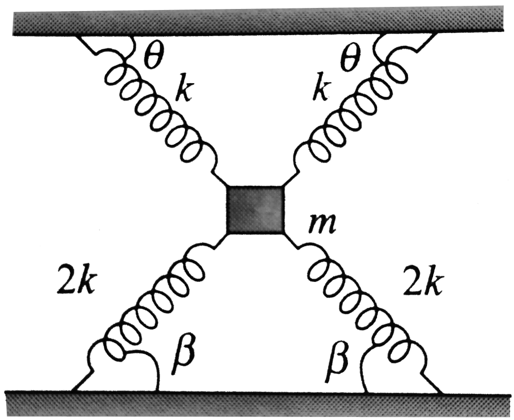
17. Disregarding gravity, find the period of oscillation of the particle connected with four springs as shown in the figure.

$(given : \theta = 45^\circ . \beta = 30^\circ)$



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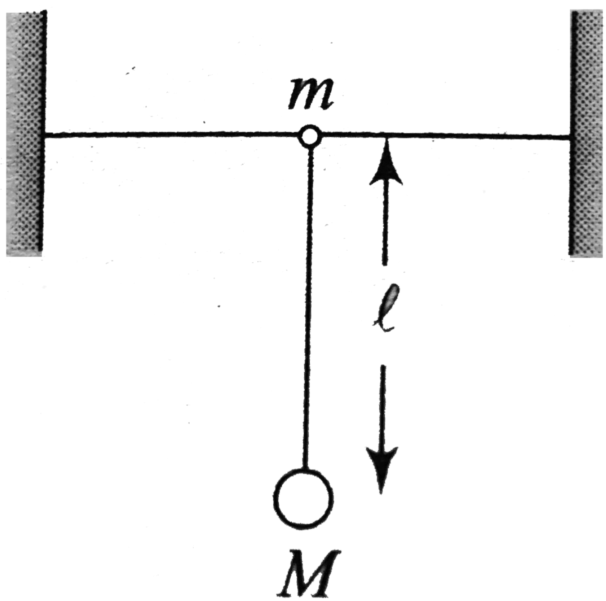
18. A smooth of mass m_1 is lying on a rigid horizontal string A bob of mass m_2 hangs from, the ring by an inextensible light string of length l. Find angular frequency of oscillation of the system.



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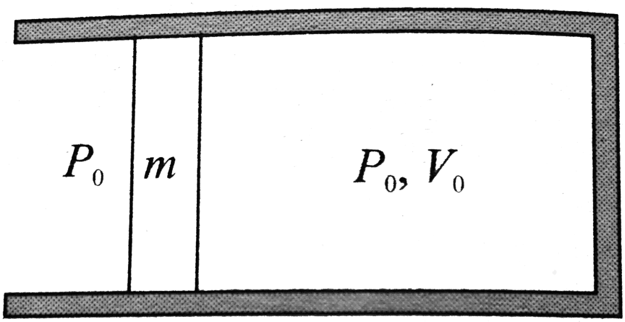
19. A smooth piston of mass m area of cross - section A is in equilibrium in a gas jar when the pressure of the gas is P_0. Find the angular frequency of oscillation of the piston, assuming adiabatic Change of state of the gas.



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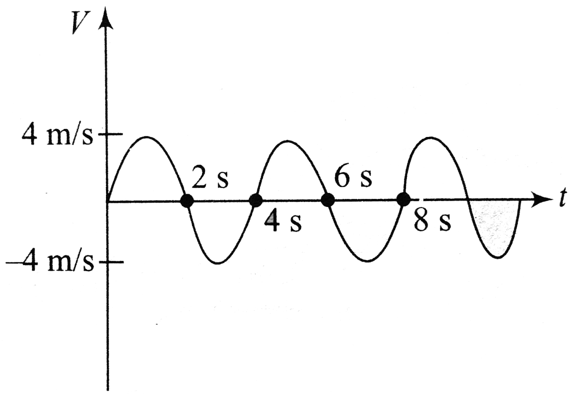
20. If velocity of a partical moving along a straight line changes sinusoidally with time as shown in given graph. Find the average speed over time interval $t = 0$ to $t = 2(2n - 1)$ second, n being any positive interget.



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21. In the figure shown, mass $2m$ connected with a spring of force constant k is at rest and in equilibrium. A partical of mass m is released from height $4.5mg/k$ from $2m$. The partical stick to the block. Neglecting the duration of collision find time from the release of m to the moment when the spring has maximum compression.

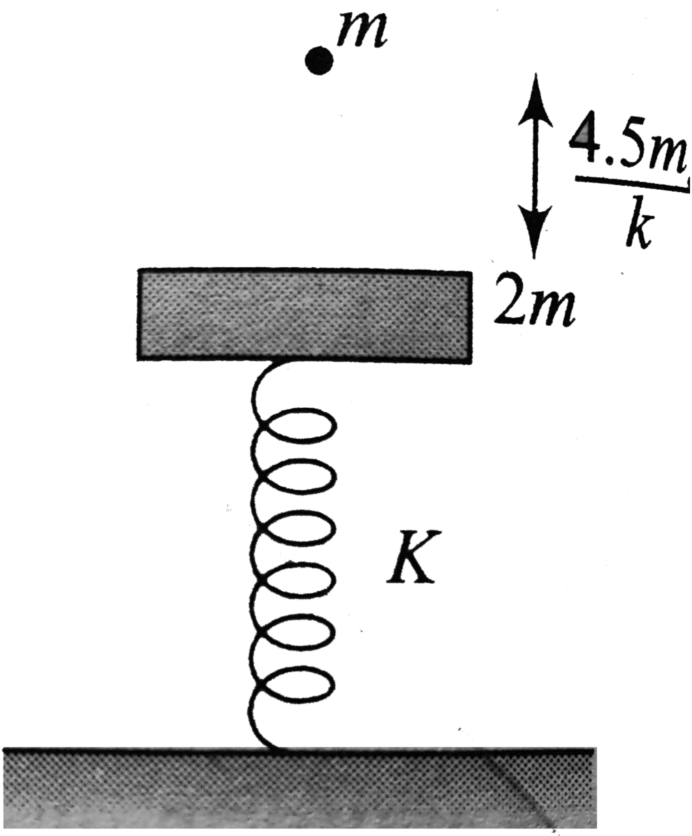

Fig. 4.141

Watch Video Solution

Single Correct

1. While a particle executes linear simple harmonic motion

A. its linear velocity and acceleration pass through their maximum and minimum values once in each oscillation.

B. Its linear velocity and acceleration pass through their maximum and minimum values twice in each oscillation.

C. its linear velocity and acceleration pass through their maximum and minimum values four times in each oscillation.

D. its linear velocity and acceleration always attain their peak values simlataneaously.

Answer: B

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2. While a particle executes simple harmonic motion, the rate of change of acceleration is maximum and minimum respectively at

A. the mean position and extreme positions

B. the extreme positions and mean position

C. the mean position alternatively

D. the extreme positions alternatively.

Answer: A

3. A hollow sphere is filled with water. It is hung by a long thread. As the water flows out of a hole at the bottom, the period of oscillation will

A. go on increasing

B. go on decreasing

C. first increases and then decreases

D. first decreases and then increases

Answer: D

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4. A simple pendulum oscillates slightly above a large horizontal metal plate. The bob is given a charge. The time period

A. has no reffect, whatever be the nature of charge

B. always decreases, whatever be the nature of charge

C. always increases, whatever be the nature of charge

D. a increases or decreases depending upon the nature of charge.

Answer: B

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5. A block is resting on a piston which executes simple harmonic motion in vertical plain with a period of $2.0s$ in vertical plane at an amplitude just sufficient for the block to separate from the piston. The maximum velocity of the piston is

A. $\frac{5}{\pi}\frac{m}{s}$

B. $\frac{10}{\pi}\frac{m}{s}$

C. $\frac{\pi}{2}\frac{m}{s}$

D. $\frac{20}{\pi}\frac{m}{s}$

Answer: B

Watch Video Solution

6. The number of independent constituent simple harmonic motions yielding a resultant displacement equation of the periodic motion as $y = 8\sin^2\left(\frac{t}{2}\right)\sin(10t)$ is

A. 8

B. 6

C. 4

D. 3

Answer: D

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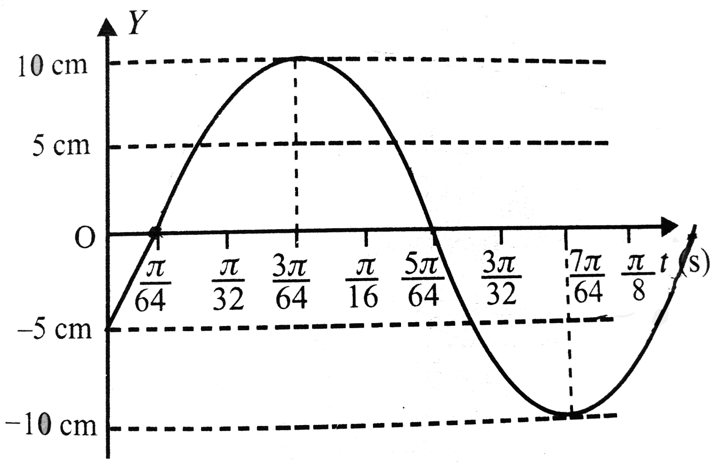
7. 

The diagram below shows a sinusoidal curve. The equation of the curve will be

A. $y = 10\sin\left(16t + \frac{\pi}{4}\right)cm$

B. $y = 10\sin\left(16t + \frac{\pi}{3}\right)cm$

C. $y = 10\sin\left(16t - \frac{\pi}{4}\right)cm$

D. $y = 10\cos\left(16t + \frac{\pi}{4}\right)cm$

Answer: C

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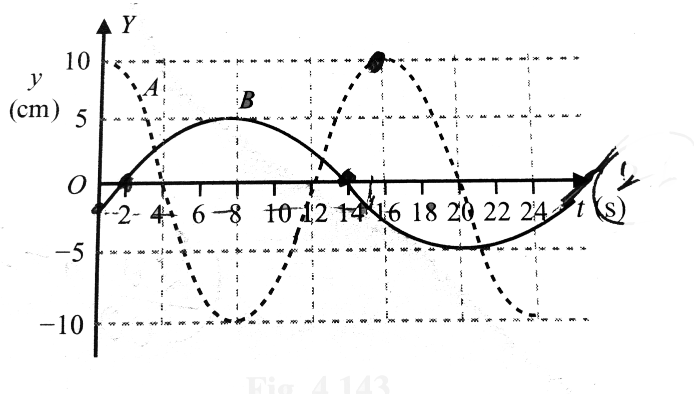
8.



The following figure shows the displacement versus time graph for two particles A and B executing simple harmonic motions. The ratio of their maximum velocities is

A. $3:1$

B. $1:3$

C. $1:9$

D. $9:1$

Answer: A

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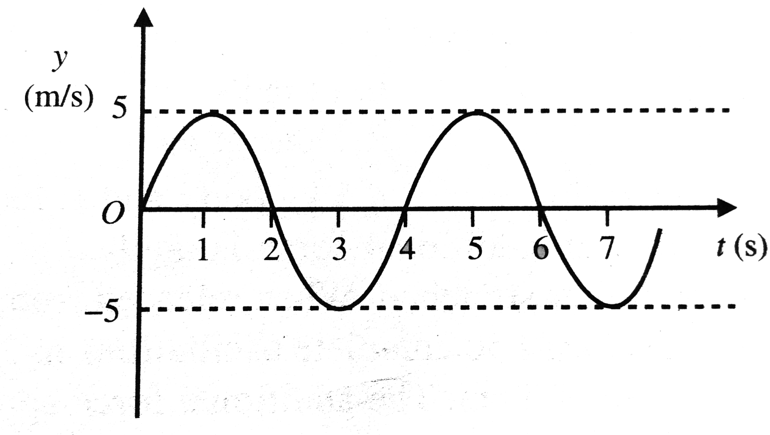
9. 

The variation of velocity of a particle executing SHM with time is shown is fig. The velocity of the particle when a phase change of $\frac{\pi}{6}$ takes place from the instant it is at one of the extreme positions will be

A. $3.53\frac{m}{s}$

B. $2.5\frac{m}{s}$

C. $4.330\frac{m}{s}$

D. none of these

Answer: B

Watch Video Solution

10. In the previous problem, the displacement of the particle from the mean position corresponding to the instant mentioned is

A. $\frac{5}{\pi}m$

B. $\frac{5\sqrt{3}}{\pi}m$

C. $\frac{10\sqrt{3}}{\pi}m$

D. $\frac{5\sqrt{3}}{2\pi}m$

Answer: B

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11. In problem 11446787 the maximum displacement and acceleration of the particle are respectively:

A. $\frac{5\sqrt{3}\pi}{2}\frac{m}{s}$

B. $\frac{5\pi^2}{2}\frac{m}{s^2}$

C. $\frac{5\sqrt{3}\pi}{4}\frac{m}{s^2}$

D. $5\sqrt{3}\frac{m}{s^2}$

Answer: C

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12. In problem 9 the acceleration of the particle is

A. $\frac{10}{\pi}m$ and $5\pi\frac{m}{s^2}$

B. $\frac{5}{\pi}m$ and $\frac{5\pi}{2}\frac{m}{s^2}$

C. $\frac{10}{\pi}m$ and $\frac{5\pi}{2}\frac{m}{s^2}$

D. $\frac{5}{\pi}m$ and $\frac{5\pi}{4}\frac{m}{s^2}$

Answer: C

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13.

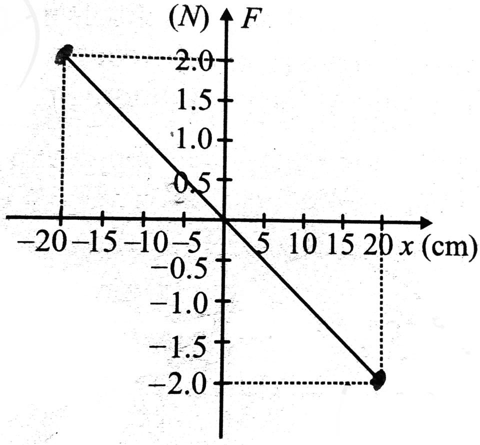

Figure. Shows the variation of force acting on a particle of mass 400 g executing simple harmonic motion. The frequency of oscillation of the particle is

A. $4s^{-1}$

B. $\left(\frac{5}{2\pi}\right)s^{-1}$

C. $\left(\frac{1}{8\pi}\right)s^{-1}$

D. $\left(\frac{1}{2\pi}\right)s^{-1}$

Answer: B

Watch Video Solution

14. A block of mass $1kg$ hangs without vibrating at the end of a spring whose force constant is $200\frac{N}{m}$ and which is attached to the ceiling of an elevator. The elevator is rising with an upward acceleration of $\frac{g}{3}$ when the acceleration suddenly ceases. The angular frequency of the block after the acceleration ceases is

A. $13\frac{rad}{s}$

B. $14\frac{rad}{s}$

C. $15\frac{rad}{s}$

D. none of these

Answer: B

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15. A vertical spring carries a $5kg$ body and is hanging in equilibrium an additional force is applied so that the spring is further stretched. When released from this position. It performs 50 complete oscillation in 25 s, with an amplitude of 5 cm. The additional force applied is

A. 80 N

B. $80\pi^2 N$

C. $4\pi^2 N$

D. $4N$

Answer: C

Watch Video Solution

16. A particle performs SHM in a straight line. In the first second, starting from rest, it travels a distance a and in the next second it travels a distance b in the same side of mean position. The amplitude of the SHM is

A. $\dfrac{2a^2}{3b-a}$

B. $\dfrac{3a^2}{3a-b}$

C. $\dfrac{2a^2}{3a-b}$

D. $\dfrac{3a^2}{3b-a}$

Answer: C

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17. A particle free to move along the (x - axis) hsd potential energy given by $U(x) = k\left[1 - \exp\left(-x^2\right)\right] f$ or $-oo \leq x \leq +oo$, where (k) is a positive constant of appropriate dimensions. Then.

A. for small displacement from $x = 0$, the motion is simple harmonic.

B. if its total mechanical energy is $\frac{k}{2}$, it has its minimum kinetic energy at the origin

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

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

Answer: A

Watch Video Solution

18. Two simple harmonic motion are represented by equations

$y_1 = 4\sin(10t + \phi) \Rightarrow y_2 = 5\cos 10t$

What is the phase difference between their velocities ?

A. ϕ

B. $-\phi$

C. $\left(\phi+\frac{\pi}{2}\right)$

D. $\left(\phi-\frac{\pi}{2}\right)$

Answer: D

Watch Video Solution

19. The matallic bob of a simple pendulum has the relative density ρ. The time period of this pendulum is T it the metallic bob is immersed in water the new time period is given by

A. (a)$2\pi\sqrt{\frac{l}{ng}}$

B. (b)$2\pi\sqrt{\frac{l}{\left(1-\frac{1}{n}\right)g}}$

C. (c)$2\pi\sqrt{\frac{\ln}{g}}$

D. (d)$2\pi\sqrt{\frac{l}{(n-1)g}}$

Answer: B

Watch Video Solution

20. Two particles move parallel to x - axis about the origin with the same amplitude and frequency. At a certain instant they are found at distance $\frac{A}{3}$ from the origin on opposite sides but their velocities are found to be in the same direction. What is the phase difference between the two ?

A. $\cos^{-1}\left(\frac{7}{9}\right)$

B. $\cos^{-1}\left(\frac{5}{9}\right)$

C. $\cos^{-1}\left(\frac{4}{9}\right)$

D. $\cos^{-1}\left(\frac{1}{9}\right)$

Answer: A

Watch Video Solution

21. The potential energy of a particle executing SHM along the x-axis is given by $U = U_0 - U_0 \cos ax$. What is the period of oscillation?

A. $2\pi\sqrt{\frac{ma}{U_0}}$

B. $2\pi\sqrt{\frac{U_0}{ma}}$

C. $\frac{2\pi}{a}\sqrt{\frac{m}{U_0}}$

D. $2\pi\sqrt{\frac{m}{aU_0}}$

Answer: C

Watch Video Solution

22. A particle executing SHM of amplitude a has displace ment $\frac{a}{2}$ at $t = \frac{T}{4}$ and a negative velocity. The epoch of the particle is

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

B. $\frac{2\pi}{3}$

C. π

D. $\frac{5\pi}{3}$

Answer: A

Watch Video Solution

23. A block of mass 4 kg hangs from a spring constant $k = 400\frac{N}{m}$. The block is pulled down through 15 cm below and released. What is its kinetic energy when the block is 10 above the equilibrium position.?

A. $5J$

B. $2.5J$

C. $1J$

D. $1.9J$

Answer: B

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24. A body of mass 100 g attached to a spring executed SHM of period 2 s and amplitude 10 cm. How long a time is required for it to move from a point 5 cm below its equilibrium position to a point 5 cm above it, when it makes simple harmonic vertical oscillation (take $g = 10\frac{m}{s^2}$)?

A. 0.6 s

B. $\frac{1}{3}s$

C. $1.5s$

D. $2.2s$

Answer: B

Watch Video Solution

25. A particle executing SHM has velocities u and v and acceleration a and b in two of its position. Find the distance between these two positions.

A. $\frac{u^2+v^2}{a+b}$

B. $\dfrac{v^2 + u^2}{a - b}$

C. $\dfrac{v^2 + u^2}{a + b}$

D. $\dfrac{v^2 - u^2}{a - b}$

Answer: A

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26. Two particles are executing identical simple harmonic motions described by the equations $x_1 = a\cos\left(\omega t + \frac{\pi}{6}\right)$ and $x_2 = a\cos\left(\omega t + \frac{\pi}{3}\right)$. The minimum interval of time between the particles crossing the respective mean positions is

$$\frac{\pi}{2\omega}$$

A. $\frac{\pi}{2\omega}$

B. $\frac{\pi}{3\omega}$

C. $\frac{\pi}{4\omega}$

D. $\frac{\pi}{6\omega}$

Answer: D

Watch Video Solution

27. The KE and PE , at is a particle executing SHM with amplitude A will be equal when its displacement is

A. $A\sqrt{2}$

B. $\frac{A}{2}$

C. $\frac{A}{\sqrt{2}}$

D. $A\sqrt{\frac{2}{3}}$

Answer: C

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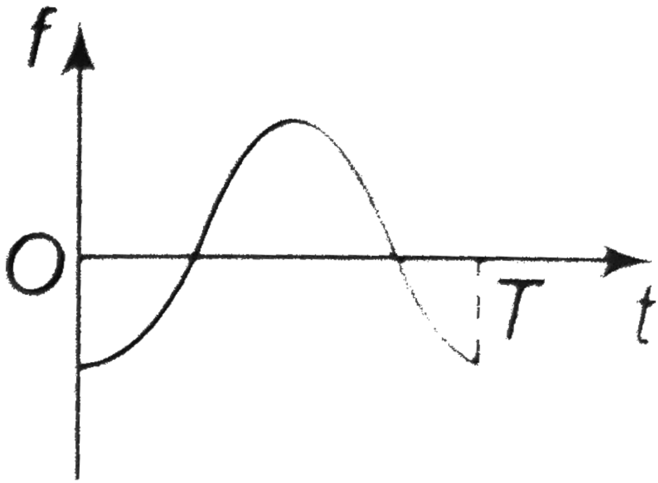
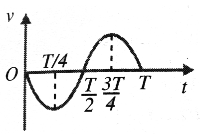
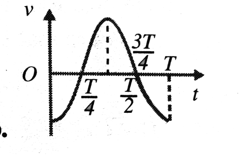
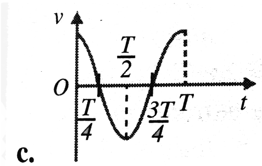
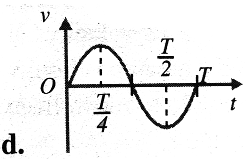
28. A body is performing simple harmonic motion with amplitude a and time period T variation of its acceleration (f) with time(t) is shown in figure If at time t velocity of the body is v which of the following graph is correct?



A. a. 

B. b. 

C. c. 

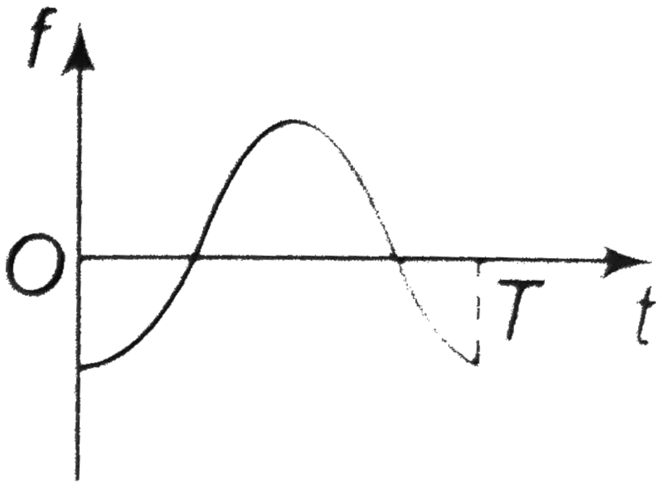
D. d. 

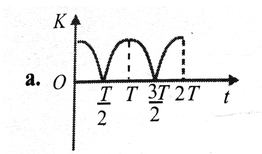
Answer: A

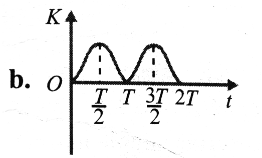
Watch Video Solution

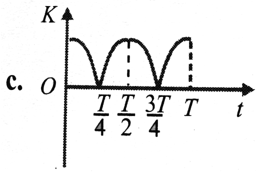
29. A body is performing simple harmonic motion with amplitude a and time period T variation of its acceleration (f) with time(t) is shown in figure

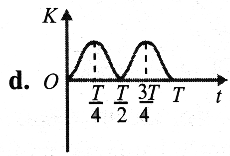
If at time t velocity of the body is v which of the following graph is correct?



A. 

B. 

C. 

D. 

Answer: D

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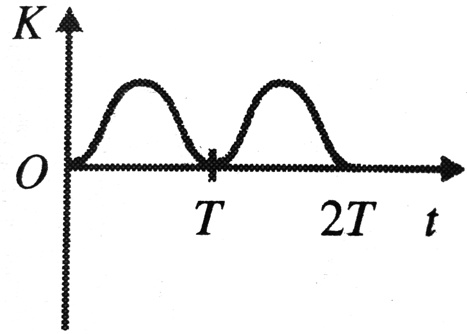
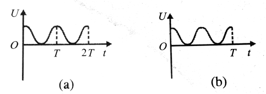


Fig. 4.148

30.

A particle is performing SHM. Its kinetic energy K varies with time t as shown in the figure. Then

A. 

Period of oscillation of the particle is equal to T.

B. excess potential energy U of the particle varies with time t as shown in Fig. a

C. excess potential energy U of the particle varies with time t as shown in fig. b

D. none of these

Answer: B

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31. Two particle P and Q describe $S.H.M.$ of same amplitude a same frequency f along the same straight line .The maximum distance between the two particles is $a\sqrt{2}$ The phase difference between the two particle is

A. zero

B. $\frac{\pi}{2}$

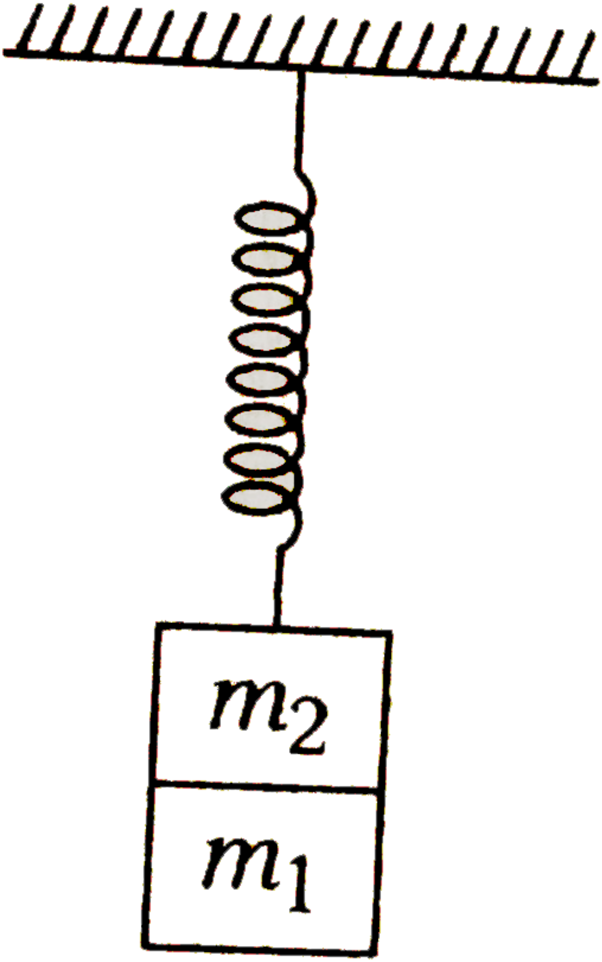
C. $\frac{\pi}{6}$

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

Answer: B

Watch Video Solution

32. Two masses m_1 and m_2 are suspended together by a massless spring of spring constant k as shown in figure. When the masses are in equilibrium , m_1 is removed without the disturbing the system. Calculate the amplitude of oscillation and the angular frequency of m_2.



A. $\frac{m_1 g}{k}$

B. $\frac{m_2 g}{k}$

C. $\dfrac{(m_1 + m_2)g}{k}$

D. $\dfrac{(m_2 - m_1)g}{k}$

Answer: A

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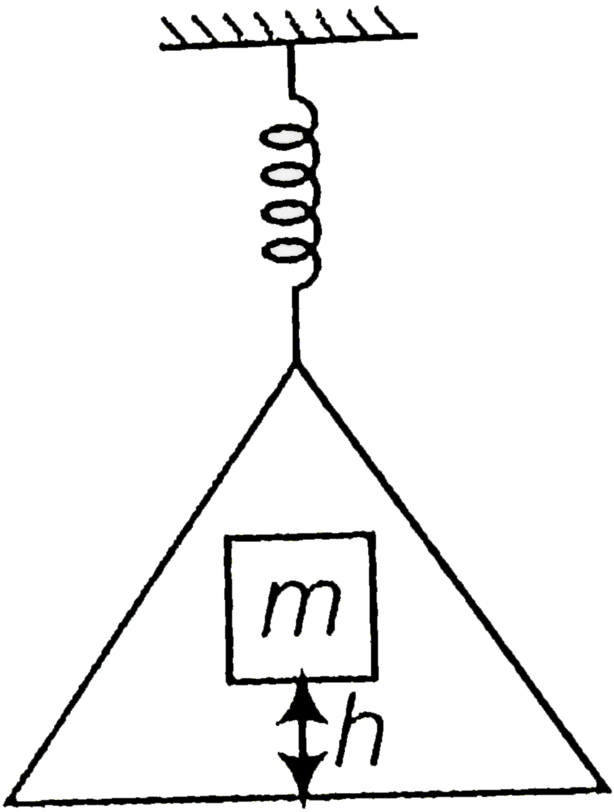
33. A load of mass m falls from a height h on the sclae pan hung from a spring as shown.If the spring constant is k and mass of the scale pan is zero and the mass m does not bounce relative to the pan, then the amplitude of vibration is



A. $\frac{mg}{k}\sqrt{1-\frac{2hk}{mg}}$

B. $\frac{mg}{k}$

C. $\frac{mg}{k}+\frac{mg}{k}\sqrt{1+\frac{2hk}{mg}}$

D. $\frac{mg}{k} - \frac{mg}{k}\sqrt{1 - \frac{2hk}{mg}}$

Answer: C

Watch Video Solution

34. Frequency of a particle executing SHM is 10 Hz. The particle is suspended from a vertical spring. At the highest point of its oscillation the spring is unstretched. Maximum speed of the particle is (g=10m/s^2

A. $2\pi\frac{m}{s}$

B. $\pi \frac{m}{s}$

C. $\frac{1}{\pi} \frac{m}{s}$

D. $\frac{1}{2\pi} / \frac{m}{s}$

Answer: D

Watch Video Solution

35. The potential energy of a particle of mass 1 kg in motin along the x-axis is given by

U = 4(1-cos2x)J

Here, x is in meter. The period of small osciallationis (in second) is

A. 2π

B. π

C. $\frac{\pi}{2}$

D. $\sqrt{2}\pi$

Answer: C

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36. 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).

A. $0.05m$

B. $0.06m$

C. $0.01m$

D. none of these

Answer: B

Watch Video Solution

37. The string of a simple pendulum replaced by a uniform rod of length L and mass M while the bob has a mass m. It is allowed to make small oscillation. Its time period is

A. $2\pi\sqrt{\left(\frac{2M}{3m}\right)\frac{L}{g}}$

B. $2\pi\sqrt{\frac{2(M+3m)L}{3(M+2m)g}}$

C. $2\pi\sqrt{\left(\frac{M+m}{M+3m}\right)\frac{L}{g}}$

D. $2\pi\sqrt{\left(\frac{2m+M}{3(M+2m)}\right)\frac{L}{g}}$

Answer: B

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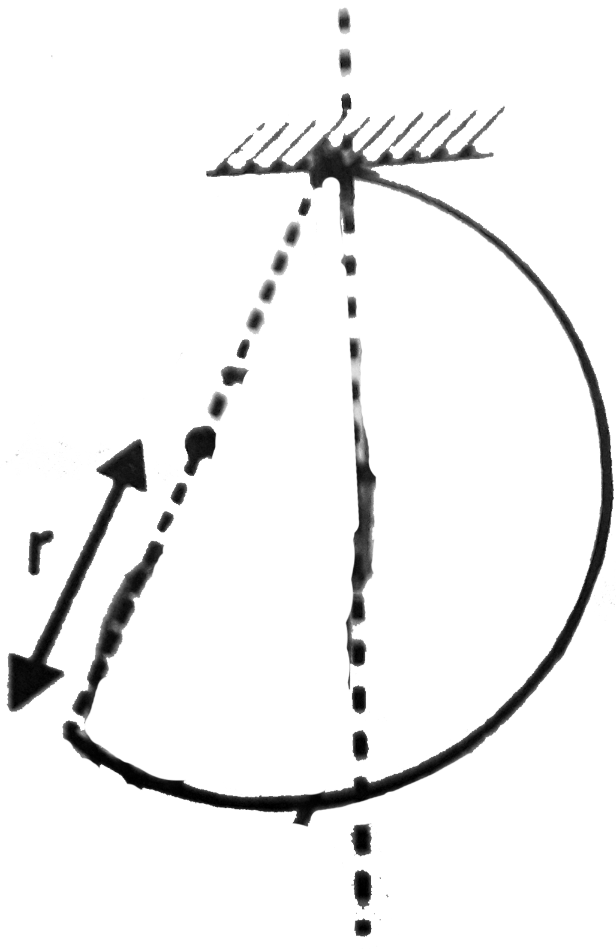


38.

A uniform semicurcular ring having mass m and radius r is hanging at one of its ends freely as shown if Fig. The ring is slightly disturbed so the it oscillates in its own plane. The time period of oscillation of the ring is

A. $2\pi\sqrt{\frac{r}{g\left(1+\frac{1}{\pi^2}\right)}}$

B. $2\pi\sqrt{\frac{r}{g\left(1+\frac{4}{\pi^2}\right)^{\frac{1}{2}}}}$

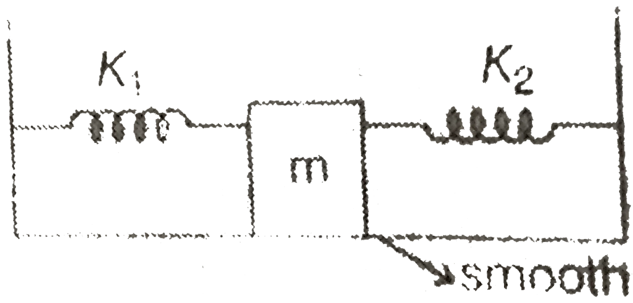
C. $2\pi\sqrt{\frac{r}{g\left(1-\frac{2}{\pi^2}\right)^{\frac{1}{2}}}}$

D. $2\pi\sqrt{\frac{2r}{g\left(1+\frac{4}{\pi}\right)^{\frac{1}{2}}}}$

Answer: D

View Text Solution

39. Two springs with negligible massess and force constant of $k_1 = 200Nm^{-1}$ and $k_2 = 160Nm^{-1}$ are attached to the block of mass m = 10kg as shown in the figure. Initially the block is at rest at the equilibrium position the block is at rest at the equilibrium position nor compressed. At time t=0, sharp impulse of 50 N-s is given to the block.



A. Period of oscillations for the mass m is $\frac{\pi}{6}$s.

B. Maximum velocity of the mass m during its oscillation is $10\frac{m}{s}$

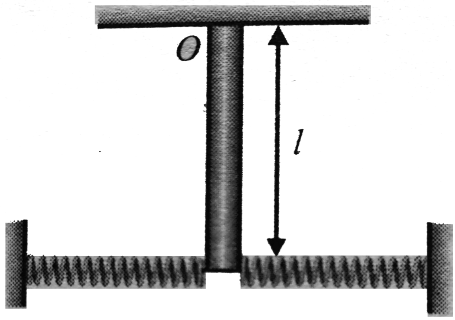
C. Data are insufficient to determine maximum velocity.

D. Amplitude of oscillation is $0.83m$.

Answer: D

Watch Video Solution

The frequency of small os



40.

Fig. 4.153

A thin uniform vertical rod of mass m and length l pivoted at point O is shown is Fig. The combined stiffness of the springs is equal to k. The mass of the spring is negligible. Te frequency of small oscillation is .

A. $\sqrt{\frac{3k}{2m}+\frac{g}{l}}$

B. $\sqrt{\frac{3k}{2m}+\frac{3g}{l}}$

C. $\sqrt{\frac{3k}{m}+\frac{3g}{2l}}$

D. $\sqrt{\frac{3k}{m}+\frac{2g}{3l}}$

Answer: C

Watch Video Solution

41. The period of a particle executing SHM is 8 s . At t=0 it is at the mean position . The ratio of the distances covered by the particle in the 1st second to the 2nd second is

A. $\sqrt{2}:1$

B. $1 : (\sqrt{2} - 1)$

C. $(\sqrt{2} + 1) : \sqrt{2}$

D. $(\sqrt{2} - 1) : 1$

Answer: B

Watch Video Solution

42. A particle executed S.H.M. starting from its mean position at $t = 0$, If its velocity is $\sqrt{3}b\omega$, when it is at a distance b from the mean positoin, when $\omega = \frac{2\pi}{T}$, the time taken by the particle to move from b to the extreme position on the same side is

A. $\frac{5\pi}{6\omega}$

B. $\frac{\pi}{3\omega}$

C. $\frac{\pi}{2\omega}$

D. $\frac{\pi}{4\omega}$

Answer: B

Watch Video Solution

43. In a certain oscillatory system (particle is performing SHM), the amplitude of motion is 5 m and the time period is 4 s. the minimum time taken by the particle for passing betweens points, which are at distances of 4 m and 3 m from the centre and on the same side of it will approximately be

A. $\frac{16}{45} s$

B. $\frac{7}{45} s$

C. $\frac{8}{45} s$

D. $\frac{13}{45} s$

Answer: C

Watch Video Solution

44. A particle of mass m moving along x-axis has a potential energy $U(x) = a + bx^2$ where a and b are positive constant. It will execute simple harmonic motion with a frequency determined by the value of

A. b alone

B. b and a alone

C. b and m alone

D. b,a and m alone

Answer: C

Watch Video Solution

45. The instantaneous displacement x of a particle executing simple harmonic motion is given by $x = a_1 \sin \omega t + a_2 \cos\left(\omega t + \frac{\pi}{6}\right)$. The amplitude A of oscillation is given by

A. $\sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos\left(\frac{\pi}{6}\right)}$

B. $\sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos\left(\frac{\pi}{3}\right)}$

C. $\sqrt{a_1^2 + a_2^2 - 2a_1a_2\cos\left(\frac{\pi}{6}\right)}$

D. $\sqrt{a_1^2 + a_2^2 - 2a_1a_2\cos\left(\frac{\pi}{3}\right)}$

Answer: D

Watch Video Solution

46. A simple harmonic motion along the x-axis has the following properties: amplitude $= 0.5m$ the time to go from one extreme position to other is $2s$ and $x = 0.3m$ at $t = 0.5$. the general equation of the simple harmonic motion is

A. $x=(0.5m)\sin\left[\frac{\pi t}{2}+8^{\circ}\right]$

B. $x=(0.5m)\sin\left[\frac{\pi t}{2}-8^{\circ}\right]$

C. $x=(0.5m)\cos\left[\frac{\pi t}{2}+8^{\circ}\right]$

D. $x=(0.5m)\cos\left[\frac{\pi t}{2}-8^{\circ}\right]$

Answer: B

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47. A spring balance has a scale that reads from 0 to 50 kg. The length of the scale is 20cm. A body suspended from this balance, when displaced and released, oscillates with a period of 0.6 s. What is the weight of the body ?

A. 10 kg

B. 25 kg

C. 18 kg

D. 22.8 kg

Answer: D

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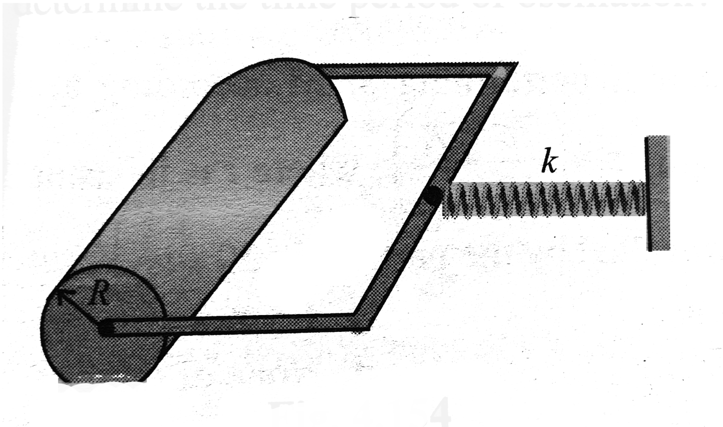

48.

A soil cylinder of mass M and radius R is connected to a spring as shown in fig. The cylinder is placed on a rough horizontal surface. All the parts except the cylinder shown in the figure are light. If the cylinder is displaced slightly from its mean position and released, so that it performs pure rolling back and forth about its equilibrium position, determine the time period of oscillation?

A. (a)$2\pi\sqrt{\frac{M}{k}}$

B. (b)$2\pi\sqrt{\frac{3M}{2k}}$

C. (c)$2\pi\sqrt{\frac{3M}{k}}$

D. (d)none of these

Answer: B

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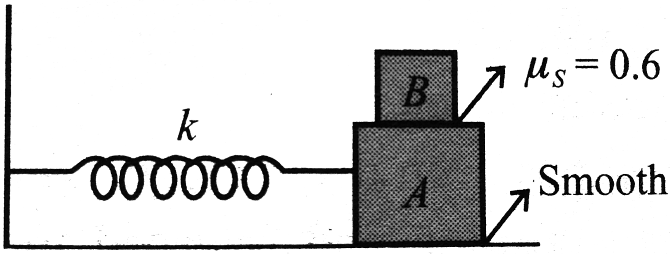

49.

A block A is connected to spring and performs simple harmonic motion with a time period of 2 s. Another block B restes on a. The coefficient of static friction between A and B is $\mu_S = 0.6$. The maximum amplitude of oscillation which the system can have so that there is no relative motion between A and B is (take $\pi^2 = g = 10$)

A. (a)0.3 m

B. (b)0.6 m

C. (c)0.4 m

D. (d)0.52 m

Answer: B

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50. A block of mass m is suspended from the ceiling of a stationary standig elevator through a spring of spring constant k. Suddenly, the cable breaks and the elevator starts falling freely. Show that the bklock now executes a simple harmonic motion of amplitude $m\frac{g}{k}$ in the elevator

A. the block executes simple harmonic motion with time period $2\pi\sqrt{\frac{m}{k}}$

B. the block excutes simple harmonic motion with amplitude $\frac{mg}{k}$

C. the block executes simple harmonic motion about its mean position and the mean position is the position When the spring acquires its natural length.

D. all of the above.

Answer: D

Watch Video Solution

51. A mass m attached to a spring of spring constant k is stretched a distance x_0 from its equilibrium position and released with no initial velocity. The maximum speed attained by mass in its subsequent motion and the time at which this speed would be attained are, respectively.

A. $\sqrt{(k)(m)}x_0, \pi\sqrt{\frac{m}{k}}$

B. $\sqrt{\frac{k}{m}}\frac{x_0}{2}, \frac{\pi}{2}\sqrt{\frac{m}{k}}$

C. $\sqrt{\frac{k}{m}}x_0, \frac{\pi}{2}\sqrt{\frac{m}{k}}$

D. $\sqrt{\frac{k}{m}}\frac{x_0}{2}, \pi\sqrt{\frac{m}{k}}$

Answer: C

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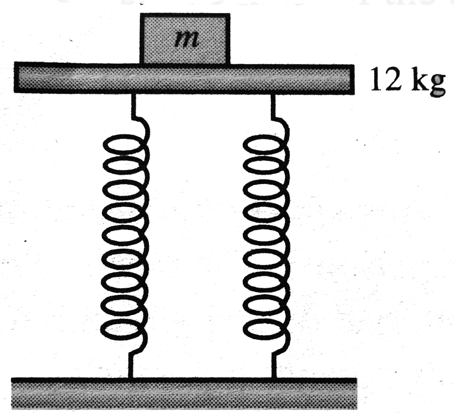

52.

A plank of mass 12 kg is supported by two identical springs as shown is Fig. The plank always remains horizontal. When the plank is pressed down and released it performs simple harmonic motion with time period 3 s. When a block of m is attached to the plank the time priod changes to 6 s. The mass of the block is

A. 48 kg

B. 36 kg

C. 24 kg

D. 12 kg

Answer: B

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53. The time taken by a particle performing SHM to pass from point A and B where it is velocities are same is 2s. After another 2 s it returns to B. The time period oscillation is (in seconds)

A. 2 s

B. 4 s

C. 6 s

D. 8 s

Answer: D

Watch Video Solution

54. Two springs are made to oscillate simple harmonically due to the same mass individually. The time periods obtained are T_1 and T_2. If both the springs are connected in series and then made to oscillate by the same mass, the resulting time period will be

A. $T_1 + T_2$

B. $\frac{T_1 T_2}{T_1 + T_2}$

C. $\sqrt{T_1^2 + T_2^2}$

D. $\frac{T_1 + T_2}{2}$

Answer: C

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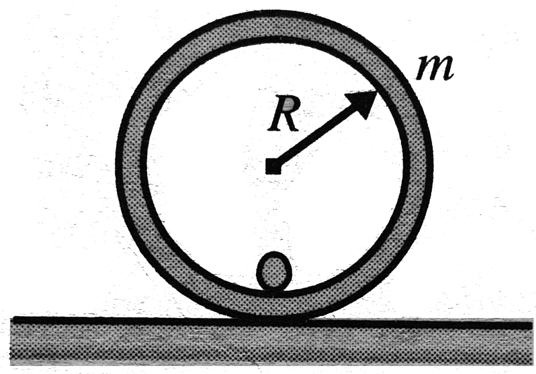
55. 

A thin-walled tube of mass m and radius R has a rod of mass m and vry small cross section soldered on its inner surface. The side-view of the arrangement is as shown in the following figure.

The entire arrangement is placed on a rough horizontal surface. The system is given a small angular displacement from its equilibrium position, as a result, the system performs oscillations. The time period of resulting oscillations if the tube rolls without slipping is

A. (a)$2\pi\sqrt{\frac{4R}{g}}$

B. (b)$2\pi\sqrt{\frac{2R}{g}}$

C. (c)$2\pi\sqrt{\frac{R}{g}}$

D. (d)none of these

Answer: B

Watch Video Solution

56. A thin uniform rod of mass 1 kg and length 12 cm is suspended by a wire that passes through its centre and is perpendicular to its length.The wire is twisted and the rod is set oscillating. Time period of oscillation is found to be 3 s. When a flat triangular plate is suspended in same way through its centre of mass, the time period is found to be 6 s. The moment of inertia of the tringular plate about this axis is

A. (a)$0.12kg - m^2$

B. (b)$0.24kg - m^2$

C. (c)$0.48kg - m^2$

D. (d)information insufficient

Answer: C

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57. A particle performs SHM about $x = 0$ such that at $t = 0$ it is at $x = 0$ and moving towards positive extreme. The time taken by it to go from $x = 0$ to $x = \frac{A}{2}$ is____ time the time taken to go from $x = \frac{A}{2}$ to A. The most suitable option for the blank space is

A. 2

B. $\frac{1}{2}$

C. $\frac{3A}{T}$

D. $\frac{A}{2T}$

Answer: B

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58. A particle performs SHM with a period T and amplitude a. The mean velocity of particle over the time interval during which it travels $a/2$ from the extreme position is

A. $\frac{A}{T}$

B. $\frac{2A}{T}$

C. $\frac{3A}{T}$

D. $\frac{A}{2T}$

Answer: C

Watch Video Solution

59. A particle performs simple harmonic motion about O with amolitude A and time period T. The magnitude of its acceleration at $t=\frac{T}{8}$s after the particle reaches the extreme position would be

A. $\frac{4\pi^2 A}{\sqrt{2}T^2}$

B. $\frac{4\pi^2 A}{T^2}$

C. $\frac{2\pi^2 A}{\sqrt{2T^2}}$

D. none of these

Answer: A

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60. In the previous question, the magnitude of velocity of particle at the mentioned instant is

A. $\frac{\pi A}{T}$

B. $\frac{\sqrt{2}\pi A}{T}$

C. zero

D. $\sqrt{\frac{7}{8}} \times \frac{2\pi A}{T}$

Answer: B

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61. An object of mass 4 kg is attached to a spring having spring constant $100\frac{N}{m}$. It performs simple harmonic motion on a smooth horizontal surface with an amplitude of 2 m. A 6 kg object is dropped vertically onto the 4 kg object when it crosses the mean position, and sticks to it. the change in amplitude of oscillation due to collision is

A. $1m$

B. $zero$

C. $2\left[1-\sqrt{\frac{2}{5}}\right]$

D. $2\left[1-\frac{1}{\sqrt{5}}\right]$

Answer: C

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62. A cork floating on the pond water executes a simple harmonic motion, moving up and down over a range of 4 cm. The time period of the motion is 1 s. at $t = 0$, the cork is at its lowest position of oscillation, the position and velocity of the cork at $t = 10.5s$, would be

A. 2 cm above the mean position, $0\frac{m}{s}$

B. 2 cm below the mean position $0\frac{m}{s}$

C. 1 cm above the mean position $2\sqrt{3}\pi\frac{m}{s}$ up

D. 1 cm below the mean position, $2\sqrt{3}\pi\frac{m}{s}$ up

Answer: A

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63. A spring is placed in vertical position by suspending it from a hook at its top. A similar hook on the bottom of the spring is at 11 cm above a table top. A mass of 75 g and of negligible size is then suspended from the bottom hook, which is measured to be 4.5 cm above the table top. The mass is then pulled down a distance of 4 cm and released. Find the approximate. Position of the bottom hook after 5 s? Take $g = 10\frac{m}{s^2}$ and hook's mass to be negligible.

A. 5 cm above the table top

B. 4.5 cm above the table top

C. 9 cm above the table top

D. 0.5 cm above the table top

Answer: D

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64. A particle is performing SHM according to the equation $x = (3cm)\sin\left(\frac{2\pi t}{18} + \frac{\pi}{6}\right)$, where t is in seconds. The distance travelled by the particle in 39 s is

A. $24cm$

B. $1.5cm$

C. $25.5cm$

D. none of these

Answer: C

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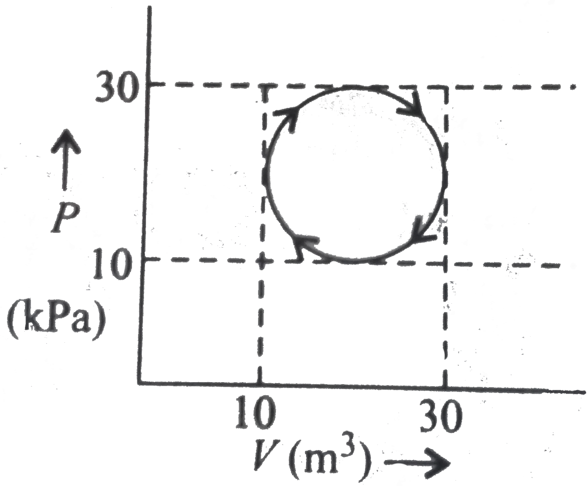
65. Which one is not correct for a cyclic process as shown in the figure ?



A. new equilibrium position is at 35 cm from P_1 and time period of simple harmonic motion is $\frac{\pi}{100}$ s.

B. New equilibrium position is at 20 cm from P_1 and time period of simple harmonic motion is $\frac{\pi}{100}s$

C. new equilibrium position is at 35 cm from P_1 and time period of simple harmonic motion is $\frac{\pi}{25}s$

D. new equilibrium position is at 30 cm from P_1 and time period of simple harmonic motion is $\frac{\pi}{26}$ s

Answer: A

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66. A particle of mass m is present in a region where the potential energy of the particle depends on the x-coordinate according to the expression $U = \frac{a}{x^2} - \frac{b}{x}$, where a and b are positive constant. The particle will perform.

A. oscillatory motion but not simple harmonic motion about its mean position for small displacements

B. simple harmonic motion with time period $2\pi\sqrt{\frac{8a^2m}{b^4}}$ about its mean position for small displacements

C. neither simple harmonic motion nor oscillatory about its mean position for small displacements

D. none of the above

Answer: D

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67. A particle performing simple harmonic motion having time period 3 s is in phase with another particle which also undergoes simple harmonic motion at $t = 0$. The time period of second particle is T (less that 3s). If they are again in the same phase for the third time after 45 s, then the value of T will be

A. 2.8 s

B. 2.7 s

C. 2.5 s

D. none of these

Answer: C

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68. A particle performs SHM on x- axis with amplitude A and time period period T .The time taken by the particle to travel a distance $A/5$ starting from rest is

A. $\frac{T}{20}$

B. $\frac{T}{2\pi}\cos^{-1}\left(\frac{4}{5}\right)$

C. $\frac{T}{2\pi}\cos^{-1}\left(\frac{1}{5}\right)$

D. $\frac{T}{2\pi}\sin^{-1}\left(\frac{1}{5}\right)$

Answer: B

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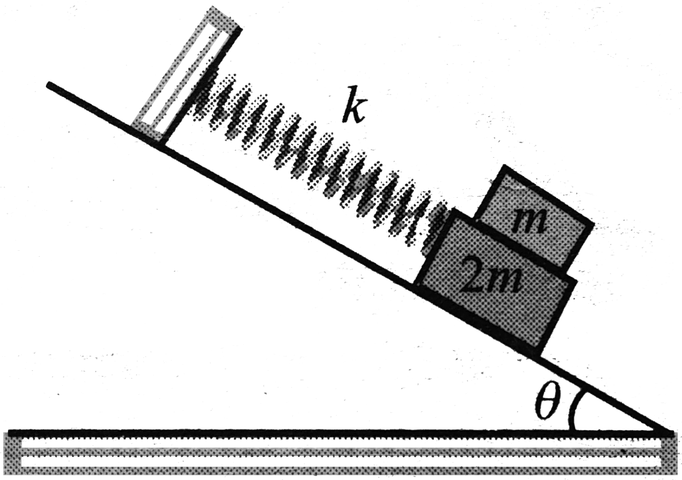
69.



The coefficient of friction between block of mass m and $2m$ is $\mu = 2\tan\theta$. There is no friction between block of mass 2 m and inclined plane. The maximum amplitude of the two block system for which there is no relative motion between both the blocks is

A. $g\sin\theta\sqrt{\frac{k}{m}}$

B. $\frac{mg\sin\theta}{k}$

C. $\frac{3mg\sin\theta}{k}$

D. none of these

Answer: C

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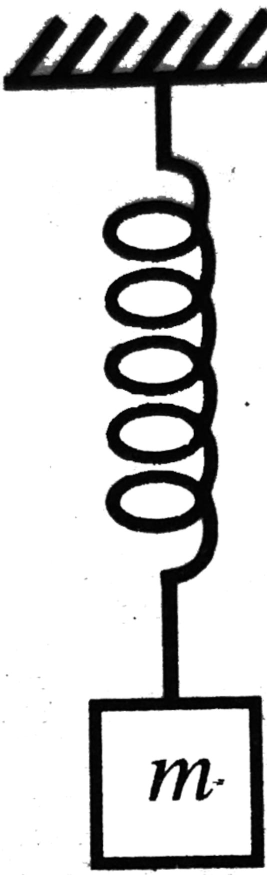
70. 

A block of mass m is suspended from a spring and executes vertical SHM of time period T as shown in Fig. The amplitude of the SHM is A and spring is never in compressed state during the oscillation.

The magnitude of minimum force exerted by spring on the block is

A. $mg - \frac{4\pi^2}{T^2}mA$

B. $mg + \frac{4\pi^2}{T^2}mA$

C. $mg - \frac{\pi^2}{T^2}mA$

D. $mg + \frac{\pi^2}{T^2}mA$

Answer: A

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71. A particle performs SHM of amplitude A along a straight line. When it is at distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount $\frac{1}{2}m\omega^2A^2$ due to an impulsive force. Then its new amplitude becomes.

A. $\frac{\sqrt{5}}{2}A$

B. $\frac{\sqrt{3}}{2}A$

C. $\sqrt{2}A$

D. $\sqrt{5}A$

Answer: C

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72. A horizontal spring -block system of mass $2kg$ executes $S.H.M$ when the block is passing through its equilibrium position an object of mass $1kg$ is put on it the two move together The new amplitude of vibration is $(A$ being its initial amplitude)

A. $\sqrt{\frac{2}{3}}$A

B. $\sqrt{\frac{3}{2}}A$

C. $\sqrt{2}A$

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

Answer: A

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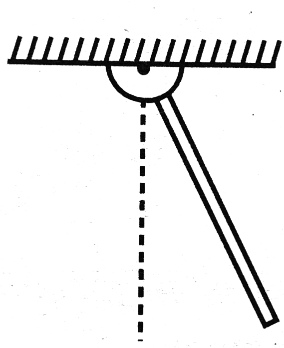

73.

A metre stick swinging in vertical plane about a fixed horizontal axis passing through its one end undergoes small oscillation of frequency f_0. If the bottom half of the stick were but off, then its new frequency of small oscillation woul become.

A. f_0

B. $\sqrt{2}f_0$

C. $2f_0$

D. $2\sqrt{2}f_0$

Answer: B

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74. A physical pendulum is positioned so that its centre of gravity is above the suspension point. When the pendulum is realsed it passes the point of stable equilibrium with an angular velocity ω. The period of small oscollations of the pendulum is

A. $\frac{4\pi}{\omega}$

B. $\frac{2\pi}{\omega}$

C. $\frac{\pi}{\omega}$

D. $\frac{\pi}{2\omega}$

Answer: A

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75. A particle executing harmonic motion is having velocities v_1 and v_2 at distances is x_1 and x_2 from the equilibrium position. The amplitude of the motion is

A. $\sqrt{\dfrac{v_1^2 + x_2 - v_2^2 x_1}{v_1^2 - v_2^2}}$

B. $\sqrt{\dfrac{v_1^2 x_1^2 - v_2^2 x_2^2}{v_1^2 + v_2^2}}$

C. $\sqrt{\dfrac{v_1^2 x_2^2 - v_2^2 x_1^2}{v_1^2 - v_2^2}}$

D. $\sqrt{\dfrac{v_1^2 x_2^2 + v_2^2 x_1^2}{v_1^2 + v_2^2}}$

Answer: C

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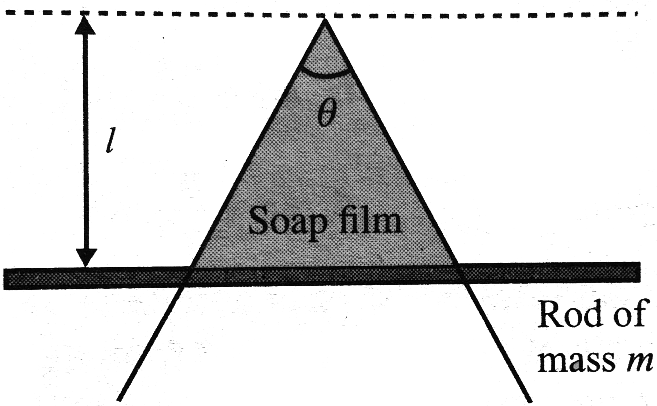
76.



A wire is bent an an angle θ. A rod of mass m can slide along the bended wire without friction as shown in Fig. A soap film is maintained in the frame kept in a vertical position and the rod is in equilibrium as shown in the figure. If rod is displaced slightly in vertical direction, then the time period of small oscillation of the rod is

A. $2\pi\sqrt{\frac{l}{g}}$

B. $2\pi\sqrt{\frac{l\cos\theta}{g}}$

C. $2\pi\sqrt{\frac{l}{g\cos\theta}}$

D. $2\pi\sqrt{\frac{l}{\mathrm{g}\tan\theta}}$

Answer: A

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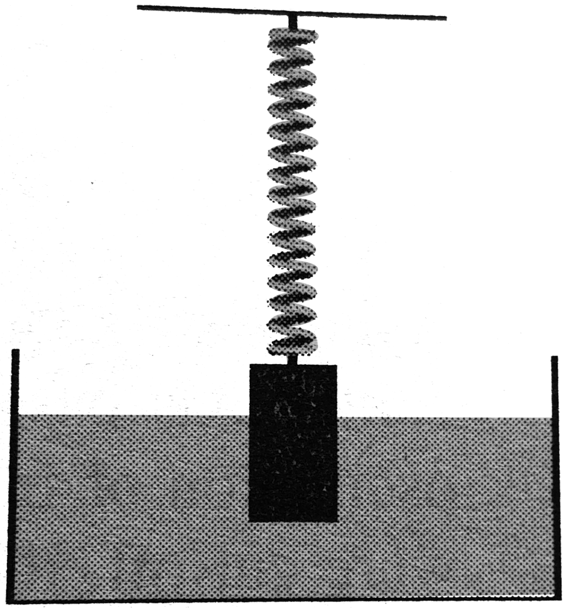

77.

A solid right circular cylinder of weight 10 kg and cross sectional area $100cm^2$ is suspended by a spring, where $k = 1\frac{kg}{cm}$, and hangs partially submerged in water of density $1000\frac{kg}{m^3}$ as shown in Fig. What is its perod when it makes simple harmonic vertical oscillations? (Take $g = 10\frac{m}{s^2}$)

A. 0.6 s

B. 1 s

C. 1.5 s

D. 2.2 s

Answer: A

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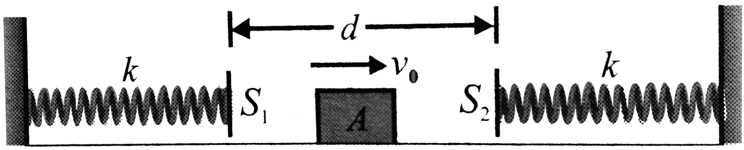

Fig. 4.164

78.

A block A of mass m is placed on a smooth horizontal platform P and between two elastic massless springs S_1 and S_2 fixed horizontally to two fixed vertical walls. The elastic constants of the two springs are equal to k and the equilibrium distance between the two springs both in relaxed states is d. The block is given a velocity v_0 initially towards one of the springs and it then oscillated between the springs. The time period T of oscillations and the minimum separation d_m of the spring will be

A. $T = 2\left(\frac{d}{v} + \pi\sqrt{\frac{m}{k}}\right), d_m = d$

B. $T = 2\left(\frac{d}{v} + 2\pi\sqrt{\frac{m}{k}}\right), d_m = d - v\sqrt{\frac{m}{k}}$

C. $T = 2\left(\frac{d}{v} + 2\pi\sqrt{\frac{m}{k}}\right), d_m = d - 2v\sqrt{\frac{m}{k}}$

D. $T = 2\pi\sqrt{\frac{m}{k}}, d_m = d$

Answer: A

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79. A certain simple harmonic vibrator of mass 0.1 kg has a total energy of 10 J. Its displacement from the mean position is 1 cm when it has equal kinetic and potential energies. The amplitude A and frequency n of vibration of the vibrator are

A. $A=\sqrt{2}cm, n=\frac{500}{\pi}Hz$

B. $A=\sqrt{2}cm, n=\frac{1000}{\pi}Hz$

C. $A=\frac{1}{\sqrt{2}}cm, n=\frac{500}{\pi}Hz$

D. $A=\frac{1}{\sqrt{2}}cm, n=\frac{1000}{\pi}$Hz

Answer: A

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80. A simple pendulum of length l and mass m is suspended in a car that is moving with constant speed v around a circle of radius r. Find the period of oscillation and equilibrium position of the pendulum.

A. $\frac{1}{2\pi}\sqrt{\frac{g}{l}}$

B. $\frac{1}{2\pi}\sqrt{\frac{g}{R}}$

C. $\frac{1}{2\pi}\sqrt{\frac{\left(g^2+\frac{v^4}{R^2}\right)}{l}}$

D. $\frac{1}{2\pi}\sqrt{\frac{v^2}{Rl}}$

Answer: C

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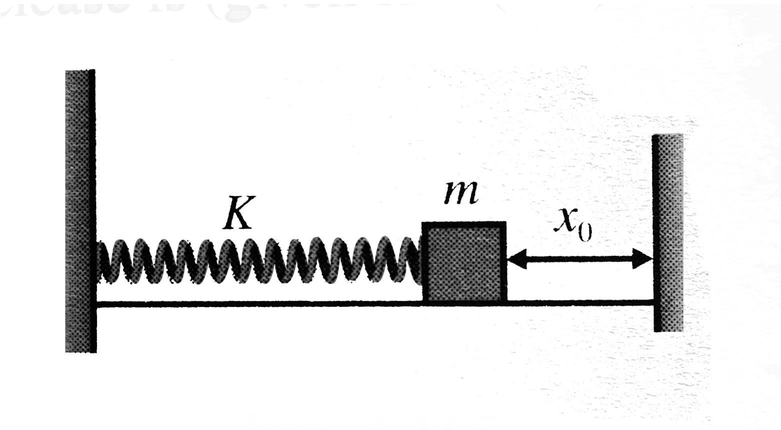

81.

One end of a spring of force constant K is fixed to a vertical wall and the other to a body of mass m resting on a smooth horizontal surface. There is another wall at a distance x_0 from the body. The spring is then compressed by $3x_0$ and released.

The time taken to strike the wall from the instant of release is (given $\sin^{-1}\left(\frac{1}{3}\right) = \left(\frac{\pi}{9}\right)$)

A. $\frac{\pi}{6}\sqrt{\frac{m}{K}}$

B. $\frac{2\pi}{3}\sqrt{\frac{m}{K}}$

C. $\frac{\pi}{4}\sqrt{\frac{m}{K}}$

D. $\frac{11\pi}{18}\sqrt{\frac{m}{K}}$

Answer: D

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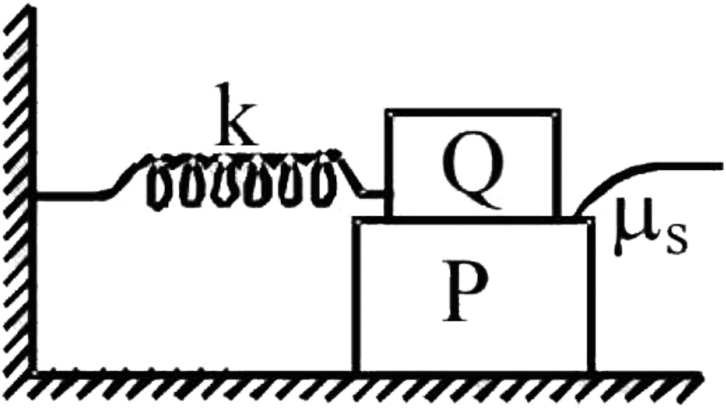
82. A block P of mass m is placed on horizontal frictionless plane. A second block of same mass m is placed on it and is connected to a spring of spring constant k, the two blocks are pulled by distance A. Block Q oscillates without slipping. What is the maximum value of frictional force between the two blocks.



A. zero

B. K

C. $\frac{KA}{2}$

D. μg

Answer: C

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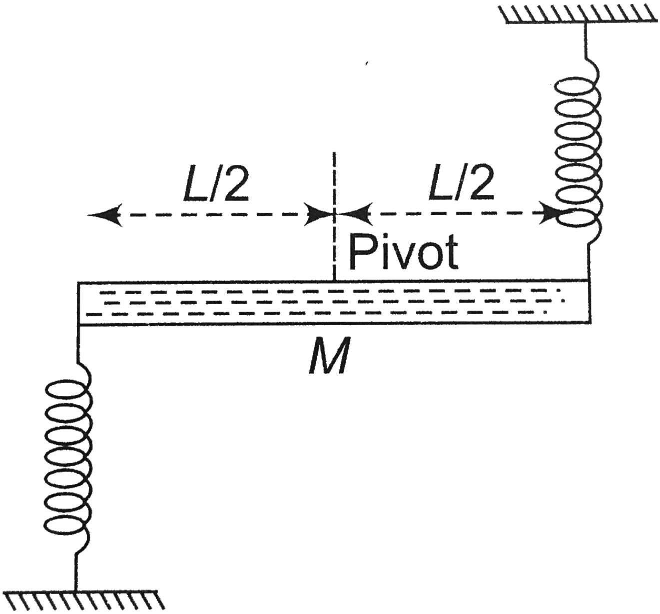
83. A uniform stick of mass M and length L is pivoted its come its ends are attached to two spring each of the constant K. In the position shown in figure the same through a small length when spring is display through a small angle of and released. The stick :



A. executes non periodec motion

B. executes periodic motion which is not simple

harmonic .

C. executes SHM of frequency $\frac{1}{2\pi}\sqrt{\frac{6K}{M}}$.

D. ececutes SHM of frequency $\frac{1}{2\pi}\sqrt{\frac{K}{2M}}$.

Answer: C

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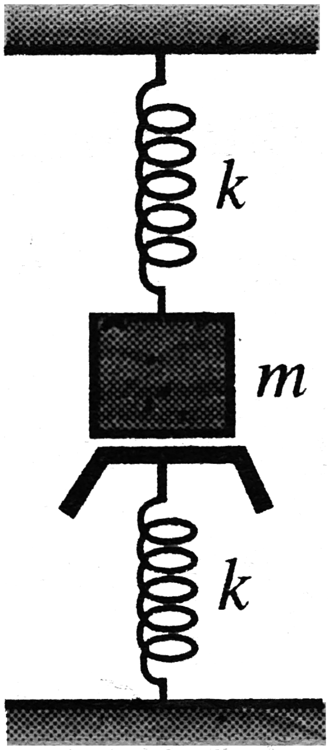

84.

A mass m is suspended from a spring of force constant k and just touches another identical spring fixed to the floor as shown in the fig. The time period of small oscillations is

A. $2\pi\sqrt{\frac{m}{k}}$

B. $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{\frac{k}{2}}}$

C. $\pi\sqrt{\frac{m}{\frac{3k}{2}}}$

D. $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{2k}}$

Answer: D

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85. A street car moves rectilinearly from station A to the next station B (from rest to rest) with an acceleration varying according to the law

$f = a - bx,$ where a and b are constants and x is the distance from station A. The distance between the two stations and the maximum velocity are

A. $x = \frac{2a}{b}, v_{\max} = \frac{a}{\sqrt{b}}$

B. $x = \frac{b}{2a}, v_{\max} = \frac{a}{b}$

C. $x = \frac{a}{2b}, v_{\max} = \frac{b}{\sqrt{a}}$

D. $x = \frac{a}{b}, v_{\max} = \frac{\sqrt{a}}{b}$

Answer: A

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86. Two particles P and Q describes SHM of same amplitude a and frequency v along the same straight line. The maximum distance between the two particles is $\sqrt{2}a$. The initial phase difference between them is

A. zero

B. $\frac{\pi}{2}$

C. $\frac{\pi}{6}$

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

Answer: B

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87. The velocity v of a particle of mass is moving along a straight line change with time t as $\frac{d^2v}{dt^2} = -Kv$ where K is a particle constant which of the following statement is correct?

A. the particle does not perform SHM.

B. The particle performs SHM with time period $2\pi\sqrt{\frac{m}{K}}$

C. The particle performs SHM with frequency $\frac{\sqrt{K}}{2\pi}$

D. The particle performs SHM with time period

$$\frac{2\pi}{K}.$$

Answer: C

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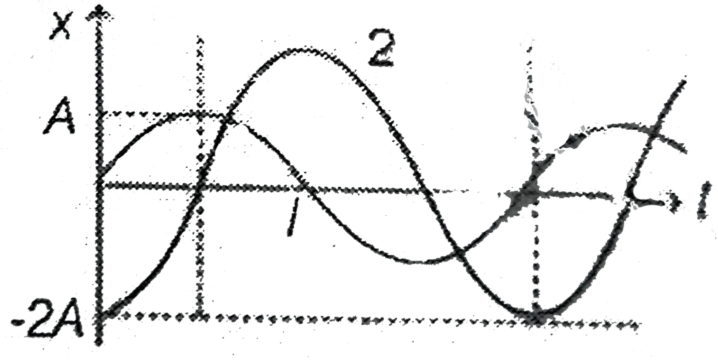
88. The osciallations represented by curve 1 in the graph are expressed by equation $x = A \sin \varepsilon t$. The equation for the oscillations represented by curve

2 is expressed as



A. $x = 2A\sin\left(\omega t - \frac{\pi}{2}\right)$

B. $x = 2A\sin\left(\omega t + \frac{\pi}{2}\right)$

C. $x = -2A\sin\left(\omega t - \frac{\pi}{2}\right)$

D. $x = A\sin\left(\omega t - \frac{\pi}{2}\right)$

Answer: A

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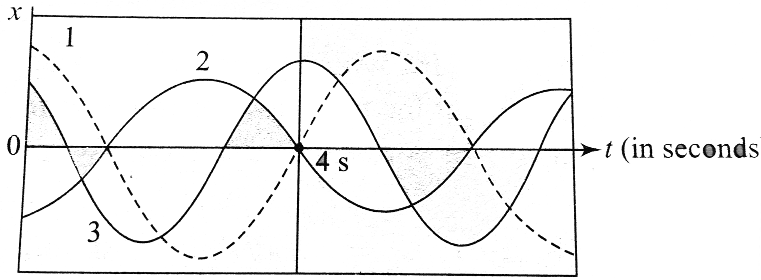


Fig. 4.170

89.

Graph shows the $x(t)$ curves for the three experiments involving a particular spring block system oscillating in SHM. The kinetic energy of the system is maximum at $t = 4$ s. For the situation.

A. 1

B. 2

C. 3

D. same in all

Answer: A

Watch Video Solution

90. The acceleration of a particle is $a = -100x + 50$. It is released from $x = 2$. Here, a and x are in SI units

A. periodic, oscillatory but not SHM.

B. periodic but not oscillatory

C. oscillatory but not periodic.

D. simple harmonic.

Answer: D

Watch Video Solution

91. In the above question, the speed of the particle at origin will be:

A. $10\sqrt{2}\frac{m}{s}$

B. $1.5\frac{m}{s}$

C. $10\frac{m}{s}$

D. none of these

Answer: A

View Text Solution

92. A particle performs SHM of amplitude A along a straight line. When it is at distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount $\frac{1}{2}m\omega^2 A^2$ due to an impulsive force. Then its new amplitude becomes.

A. $\frac{\sqrt{5}}{2}A$

B. $\frac{\sqrt{3}}{2}A$

C. $\sqrt{2}A$

D. $\sqrt{5}A$

Answer: C

Watch Video Solution

93. A uniform pole length $l = 2l$, is laid on a smooth horizontal table as shown in figure. The mass of poleis M and it is connected to a frictionless axis at O. A spring with force constant k is connected to the other end. The pole is displaced by a small angle θ_0 from equilibrium possition and released such that it it performs small oscillation. Find its angular frequency.

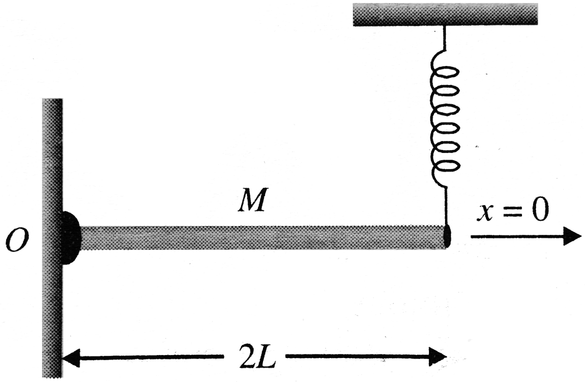


Fig. 4.85

A. $\sqrt{\frac{3k}{m}}$

B. $\sqrt{\frac{k}{3m}}$

C. $\sqrt{\frac{3k}{m}+\frac{3g}{2L}}$

D. $\sqrt{\frac{k}{m}}$

Answer: A

Watch Video Solution

94. A small mass executes linear SHM about O with amplitude a and period T. Its displacement from O at time $T/8$ after passing through O is:

A. $\frac{a}{8}$

B. $\frac{a}{2\sqrt{2}}$

C. $\frac{a}{2}$

D. $\frac{a}{\sqrt{2}}$

Answer: D

Watch Video Solution

95. The period of a particle executing SHM is 8 s . At t=0 it is at the mean position . The ratio of the distances covered by the particle in the 1st second to the 2nd second is

A. $\frac{1}{\sqrt{2}+1}$

B. $\sqrt{2}$

C. $\frac{1}{\sqrt{2}}$

D. $\sqrt{2}+1$

Answer: D

Watch Video Solution

96. A particle performs SHM with a period T and amplitude a. The mean velocity of particle over the time interval during which it travels $a/2$ from the extreme position is

A. $\frac{a}{T}$

B. $\frac{2A}{T}$

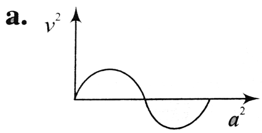
C. $\frac{3A}{T}$

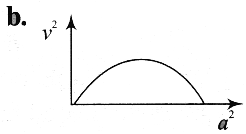
D. $\frac{A}{2T}$

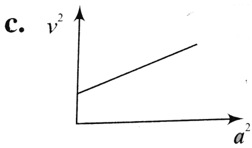
Answer: C

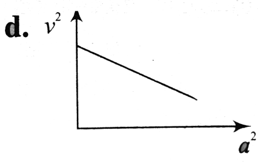
Watch Video Solution

97. A graph of the square of the velocity against the square of the acceleration of a given simple harmonic motion is

A. 

B. 

C. 

D. 

Answer: D

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98. A plank with a small block on top of it is under going vertical SHM. Its period is $2\,\text{sec.}$ The minium amplitude at which the block will separate from plank is :

A. $\frac{10}{\pi^2}$

B. $\frac{\pi^2}{10}$

C. $\frac{20}{\pi^2}$

D. $\frac{20}{\pi^2}$

Answer: A

Watch Video Solution

99. The potential energy of a harmonic oscillator of mass 2 kg in its mean positioin is 5J. If its total energy is 9J and its amplitude is 0.01m, its period will be

A. $\frac{\pi}{10}s$

B. $\frac{\pi}{20}$s

C. $\frac{\pi}{50}s$

D. $\frac{\pi}{100}s$

Answer: D

Watch Video Solution

100. A spring mass system preforms $S.H.M$ if the mass is doubled keeping amplitude same, then the total energy of $S.H.M$ will become :

A. double

B. half

C. unchanged

D. 4 times

Answer: C

Watch Video Solution

101. A particle of mass m moves in a one dimensional potential energy $U(x) = -ax^2 + bx^4$, where a and b are positive constant. The angular frequency of small oscillation about the minima of the potential energy is equal to

A. $\pi\sqrt{\frac{a}{2b}}$

B. $2\sqrt{\frac{a}{m}}$

C. $\sqrt{\frac{2a}{m}}$

D. $\sqrt{\frac{a}{2m}}$

Answer: B

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102. A particle of mass m moves in the potential energy U shoen above. The period of the motion when the particle has total energy E is

A. $2\pi\sqrt{\frac{m}{k}}+4\sqrt{\frac{2E}{mg^2}}$

B. $2\pi\sqrt{\frac{m}{k}}$

C. $\pi\sqrt{\frac{m}{k}}+2\sqrt{\frac{2E}{mg^2}}$

D. $2\sqrt{\frac{2E}{mg^2}}$

Answer: C

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103. The displacement of a body executing SHM is given by $x=A\sin(2\pi t+\pi/3)$. The first time from $t=0$ when the velocity is maximum is

A. $\frac{1}{12}$s

B. 0.16 s

C. 0.25 s

D. 0.33 s

Answer: A

Watch Video Solution

104. Two particles are executing SHM in a straight line. Amplitude A and the time period T of both the particles are equal. At time t=0, one particle is at displacement $x_1 = +A$ and the other $x_2 = \left(-\frac{A}{2}\right)$ and they are approaching towards each other. After what time they across each other? $\frac{T}{4}$

A. $\frac{T}{3}$

B. $\frac{T}{4}$

C. $\frac{4T}{6}$

D. $\frac{T}{6}$

Answer: D

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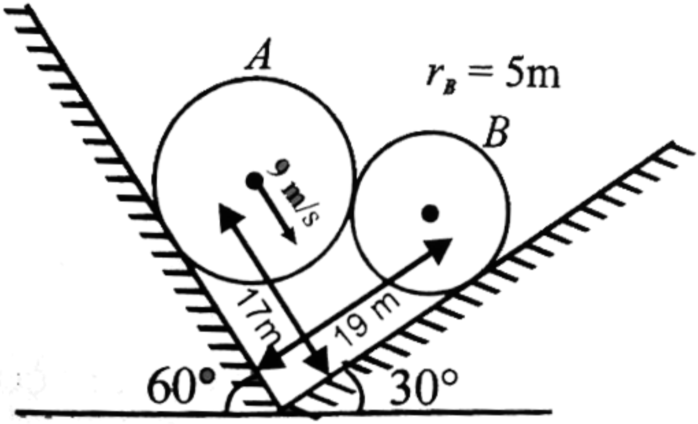
105.



System is shown in the figure. Velocity of sphere A is 9 $\frac{m}{s}$. Find the speed of sphere B.

A. $2\pi\sqrt{\frac{\sqrt{2}l}{3g}}$

B. $2\pi\sqrt{\frac{2\sqrt{2}l}{3g}}$

C. $2\pi\sqrt{\frac{2l}{3g}}$

D. $3\pi\sqrt{\frac{l}{3g}}$

Answer: C

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106. A particle is subjected to two mutually perpendicular simple harmonic such that its x and y coordinates are given by $x = 2\sin\omega t, y = 2\sin\left(\omega t + \frac{\pi}{4}\right)$ The path of the particle will be

A. an ellipse

B. a straight line

C. a parabola

D. circle

Answer: A

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107. Two simple harmonic motions $y_1 = A \sin \omega t$ and y_2 = Acosωt are superimposed on a particle of mass m. The total mechanical energy of the particle is

A. $\frac{1}{2}m\omega^2A^2$

B. $m\omega^2A^2$

C. $\frac{1}{4}m\omega^2 A^2$

D. zero

Answer: B

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Multiple Correct

1. A coin is placed on a horizontal platform which undergoes vertical simple harmonic motion of angular frequency ω. The amplitude of oscillation is gradually increased. The coin will leave contact with the platform for the first time

A. at the highest position of the platform

B. at the mean position of the platform

C. for an amplitude of $\frac{g}{\omega^2}$

D. for and amplitude of $\sqrt{\frac{g}{\omega}}$

Answer: A::C

View Text Solution

2. For a simple harmonic motion with given angular frequency ω, two arbitrary initial conditions are necessary and sufficient to determine the motion completely. These initial conditions may be

A. initial position and initial velocity

B. amplitude and initial phase

C. total energy of oscillation and amplitude

D. total energy of oscillation and initial phase.

Answer: A::B::D

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3. The potential energy U of a body of unit mass moving in one dimensional conservative force field is given by $U = x^2 - 4x + 3$. All units are is SI. For this situation mark out the correct statement (s).

A. The body will perform simple harmonic motion about $x = 2$ units.

B. The body will perform oscillatory motion but not simple harmonic motion.

C. The body will perform simple harmonic motion with time period $\sqrt{2}\pi s$.

D. If speed of the body at equilibrium position is $4\frac{m}{s}$, then the amplitude of oscillation would be $2\sqrt{2}$m

Answer: A::C::D

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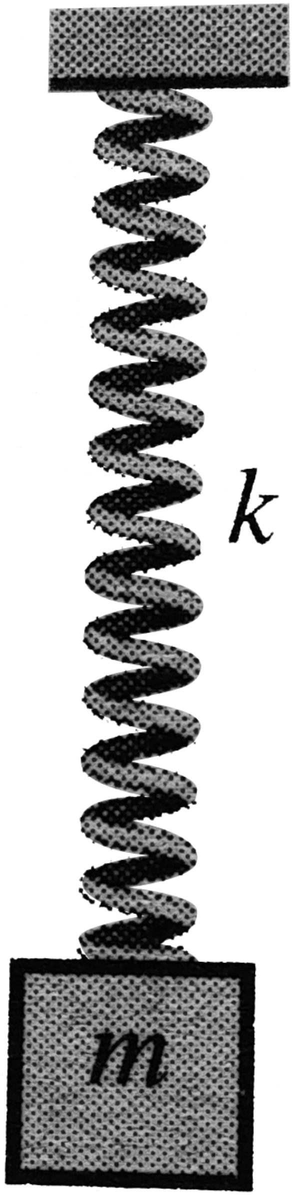

4.

For the spring pendulum shown in fig. the value of

For the spring pendulum shown in fig. the value of spring constant is $3 \times 10^4 \frac{N}{m}$ and amplitude of oscillation is $0.1 m$. The total mechanical energy of oscillating system is 200 J. Mark out the correct option (s).

A. Minimum PE of the oscillating system is 50 J

B. Maximum PE of the oscillating system is 200J

C. maximum KE of the oscillating system is 200 J

D. minimum KE of the oscillating system is 150 J.

Answer: A::B

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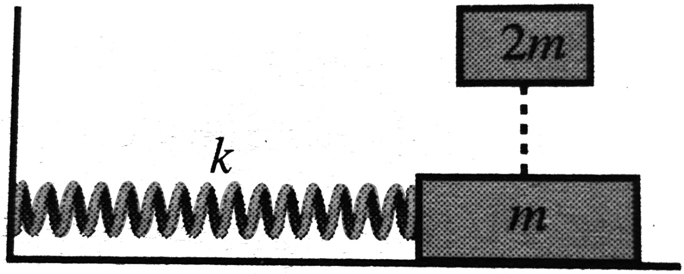

5.

An object of mass m is performing simple harmonic motion on a smooth horizontal surface as shown in Fig. just as the oscillating object reaches its extreme position, another object of mass 2 m is dropped on to oscillating object, which sticks to it. For this situation mark out the correct statement (s).

A. Amplitude of oscillations remains unchanged.

B. time period of oscillation remains unchages.

C. The total mechanical energy of the system does not change.

D. The maximum speed of oscillating object changes.

Answer: A::C::D

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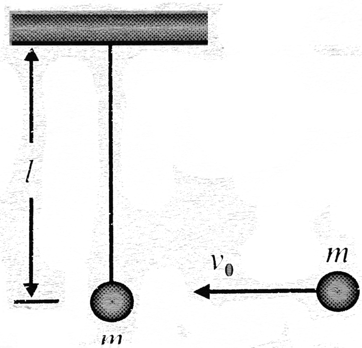
6.



A simple pendulum consists of a bob of mass m and a light string of length l as shown in the fig. another identical ball moving with the small velocity v_0 collides with the pendulum's bob and sticks to it. For this new pendulum of mass 2 m, mark out the correct statements (s).

A. Time period of the pendulum is $2\pi\sqrt{\frac{l}{g}}$.

B. The equation of motion for this pendulum is

$$\theta = \frac{v_0}{2\sqrt{gl}}\sin\left[\sqrt{\frac{g}{l}}t\right]$$

C. The equation of motion for this pendulum is

$$\theta = \frac{v_0}{2\sqrt{gl}}\cos\left[\sqrt{\frac{g}{l}}t\right].$$

D. Time period of the pendulum is $2\pi\sqrt{\frac{2l}{g}}$.

Answer: A::B

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7. A particle performing simple harmonic motion undergoes unitial displacement of $\frac{A}{2}$ (where A is the amplitude of simple harmonic motion) in 1 s. At $t = 0$, the particle may be at he extreme position or mean position the time period of the simple harmonic motion can be

A. 6s

B. 2.4s

C. 12s

D. 1.2s

Answer: A::C

View Text Solution

8. A particle is subjected to two simple harmonic motions along x and y directions according to $x = 3\sin 100\pi t, y = 4\sin 100\pi t.$

A. Motion of particle will be on ellipse travelling in clockwise direction.

B. Motion of particle will be on a straight line with slope $\frac{4}{3}$

C. Motion will be simple harmonic motion with amplitude 5.

D. Phase difference between two motions is $\frac{\pi}{2}$

Answer: B::C

View Text Solution

9. The speed of a particle moving along a straight line, when it is at a distance (x) from a fixed point of the line is given by: $v^2 = 108 - 9x^2$ (all quantities are in cgs units.) Choose the correct statement.

A. The motion is uniformly accelerated along the straight line

B. the magnitude of the acceleration at a distance 3 cm from the point is $27\frac{cm}{s^2}$

C. the motion is simple harmonic about the given fixed point

D. the maximum displacement from the fixed point is 4 cm

Answer: B::C

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10. A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the latter is at momentary rest Then.

A. the period of oscillation is $\left(\frac{2\pi}{5}\right)$

B. `the block weighs double its actual weght, then the plank is at one of the positions of momentary rest.

C. the block weighs 1.5 times its weight on the plank halfway down

D. the block weghs its true weight on the plank when the later moves fastest.

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

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11. A 20g particle is subjected to two simple harmonic motions $x_1 = 2\sin 10t$, $x_2 = 4\sin\left(10t + \frac{\pi}{3}\right)$. Where x_1 and x_2 are in metres and t is in seconds.

A. the displacement of the particle at $t = 0$ will be $2\sqrt{3}$ m

B. maximum speed of the particle will be $20\sqrt{7}\frac{m}{s}$

C. Magnitude of maximum acceleration of the particle will be $200\sqrt{7}\frac{m}{s^2}$

D. Energy of the result motion will be 28 J

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

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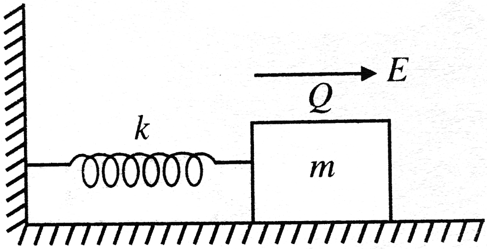

Fig. 4.176

12.

A spring block system undergoes SHM on a smooth horizontal surface, the block is now given some charge and a uniform horizontal electric field E is switched on as shown in Fig. As a result

A. (a)Time period of oscillation will increase

B. (b)Time period of oscillation will decrease

C. (c)Time period of oscillation will remain unaffected

D. (d)the mean position of SHM will shift to the right.

Answer: C::D

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13. The potential energy of a particle of mass 0.1 kg , moving along the X-axis , is given by $U = 5x(x-4)J$, where x is in metres. Choose the wrong option.

A. the particle is acted upon by a constant force

B. the speed of the particle is maximum at $x = 2m$

C. the particle executes SHM

D. the period of oscillation of the particle $\left(\frac{\pi}{5}\right)$ s

Answer: B::C::D

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14. The time period of a particle in simple harmonic motion is T. Assume potential energy at mean position to be zero. After a time of $\frac{T}{6}$ it passes its mean position ,then at t=0 its,

A. velocity will be half its maximum velocity

B. displacement will be half its amplitude

C. acceleration will be nearly 86% of its maximum

D. $KE = PE$

Answer: A::C

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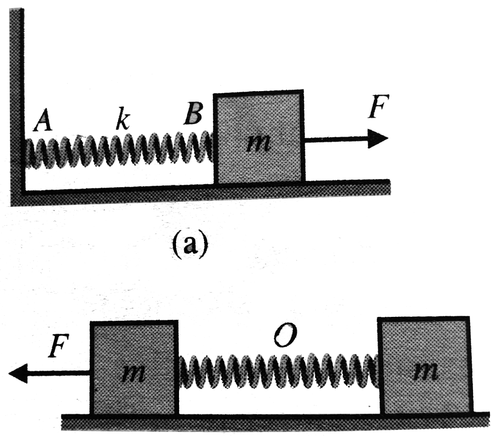
15. 

Figure. (a) shows a spring of force constant k fixed at one end and carrying a mass m at the other end placed on a horizontal frictionless surface. The spring is stretched by a force F. Figure. (b) shows the same spring with both endsf free and a mass m fixed at each free end Each of the spring is streched by the same force F. The mass in case (a) and the masses in case (b) are then released. Which of the following statements are true?

A. While oscillating the maximum extension of the spring is more in case (a) than in case (b).

B. The maximum extension of the spring is same in both cases.

C. The time period of oscillation is the same in both cases.

D. The time period of oscillation in case (a) is

$\sqrt{2}$ time that in case (b).

Answer: B::D

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16. When the point of suspendion of pendulum is moved, its period of oscillation

A. decreaes when it moves vertically upwards with an acceleration a

B. decreases when it moves vertcally downwards with acceleration greater than 2 g.

C. Increases when it moves horizontally with acceleration a

D. all of the above.

Answer: A::B

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17. The displacement time relation for a particle can be expressed as $y = 0.5\left[\cos^2(n\pi t) - \sin^2(n\pi t)\right]$ This relation shows that

A. the particle executing a SHM with amplitude $0.5\mathrm{m}$

B. the particle is executing a SHM with frequency n time that of a second's pedulum

C. the particle is executing a SHM and the velocity in its mean position is $(n\pi)\frac{m}{s}$

D. the paritcle is not executing a SHM at all

Answer: A::C

View Text Solution

18. At two particular closest instant of time t_1 and t_2 the displacements of a particle performing SHM are equal. At these instant

A. instantaneaous speed are equal

B. instantaneous acceleration are equal

C. phase of the motion are unequal

D. kinetic energies are equal

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

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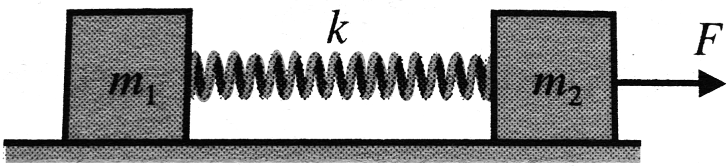
19. 

Two blocks connected by a spring rest on a smooth horizontal plane as shown in Fig. A constant force F start acting on block m_2 as shown in the figure. Which of the following statements are not correct?

A. Length of the spring increases continuously if $m_1 > m_2$.

B. Blocks start performing SHM about centre of mass of the system, which moves rectilinearly with constant acceleration.

C. Blocks start performing oscillation about centre of mass of the system with incresing amplitude.

D. Acceleration of m_2 is maximum at initial moment of time only.

Answer: A::C::D

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20. A block of mass m is suspended by a rubber cord of natural length $l = \frac{mg}{k}$, where k is force constant of the cord. The block is lifted upwards so that the cord becomes just tight and then block is released suddently. Which of the following will not be true?

A. Block performs periodic motion with amplitude greater than l.

B. Block performs SHM with amplitude equal to

l.

C. Blocks will never return to the position from

where it was released.

D. Angular frequency ω is equal to $1\frac{rad}{s}$

Answer: A::C::D

View Text Solution

21. The displacement (x) of a particle as a function

of time (t) is given by

$x = a \sin(bt + c)$

Where a,b and c are constant of motion. Choose the correct statemetns from the following.

A. The motion repeats itself in a time interval of $\frac{2\pi}{b}$

B. The energy of the particle remains constant.

C. The velocity of the particle zero at $x = \pm a$

D. The acceleration of the particle is zero at $x = \pm a$

Answer: A::B::C

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22. A simple pendulum is oscillating between extreme position P and Q about the mean position O. Wchi of the following statements are true about the motion of pendulum?

A. At point O, the acceleration of the bob is different from zero.

B. The acceleration of the bob is constant throughout the oscillation.

C. The tension in the string is contant throughout the oscillation.

D. The tension is maximum at O and minimum at P or Q.

Answer: A::D

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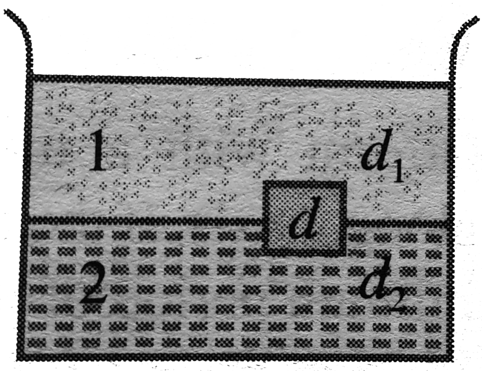

23.

A cylinderical block of density d stays fully immersed in a beaker filled with two immiscible liquids of different densities d_1 and d_2 The block is in equilibrium with half of it in liquid 1 and the other half in liquid 2 as shown in the Fig. If the block is given a displacement downwards released, then neglecting friction study the following statements.

A. It executes simple harmonic motion.

B. Its motion is periodic but not simple harmonic.

C. The frequency of oscillation is independent of the size of the cylinder.

D. The displacement of the centre of the cylinder is symmetric about its equilibrium position.

Answer: A::D

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24. A mass of 0.2 kg is attached to the lower end of a massless spring of force constant $200\frac{N}{m}$ the other end of which is fixed to a rigid support. Study the following statements.

A. In equilibrium the spring will be stretched by 1 cm.

B. If the mass is raised till the spring becomes unstretched and then released, it will go down by 2cm before moving upwards.

C. The frequency of oscillation will be nearly 5 Hz.

D. If the system is taken to the moon, the frequency of oscillation will be the same as that on the earth.

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

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25. A spring stores 5J of energy when stretched by 25 cm. It is kept vertical with the lower end fixed. A block fastened to its end is made to undergo small oscillations. If the block makes 5 oscillations each second what is the mass of the block?

A. $m = 0.16kg$

B. $m = 0.32kg$

C. $k = 160\frac{N}{m}$

D. $k = 320 \frac{N}{m}$

Answer: A::C

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26. A particle is subjected to two simple harmonic motions

$x_1 = A_1 \sin \omega t$

and $x_2 = A_2 \sin\left(\omega t + \frac{\pi}{3}\right)$

Find a the displacement at t=0, b. the maxmum speed of the particle and c. the maximum acceleration of the particle

A. $a_{\max} = \omega^2 \sqrt{A_1^2 + A_2^2 + A_1 A_2}$

B. $a_{\max} = \omega^2 \sqrt{A_1 A_2}$

C. $A = A_1 + A_2$

D. $A = \sqrt{A_1^2 + A_2^2 + A_1 A_2}$

Answer: A::D

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27. 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 motion is not simple harmonic

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

C. the phase difference between the second SHM and the resultant motion is zero.

D. the energy in the resultant motion is three times the energy in each separate SHM.

Answer: B::C

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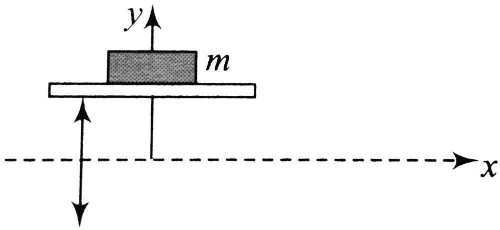

28.

A horizontal platform with a mass m placed on it is executing SHM slong y-axis. If the amplitude of oscillation is 2.5 cm, the minimum period of the motion for the mass not to be detached from the platform $\left(g = 10\frac{m}{s^2}\right)$

A. $\frac{10}{\pi} s$

B. $\frac{\pi}{10} s$

C. $\frac{\pi}{\sqrt{10}}$ s

D. $\frac{1}{\sqrt{10}}s$

Answer: B::D

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29. The speed v of a particle moving along a straight line, when it is at a distance (x) from a fixed point of the line is given by $v^2 = 108 - 9x^2$ (all equation are in CGS units):

A. (a)The motion is uniformly accelerated along the straight line

B. (b)the magnitude of the acceleration at a distance 3 cm from the point is $27\frac{cm}{s^2}$

C. (c)the motion is simple harmonic about the given fixed point

D. (d)the maximum displacement from the fixed point is 4 cm

Answer: B::C

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30. For a body executing SHM with amplitude A, time period T, maximum velocity $v_{\max}$ and phace constant zero, which of the following statements are correct for $0 \leq t \leq \frac{T}{4}$ (y is displacement from mean position)?

A. At $y = \left(\frac{A}{2}\right), v > \left(\frac{v_{\max}}{2}\right)$

B. For $v = \left(\frac{v_{\max}}{2}\right), y = \ < \left(\frac{A}{2}\right)$

C. For $t = \left(\frac{T}{8}\right), y > \left(\frac{A}{2}\right)$

D. for $y = \left(\frac{A}{2}\right), y < \left(\frac{T}{8}\right)$.

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

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31. If y,v and a represent displacement, velocity and acceleration at any instant for a particle executing SHM, which of the following statements are true?

A. v and y may have same direction.

B. v and a may have same direction.

C. a and y may have same direction.

D. a and v may have opposite direction.

Answer: A::B::D

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32. The time period of a particle in simple harmonic motion is T. Assume potential energy at mean position to be zero. After a time of $\frac{T}{6}$ it passes its mean position ,then at t=0 its,

A. velocity will be one half its mean position, its

B. displacement will be one half its amplitude

C. acceleration will be nearly 85% of its maximum acceleration

D. $KE = PE$

Answer: A::C

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33. The potential energy of a particle of mass 0.1 kg , moving along the X-axis , is given by $U = 5x(x-4)J$, where x is in metres. Choose the wrong option.

A. the particle is acted upon by a constant force

B. the speed of the particle is maximum at $x = 2m$

C. the particle executes SHM

D. the period of oscillation of the particle $\left(\frac{\pi}{5}\right)$

s

Answer: B::C::D

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34. A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the latter is at momentary rest Then.

A. the period of oscillation is $\left(\frac{2\pi}{5}\right)$

B. the block weight double its weight, when the plank is at one of the positions of momentary rest.

C. the block weighs 0.1 times its weight on the plank halfway up.

D. the block weighs 1.5 times its weight on the plank halfway down.

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

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35. A particle moves in the $x - y$ plane , accoding to the equation, $r = \left(\hat{i} + 2\hat{j}\right) A \cos \omega t.$ The motion of the particle is

A. on a straight line

B. on an ellipse

C. perodic

D. simple harmonic.

Answer: A::C::D

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Assertion Reasoning

1. Q. Statement I: The total energy of a particle performing simple harmonic motion could be negative. Statement II: Potential energy of a system could be magnetic.

A. Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. Statement I is true statement II is true, Statement II is NOT a correct explanation for

Statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: A

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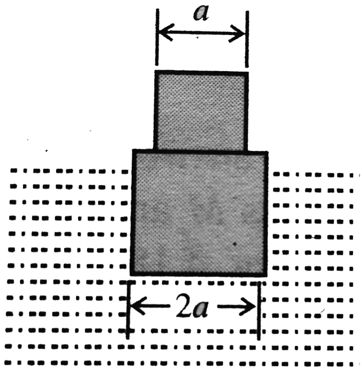

Fig. 4.181

2.

Q. Statement I: Two cubical blocks of same material and of sides a and 2a, respectively are attached rigidley and symmetrically to each other as shown. The system of two blocks is floating in water in such a way that upper surface of bigger blocks is just submerged in the water . If the system of blocks is displaced slightly in vertical directions, then the amplitude of oscillation on either side of equilibrium position would be different. Statement II: The force constant on two sides of equilibrium position in the above described situation is different.

A. Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. Statement I is true statement II is true, Statement II is NOT a correct explanation for Statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: A

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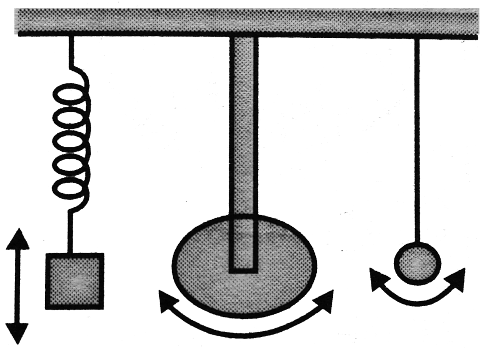

Fig. 4.182

3.

Q. Statement I Three pendulums are suspended from ceiling as shown in Fig. These three pendulums are set to oscillate as shon by arrows, and it is found that all three have same time period. Noe, all three are taken to a place where acceleration due to gravity changes to 4/9th of its value at the first place. If spring pendulum makes 60 cycles in a given time at this place, then torsion pendulum and simple pendulum will also make 60 oscillation in same (given) time interval. Statement II: Time period of torsion pendulum is independent of acceleration due to gravity.

A. (a)Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. (b)Statement I is true statement II is true, Statement II is NOT a correct explanation for Statement I.

C. (c)Statement I is true, Statement II is false

D. (d)Statement I is false, Statement II is true

Answer: D

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4. Statement I: A circular metal hop is suspended on the edge by a hook. the hoop can oscillate side to side in the plane of the hoop, or it can oscillate back and forth in a direction perpendicular to the plane of the hoop. The time period of oscillation would be more when oscillation are carried out in the plane of hoop.

Statement II: Time period of physical pendulum is more if moment of inertial of the rigid body about corresponding axis passing through the pivoted point is more.

A. (a)Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. (b)Statement I is true statement II is true, Statement II is NOT a correct explanation for Statement I.

C. (c)Statement I is true, Statement II is false

D. (d)Statement I is false, Statement II is true

Answer: A

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5. STATEMENT-1 : In simple pendulum performing $S.H.M.$, net acceleration is always between tangential and radial acceleration except at lowest point.

STATEMETN-2 : At lowest point tangential acceleration is zero.

A. (a)Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. (b)Statement I is true statement II is true, Statement II is NOT a correct explanation for Statement I.

C. (c)Statement I is true, Statement II is false

D. (d)Statement I is false, Statement II is true

Answer: D

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6. Statement I: If the amplitude of a simple harmonic oscillator is doubled, its total energy becomes four times.

Statement II: The total energy is directly proportional to the square of the smplitude of vibration of the harmonic oscillator.

A. Statement I is true statement II is true, Statement II is a correct explanation for Statement I.

B. Statement I is true statement II is true, Statement II is NOT a correct explanation for Statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: A

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Comprehension

1. One end of an ideal spring is fixed to a wall at origin O and axis of spring is parallel to x-axis. A block of mass $m = 1kg$ is attached to free end of the spring and it is performing SHM. Equation of position of the block in co-ordinate system shown in figure is $x = 10 + 3\sin(10t)$. Here, t is in second and x in cm. Another block of mass $M = 3kg$, moving towards the origin with velocity $30cm/s$ collides with the block performing SHM at $t = 0$ and gets stuck to it. Calculate

(a) new amplitude of oscillations,

(b) neweqution for position of the combined body,

(c) loss of energy during collision. Neglect friction.

A. $20\frac{rad}{s}$

B. $5\frac{rad}{s}$

C. $100\frac{rad}{s}$

D. $50\frac{rad}{s}$

Answer: B

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2. One end of an ideal spring in fixed in a wall at origin O and axis of spring is paralllel to the x-axis . A block of mass $m = 1kg$ is attached to the free end of the spring and it is performing SHm. Equation of position of the block in coordinate system Shown in Fig. is $x = 10 + 3\sin(10t)$, where t is in second and x in cm. Another block of mass $M = 3kg$ moving towards the origin with velocity $30\frac{cm}{s}$ collides with the block performing SHM at $t = 0$ and gets stuck to it.

Q. Angular frequency of oscillation after collision is

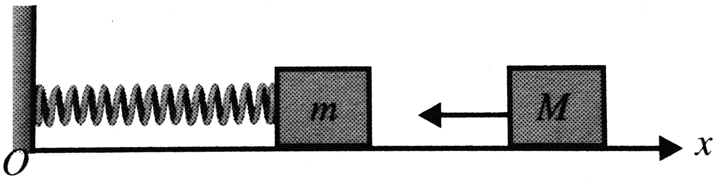

Fig. 4.183

A. 3 cm

B. 20 cm

C. 10 cm

D. 100 cm

Answer: A

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3. One end of an ideal spring in fixed in a wall at origin O and axis of spring is paralllel to the x-axis . A block of mass $m = 1kg$ is attached to the free end of the spring and it is performing SHm. Equation of position of the block in coordinate system Shown in Fig. is $x = 10 + 3\sin(10t)$, where t is in second and x in cm. Another block of mass $M = 3kg$ moving towards the origin with velocity $30\frac{cm}{s}$ collides with the block performing SHM at $t = 0$ and gets stuck to it.

Q. Angular frequency of oscillation after collision is

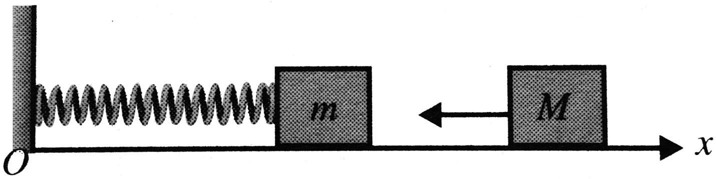

Fig. 4.183

A. $(10 + 3\sin 5t)cm$

B. $(10 - 3\sin 5t)cm$

C. $(10 + 3\cos 10t)cm$

D. $(10 - 3\cos 10t)cm$

Answer: B

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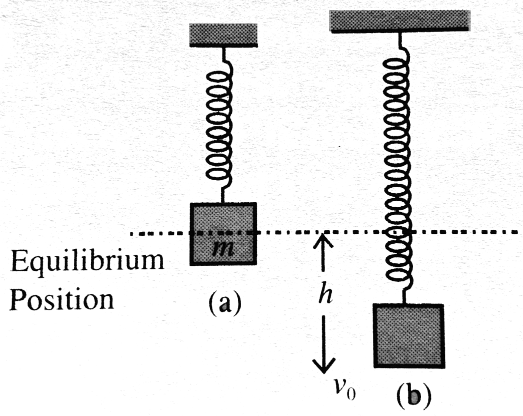
4.



A block of mass m is connected to a spring constant k and is at rest in equilibrium as shown. Now, the block is Displacement by h below its equilibrium position and imparted a speed v_0 towards down as shown in the Fig. As a result of the jerk, the block executes simple harmonic motion about its equilibrium position. Based on this information, answer the following question.

Q. The amplitude of oscillation is

A. h

B. $\sqrt{\frac{mv_0^2}{k} + h^2}$

C. $\sqrt{\frac{m}{k}v_0 + h}$

D. none of these

Answer: B

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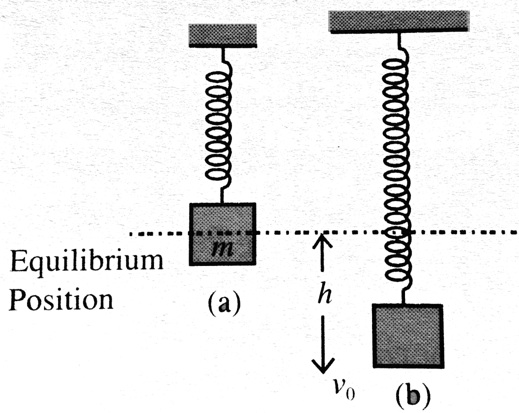
5.



A block of mass m is connected to a spring constant k and is at rest in equilibrium as shown. Now, the block is Displacement by h below its equilibrium position and imparted a speed v_0 towards down as shown in the Fig. As a result of the jerk, the block executes simple harmonic motion about its equilibrium position. Based on this information, answer the following question.

Q. The equation for the simple harmonic motion is

A. $y = -A\sin\left[\sqrt{\frac{k}{m}}t + \sin^{-1}\left(\frac{h}{A}\right)\right]$

B. $y = -A\cos\left[\sqrt{\frac{k}{m}}t + \sin^{-1}\left(\frac{h}{A}\right)\right]$

C. $y = A\sin\left[\sqrt{\frac{k}{m}}t + \cos^{-1}\left(\frac{h}{A}\right) + \frac{\pi}{2}\right]$

D. $y = A\sin\left[\sqrt{\frac{k}{m}}t + \cos^{-1}\left(\frac{h}{A}\right) + \frac{\pi}{4}\right]$

Answer: A

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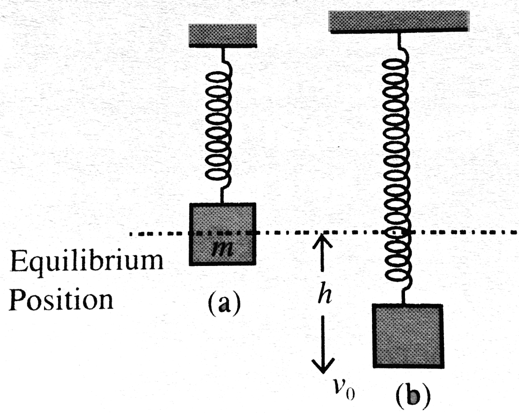
6.



A block of mass m is connected to a spring constant k and is at rest in equilibrium as shown. Now, the block is Displacement by h below its equilibrium position and imparted a speed v_0 towards down as shown in the Fig. As a result of the jerk, the block executes simple harmonic motion about its equilibrium position. Based on this information, answer the following question.

Q. Find the time taken by the block to cross the mean position for the first time.

A. $\dfrac{2\pi - \cos^{-1}\left(\frac{h}{A}\right)}{\sqrt{\frac{k}{m}}}$

B. $\dfrac{\frac{\pi}{2} - \cos^{-1}\left(\frac{h}{A}\right)}{\sqrt{\frac{k}{m}}}$

C. $\dfrac{\pi - \sin^{-1}\left(\frac{h}{A}\right)}{\sqrt{\frac{k}{m}}}$

D. $\dfrac{\pi - \sin^{-1}\left(\frac{h}{A}\right)}{2\sqrt{\frac{k}{m}}}$

Answer: C

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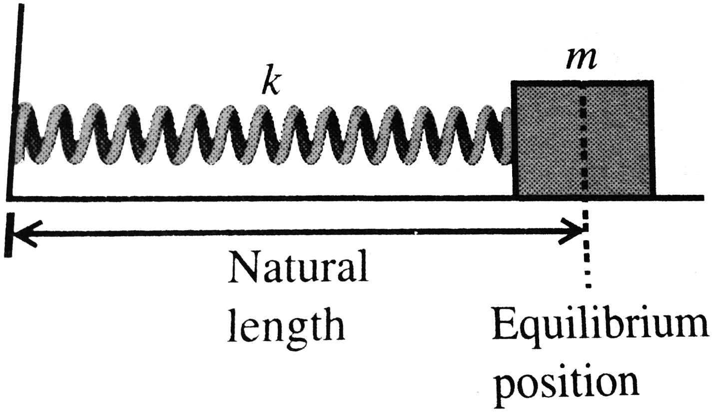
7. 

A block of mass m is connected to a spring of spring constant k as shown in Fig. The block is found at its equilibrium position $t = 1s$ and it has a velocity of $+0.25\frac{m}{s}$ at $t = 2s$. The time period of oscillation is 6 s. Based on the given information answer the following question: Q. the amplitude of oscillation is

A. $\frac{3}{2\pi} cm$

B. $3m$

C. $\frac{1}{\pi}m$

D. $1.5m$

Answer: A

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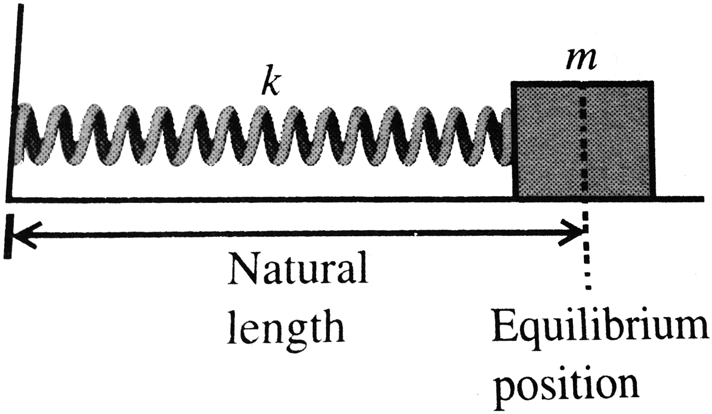
8. 

A block of mass m is connected to a spring of spring constant k as shown in Fig. The block is found at its equilibrium position $t = 1s$ and it has a velocity of $+0.25 \frac{m}{s}$ at $t = 2s$. The time period of oscillation is 6 s. Based on the given information answer the following question:

Q. Determine the velocity of particle at $t = 5s$.

A. $-0.4 \frac{m}{s}$

B. $0.5\frac{m}{s}$

C. $-0.25\frac{m}{s}$

D. none of these

Answer: C

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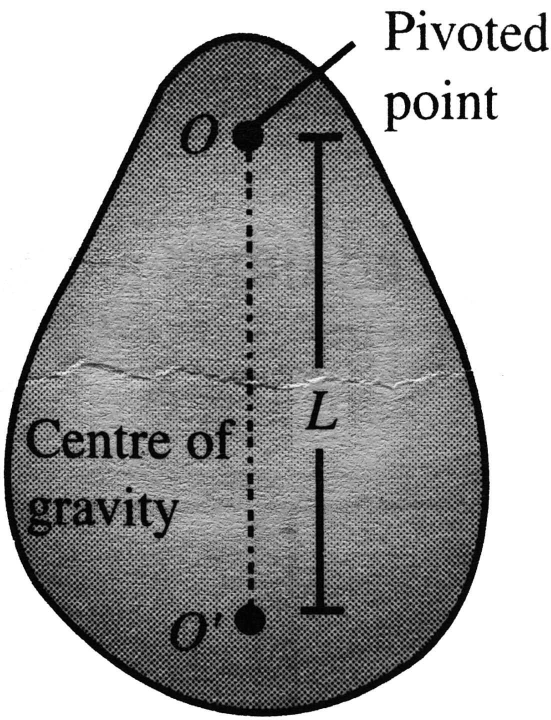

9.

In physical pendulum, the time period for small oscillation is given by $T = 2\pi\sqrt{\frac{I}{Mgd}}$ where I is the moment of inertial of the body about an axis passing through a pivoted point O and perpendicular to the plane of oscillation and d is the separation point between centre of gravity and the pivoted point. In the physical pendulum a speacial point exists where if we concentrate the entire mass of body, the resulting simple pendulum (w.r.t. pivot point O) will have the same time period as that of physical pendulum This point is termed centre of oscillation.

$T = 2\pi\sqrt{\frac{I}{Mgd}} = 2\pi\sqrt{\frac{L}{g}}$ Moreover, this point possesses two other important remarkable properties:

Property I: Time period of physical pendulum about the centre of oscillation (if it would be pivoted) is same as in the original case.

Property II: If an impulse is applied at the centre of oscillatioin in the plane of oscillation, the effect of this impulse at pivoted point is zero. Because of this property, this point is also known as the centre of percussion. From the given information answer the following question:

Q. A uniform rod of mass M and length L is pivoted about point O as shown in Figgt It is slightly rotated from its mean position so that it performs angular simple harmonic motion. For this physical pendulum, determine the time period oscillation.

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

B. $\pi\sqrt{\frac{7L}{3g}}$

C. $2\pi\sqrt{\frac{2l}{3g}}$

D. none of these

Answer: B

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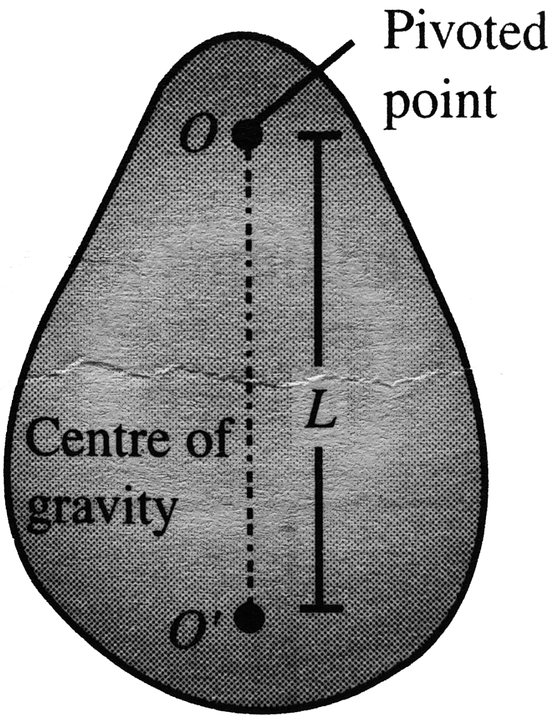
10. In physical pendulum, the time period for small oscillation is given by $T = 2\pi\sqrt{\frac{I}{Mgd}}$ where I is the moment of inertial of the body about an axis passing through a pivoted point O and perpendicular to the plane of oscillation and d is the separation point between centre of gravity and the pivoted point. In the physical pendulum a speacial point exists where if we concentrate the entire mass of body, the resulting simple pendulum (w.r.t. pivot point O) will have the same time period as that of physical pendulum This point is termed centre of oscillation.

$T = 2\pi\sqrt{\frac{I}{Mgd}} = 2\pi\sqrt{\frac{L}{g}}$ Moreover, this point possesses two other important remarkable properties:

Property I: Time period of physical pendulum about the centre of oscillation (if it would be pivoted) is same as in the original case.

Property II: If an impulse is applied at the centre of oscillatioin in the plane of oscillation, the effect of this impulse at pivoted point is zero. Because of this property, this point is also known as the centre of percussion. From the given information answer the following question:

Q. For the above question, locate the centre of oscillation.



A. $\frac{L}{4}$ from O (down)

B. $\frac{L}{4}$ from O (up)

C. $\frac{2L}{3}$ from O (down)

D. $\frac{7L}{12}$ from O (down)

Answer: D

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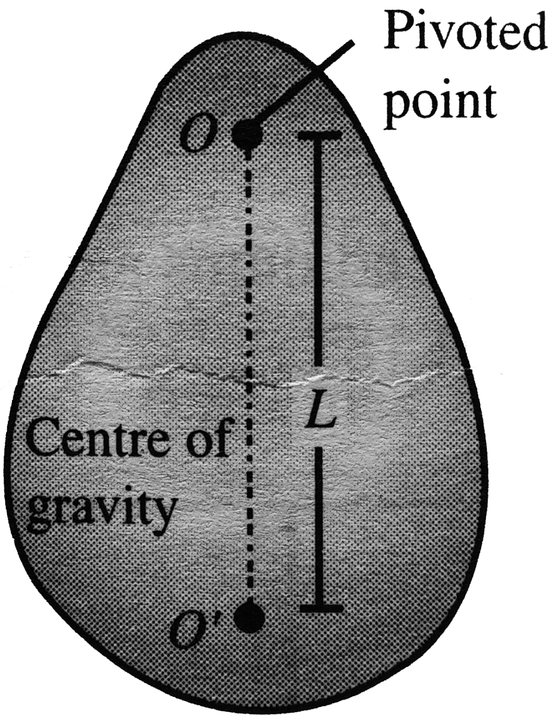
11. In physical pendulum, the time period for small oscillation is given by $T = 2\pi\sqrt{\frac{I}{Mgd}}$ where I is the moment of inertial of the body about an axis passing through a pivoted point O and perpendicular to the plane of oscillation and d is the separation point between centre of gravity and the pivoted point. In the physical pendulum a speacial point exists where if we concentrate the entire mass of body, the resulting simple pendulum (w.r.t. pivot point O) will have the same time period as that of physical pendulum This point is termed centre of oscillation.

$T = 2\pi\sqrt{\dfrac{I}{Mgd}} = 2\pi\sqrt{\dfrac{L}{g}}$ Moreover, this point possesses two other important remarkable properties:

Property I: Time period of physical pendulum about the centre of oscillation (if it would be pivoted) is same as in the original case.

Property II: If an impulse is applied at the centre of oscillatioin in the plane of oscillation, the effect of this impulse at pivoted point is zero. Because of this property, this point is also known as the centre of percussion. From the given information answer the following question:

Q. If an impulse J is applied at the centre of oscillation in the plane of oscillation, then angular velocity of the rod will be .



A. $\frac{4J}{ML}$

B. $\frac{2J}{ML}$

C. $\frac{3J}{2ML}$

D. $\frac{J}{ML}$

Answer: A

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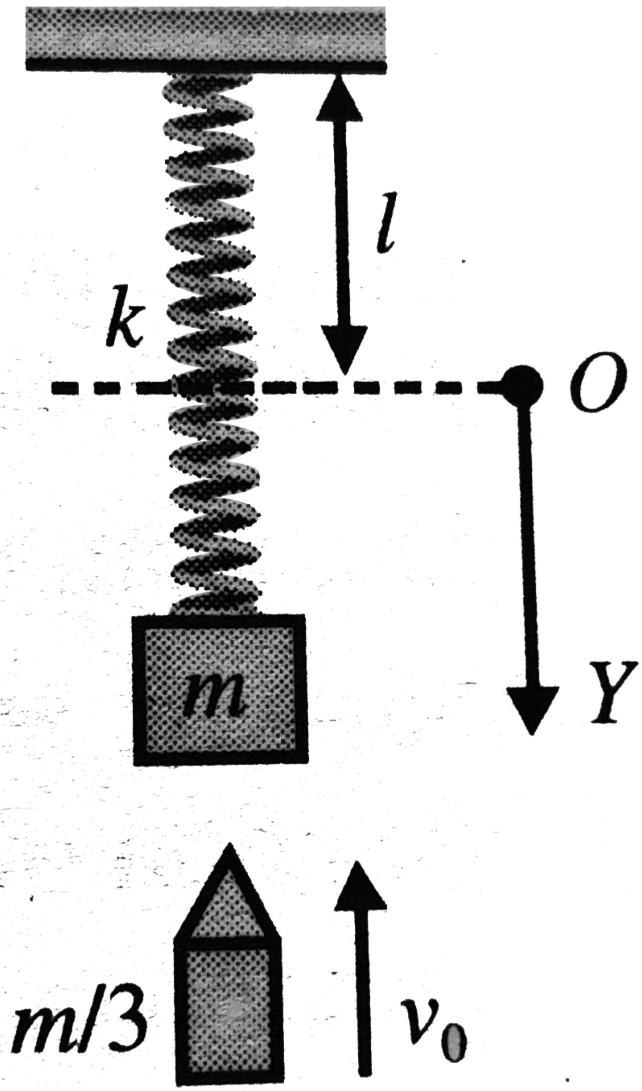

12.

A block of mass m is suspended from one end of a light spring as shown. The origin O is considered

at distance equal to natural length of the spring from the ceiling and vertical downwards direction as positive y-axis. When the system is in equilibrium a bullet of mass $\frac{m}{3}$ moving in vertical up wards direction with velocity v_0 strikes the block and embeds into it. As a result, the block (with bullet embedded into it) moves up and start oscillating. Based on the given information, answer the following question:

Q. The amplitude of oscillation would be

A. the block bullet system performs SHM about

$$y = \frac{mg}{k}.$$

B. The block bullet system performs oscillatory motion but not SHM about $y = \frac{mg}{k}$.

C. The block bullet system performs SHM about $y = \frac{4mg}{3k}$.

D. The block bullet system performs oscillatory motion but not SHM about $y = \frac{4mg}{3k}$.

Answer: C

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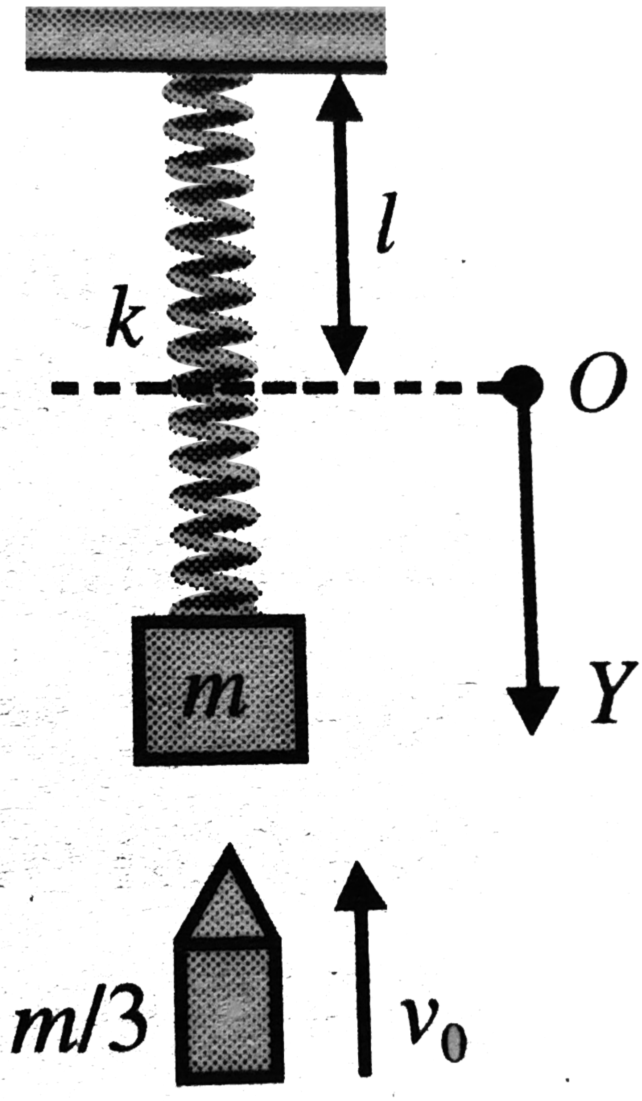

13.

A block of mass m is suspended from one end of a light spring as shown. The origin O is considered

at distance equal to natural length of the spring from the ceiling and vertical downwards direction as positive y-axis. When the system is in equilibrium a bullet of mass $\frac{m}{3}$ moving in vertical up wards direction with velocity v_0 strikes the block and embeds into it. As a result, the block (with bullet embedded into it) moves up and start oscillating. Based on the given information, answer the following question:

Q. The amplitude of oscillation would be

A. (a) $\sqrt{\left(\frac{4mg}{3k}\right)^2 + \frac{mv_0^2}{12k}}$

B. (b) $\sqrt{\frac{mv_0^2}{12k} + \left(\frac{mg}{3k}\right)^2}$

C. (c) $\sqrt{\frac{mv_0^2}{6k}+\left(\frac{mg}{k}\right)^2}$

D. (d) $\sqrt{\frac{mv_0^2}{6k}+\left(\frac{4mg}{3k}\right)^2}$

Answer: B

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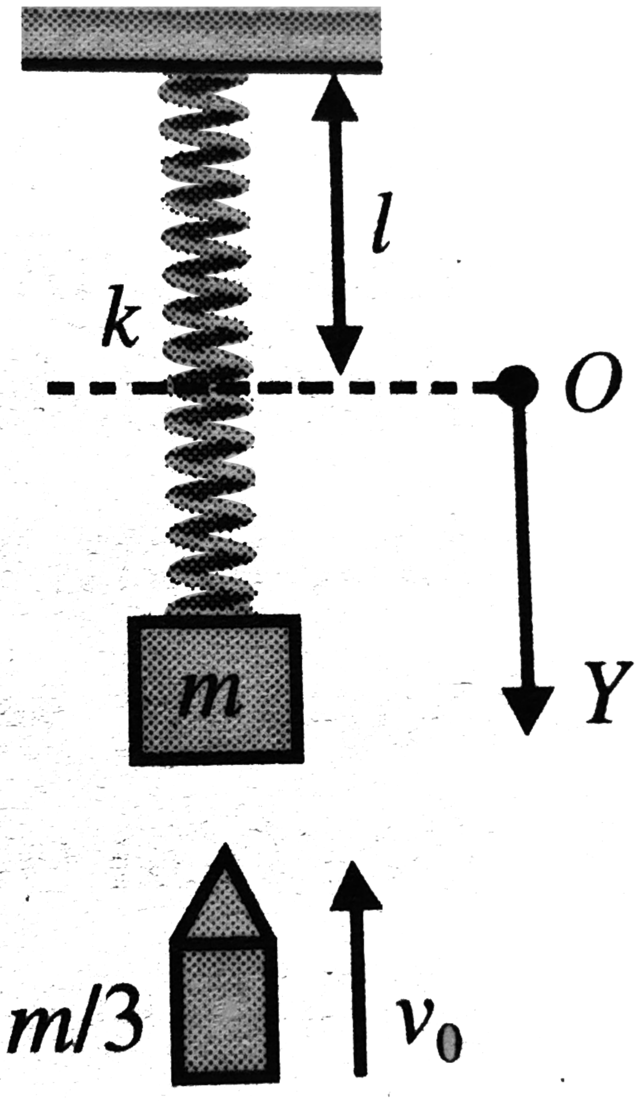

14.

A block of mass m is suspended from one end of a light spring as shown. The origin O is considered

at distance equal to natural length of the spring from the ceiling and vertical downwards direction as positive y-axis. When the system is in equilibrium a bullet of mass $\frac{m}{3}$ moving in vertical up wards direction with velocity v_0 strikes the block and embeds into it. As a result, the block (with bullet embedded into it) moves up and start oscillating. Based on the given information, answer the following question:

Q. The time taken by the block bullet system to move from $y = \frac{mg}{k}$ (initial equilibrium position) to $y = 0$ (natural length of spring) is (A represents the amplitude of motion)

A. $\sqrt{\frac{4m}{3k}}\left[\cos^{-1}\left(\frac{mg}{3kA}\right)-\cos^{-1}\left(\frac{4mg}{3kA}\right)\right]$

B. $\sqrt{\frac{3k}{4m}}\left[\cos^{-1}\left(\frac{mg}{3kA}\right)-\cos^{-1}\left(\frac{4mg}{3kA}\right)\right]$

C. $\sqrt{\frac{4m}{6k}}\left[\sin^{-1}\left(\frac{4mg}{3kA}\right)-\sin^{-1}\left(\frac{mg}{3kA}\right)\right]$

D. none of these

Answer: A

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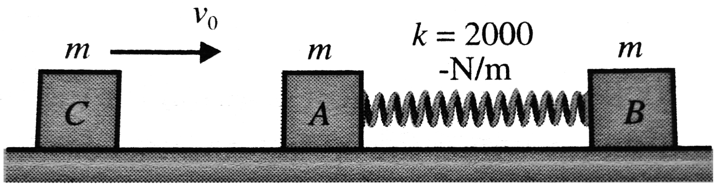

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15.

Two identical blocks A and B, each of mass $m = 3kg$, are connected with the help of an ideal spring and placed on a smooth horizontal surface as shown in Fig. Another identical blocks C moving velocity $v_0 = 0.6\frac{m}{s}$ collides with A and sticks to it, as a result, the motion of system takes place in some way

Based on this information answer the following questions:

Q. After the collision of C and A, the combined body and block B would

Option1

oscillate about centre of mass of system and centre of mass is at rest.

Option2

oscillate about centre of mass of system and centre of mass is moving.

Option3

oscillate but about different location other than the centre of mass.

Option4

not oscillate.

A. oscillate about centre of mass of system and centre of mass is at rest.

B. oscillate about centre of mass of system and centre of mass is moving.

C. oscillate but about different location other than the centre of mass.

D. not oscillate.

Answer: B

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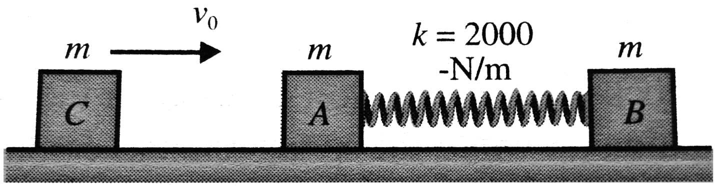

188

16.

Two identical blocks A and B, each of mass $m = 3kg$, are connected with the help of an ideal spring and placed on a smooth horizontal surface as shown in Fig. Another identical blocks C moving velocity $v_0 = 0.6\frac{m}{s}$ collides with A and sticks to it, as a result, the motion of system takes place in some way

Based on this information answer the following questions:

Q. Oscillation energy of the system i.e., part of the energy which is oscillation (changing) between potention and kinetic forms is

A. 0.27 J

B. 0.09 J

C. 0.18 J

D. 0.45 J

Answer: B

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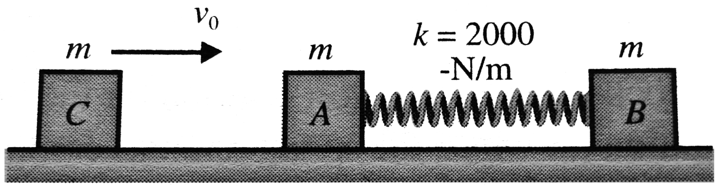

17.

Two identical blocks A and B, each of mass $m = 3kg$, are connected with the help of an ideal spring and placed on a smooth horizontal surface as shown in Fig. Another identical blocks C moving velocity $v_0 = 0.6\frac{m}{s}$ collides with A and sticks to it, as a result, the motion of system takes place in some way

Based on this information answer the following questions:

Q. The maximum compression of the spring is

A. $3\sqrt{30}\text{mm}$

B. $3\sqrt{20}\text{mm}$

C. $3\sqrt{10}mm$

D. $3\sqrt{50}\text{mm}$

Answer: C

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18.

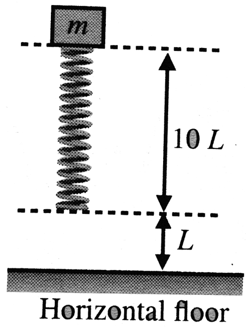

Fig. 4.189

A small block of mass m is fixed at upper end of a massive vertical spring of spring constant $k = \frac{2mg}{L}$ and natural length $10L$ The lower end of spring is free and is at a height L from fixed horizontal floor as shown. The spring is initially unstressed and the spring block system is released from rest in the shown position.

Q. At the instant the speed of block is maximum the magitude of force exeted by the spring on the block is

A. $\frac{mg}{2}$

B. mg

C. $zero$

D. none of these

Answer: B

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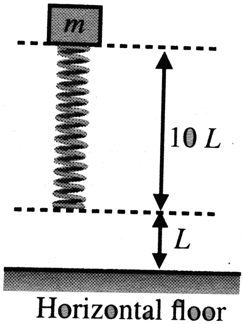

Fig. 4.189

19.

A small block of mass m is fixed at upper end of a massive vertical spring of spring constant $k = \frac{2mg}{L}$ and natural length $10L$ The lower end of spring is free and is at a height L from fixed horizontal floor as shown. The spring is initially unstressed and the spring block system is released from rest in the shown position.

Q. As the block is coming down, the maximum speed attained by the block is

A. $\sqrt{gL}$

B. $\sqrt{3gL}$

C. $\frac{3}{2}\sqrt{gL}$

D. $\sqrt{\frac{3}{2}gL}$

Answer: C

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20.

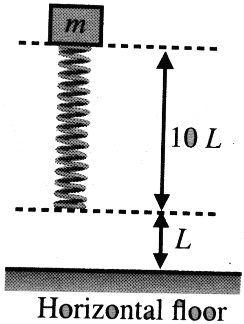

Fig. 4.189

A small block of mass m is fixed at upper end of a massive vertical spring of spring constant $k = \frac{2mg}{L}$ and natural length $10L$ The lower end of spring is free and is at a height L from fixed horizontal floor as shown. The spring is initially unstressed and the spring block system is released from rest in the shown position.

Q. Till the blocks reaches its lowest position for the first time, the time duration for which the spring remains compressed is

A. (a)$\pi\sqrt{\frac{L}{2g}}+\sqrt{\frac{L}{4g}}\frac{\sin^{-1}(1)}{3}$

B. (b)$\frac{\pi}{4}\sqrt{\frac{L}{g}}+\sqrt{\frac{L}{4g}}\frac{\sin^{-1}(1)}{3}$

C. (c)$\pi\sqrt{\frac{L}{2g}}+\sqrt{\frac{L}{4g}}\frac{\sin^{-1}(2)}{3}$

D. (d)$\frac{\pi}{2}\sqrt{\frac{L}{2g}}+\sqrt{\frac{L}{4g}}\frac{\sin^{-1}(2)}{3}$

Answer: B

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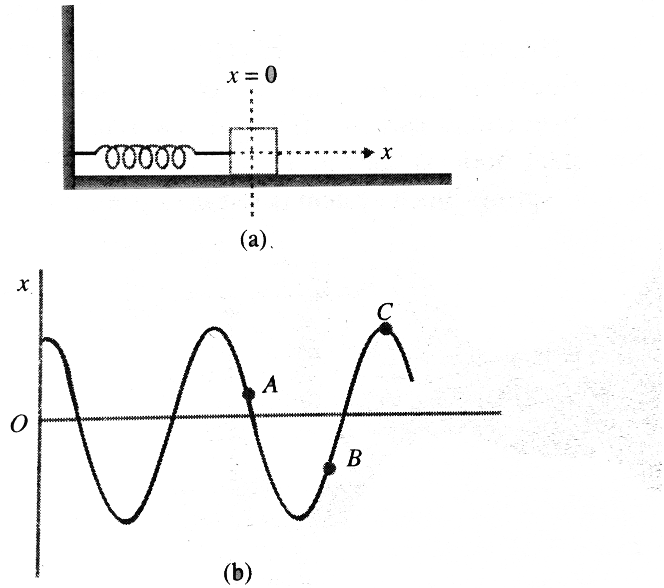
21.



A 100 g block is connected to a horizontal massless spring of force constant $25.6\frac{N}{m}$ As shown in Fig. the block is free to oscillate on a horizontal frictionless surface. The block is displaced 3 cm from the equilibrium position and , at $t=0$, it is released from rest at $x=0$ It executes simple harmonic motion with the postive

$x - direction \in decated \in Fig. Thepositiontime$

(x-t)` graph of motion of the block is as shown in

Fig.

Q. When the block is at position A on the graph, its

A. position and velocity both are negative

B. position is positive and velocity is negative

C. position is negative and velocity is positive

D. position and velocity both the positive

Answer: B

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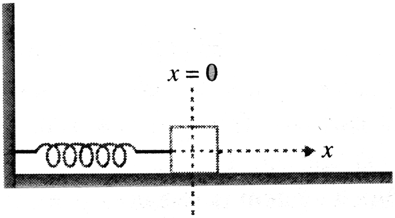
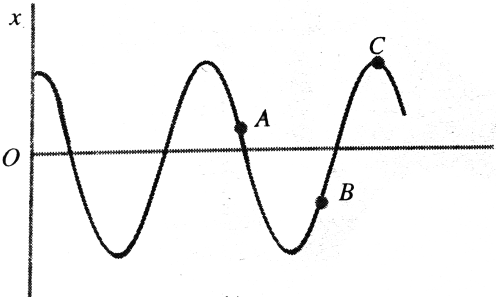


(a)



(b)

22.

A 100 g block is connected to a horizontal massless spring of force constant $25.6\frac{N}{m}$ As shown in Fig. the block is free to oscillate on a horizontal frictionless surface. The block is displaced 3 cm from the equilibrium position and , at $t = 0$, it is released from rest at $x = 0$ It executes simple harmonic motion with the postive x-direction indecated in Fig. The position time $(x - t)$ graph of motion of the block is as shown in Fig.

Q. When the block is at position B on the graph its.

A. position and velocity both are positive.

B. position is positive and velocity is negative

C. position is negative and velocity is positive

D. osition and velocity are negative.

Answer: C

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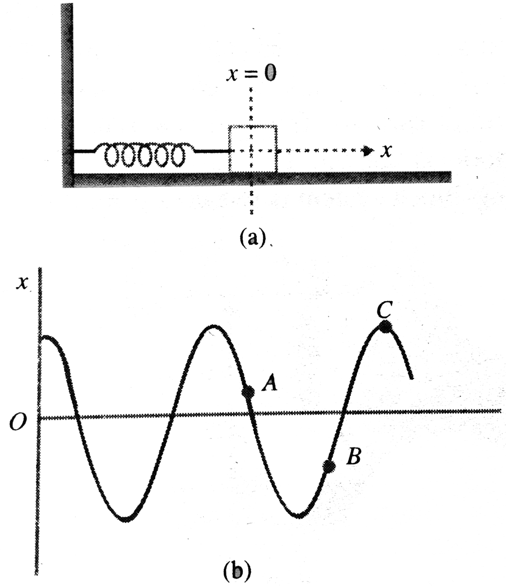

23.

A 100 g block is connected to a horizontal massless spring of force constant $25.6\frac{N}{m}$ As shown in Fig. the block is free to oscillate on a horizontal frictionless surface. The block is displaced 3 cm from the equilibrium position and , at $t = 0$, it is released from rest at $x = 0$ It executes simple harmonic motion with the postive x-direction indecated in Fig. The position time $(x - t)$ graph of motion of the block is as shown in Fig.

When the block is at position C on the graph, its

A. velocity is maximum and acceleration is zero

B. velocity is minimum and acceleration is zero

C. velocity is zero and acceleration is negative

D. velocity is zero and acceleration is positive.

Answer: C

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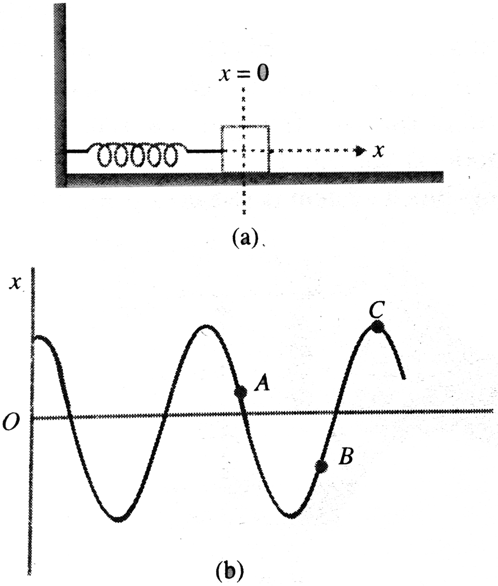

24.

A 100 g block is connected to a horizontal massless spring of force constant $25.6\frac{N}{m}$ As shown in Fig. the block is free to oscillate on a horizontal frictionless surface. The block is displaced 3 cm from the equilibrium position and , at $t=0$, it is released from rest at $x=0$ It executes simple harmonic motion with the postive x-direction indecated in Fig. The position time $(x-t)$ graph of motion of the block is as shown in Fig.

Position of the block as a function of time can now be expressed as

A. $x=3\cos\left(16t+\frac{\pi}{2}\right)cm$

B. $x=3\cos\left(16t+\frac{\pi}{3}\right)cm$

C. $x=3.5\cos\left(16t+\frac{\pi}{6}\right)cm$

D. $x=3.2\cos\left(16t+\frac{\pi}{4}\right)cm$

Answer: C

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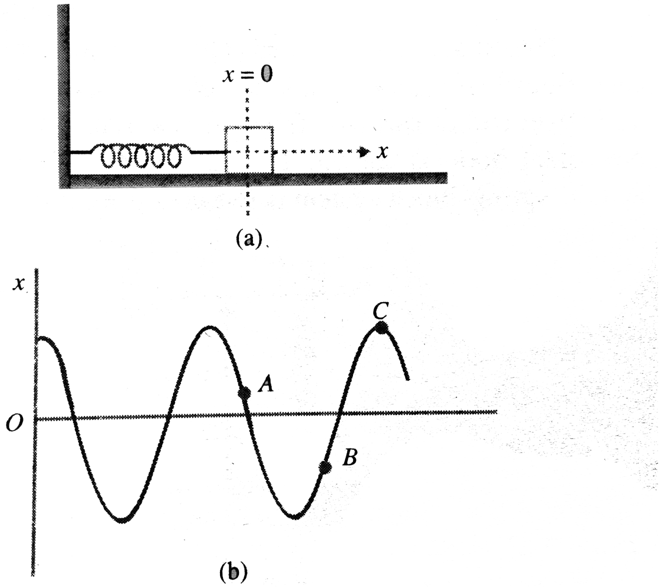
25.



A 100 g block is connected to a horizontal massless spring of force constant $25.6 \frac{N}{m}$ As shown in Fig. the block is free to oscillate on a horizontal frictionless surface. The block is displaced 3 cm from the equilibrium position and , at $t = 0$, it is released from rest at $x = 0$ It executes simple harmonic motion with the postive x-direction indecated in Fig. The position time $(x - t)$ graph of motion of the block is as shown in Fig.

Velocity of the block as a function of time can be expressed as

A. $v = -\sin 48\left(16t\frac{\pi}{2}\right)\frac{cm}{s}$

B. $v = -48\sin\left(16t\frac{\pi}{3}\right)\frac{cm}{s}$

C. $v = -56\sin\left(16t\frac{\pi}{4}\right)\frac{cm}{s}$

D. $v = -56\left(16t\frac{\pi}{6}\right)\frac{cm}{s}$

Answer: D

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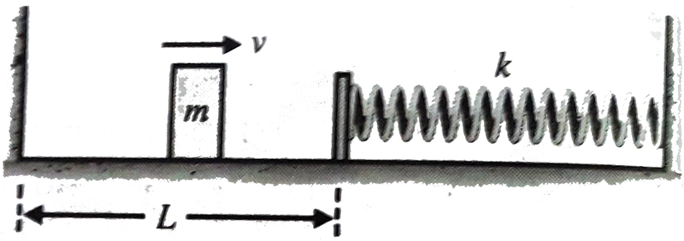
26. 

A spring having a spring constant k is fixed to a vertical wall as shown in Fig. A block of mass m moves with velocity v torards the spring from a parallel wall opposite to this wall. The mass hits the free end of the spring compressing it and is decelerated by the spring force and comes to rest and then turns the spring is decelerated by the spring force and comes to rest and then turns back till the spring acquires its natural length and contact with the spring is broken. In this process, it regains its angular speed in the opposite direction and makes a perfect elastice collision on the opposite left wall and starts moving with same speed as before towards right. The above processes are repeated and there is periodic oscillation.

Q. What is the maximum compression produced in the spring?

A. (a)$v\sqrt{\frac{m}{k}}$

B. (b)$\sqrt{\frac{m}{k}}$

C. (c)$v\sqrt{mk}$

D. (d)$v\sqrt{\frac{k}{m}}$

Answer: A

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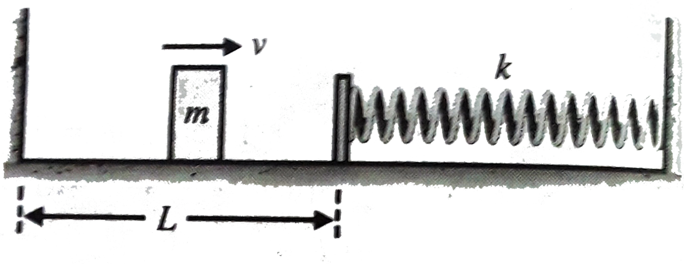
27. 

A spring having a spring constant k is fixed to a vertical wall as shown in Fig. A block of mass m moves with velocity v torards the spring from a parallel wall opposite to this wall. The mass hits the free end of the spring compressing it and is decelerated by the spring force and comes to rest and then turns the spring is decelerated by the spring force and comes to rest and then turns back till the spring acquires its natural length and contact with the spring is broken. In this process, it regains its angular speed in the opposite direction and makes a perfect elastice collision on the opposite left wall and starts moving with same speed as before towards right. The above processes are repeated and there is periodic oscillation.

Q. What is the time period of oscillation ?

A. (a)$\pi\sqrt{\frac{m}{k}}$

B. (b)$\sqrt{\frac{\pi m}{k}+\frac{L}{m}}$

C. (c)$\pi\sqrt{\frac{m}{k}+\frac{2L}{v}}$

D. (d)$\pi\sqrt{\frac{m}{k}+\frac{L}{v}}$

Answer: C

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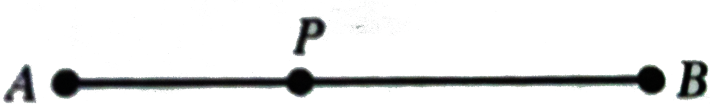
28. 

A and B are two fixed points at ta distance $3l$ apart. A particle of mass m placed at a point P

experiences the force $2\left(\frac{mg}{l}\right)\overrightarrow{P}A$ and the force $\left(\frac{mg}{l}\right)\overrightarrow{P}B$ sumultaneously. Initially at $t=0$, the particle is projected from A towards B with speed $3\sqrt{gl}$.

Q. Tha particle moves simple harmonically with period T and amplitude A.

A. $A=2l, T=2\pi\sqrt{\frac{l}{g}}$

B. $A=3l, T=2\pi\sqrt{\frac{l}{2g}}$

C. $A=2l, T=2\pi\sqrt{\frac{l}{3g}}$

D. $A=l, T=2\pi\sqrt{\frac{l}{g}}$.

Answer: C

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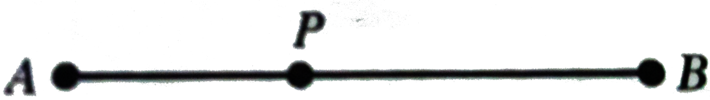
29. 

A and B are two fixed points at ta distance $3l$ apart. A particle of mass m placed at a point P experiences the force $2\left(\frac{mg}{l}\right)\overrightarrow{P}A$ and the force $\left(\frac{mg}{l}\right)\overrightarrow{P}B$ simultaneously. Initially at $t=0$, the particle is projected from A towards B with speed $3\sqrt{gl}$.

Q. The particle moves simple harmonically with period T and amplitude A.

A. $t = \frac{T}{2}$

B. $t = \frac{T}{3}$

C. $t = \frac{T}{4}$

D. $t = \frac{2T}{3}$

Answer: B

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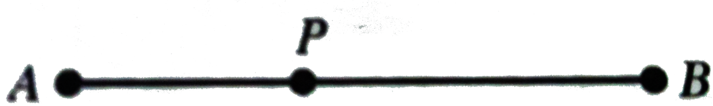
30. 

A and B are two fixed points at ta distance $3l$ apart. A particle of mass m placed at a point P

experiences the force $2\left(\frac{mg}{l}\right)\overrightarrow{P}A$ and the force $\left(\frac{mg}{l}\right)\overrightarrow{P}B$ simultaneously. Initially at $t=0$, the particle is projected from A towards B with speed $3\sqrt{gl}$.

Q. The particle moves simple harmonically with period T and amplitude A.

A. zero

B. $3\sqrt{gl}$

C. $2\sqrt{gl}$

D. $\sqrt{gl}$

Answer: A

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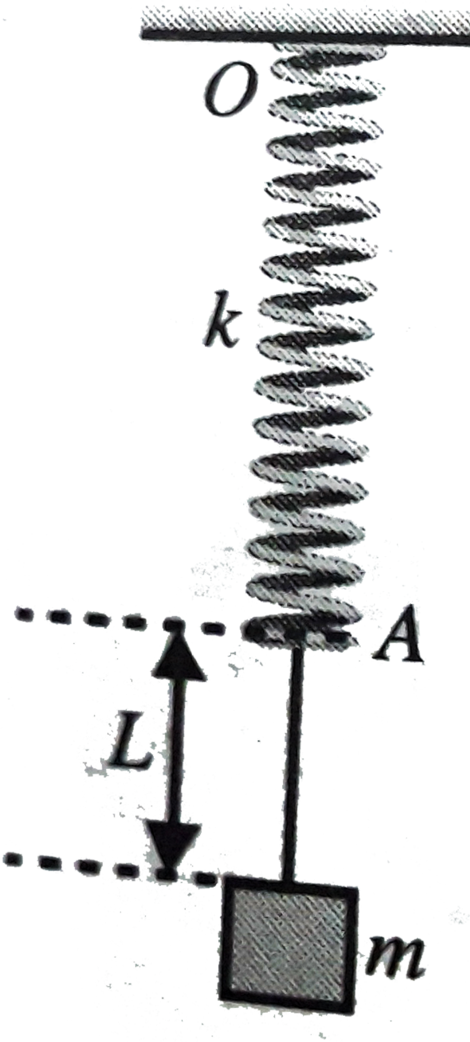

31.

A body of mass m is attached by an inelastic string to a suspended spring of spring constant k. Both the string and the spring have negligible mass and the string is inextensible and of length L. Initially, the mass m is at rest.

Q. If the mass m is now raised up to point A (the top end of the string see fig. and allowed to fall from rest, the maximum extension of the spring in the subsequent motion will be

A. L

B. $\frac{mg}{k}$

C. $\frac{mg}{k}\sqrt{1+\frac{2kL}{mg}}$

D. $\frac{mg}{k}\left[1+\sqrt{1+\frac{2kL}{mg}}\right]$

Answer: D

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32. A body of mass m is attached by an inelastic string to a suspended spring of spring constant k. Both the string and the spring have negligible mass and the string is inextensible and of length L. Initially, the mass m is at rest.

If the mass m, from the initial position of rest is pulled down a distance A and then released, assuming that the string remains taut throughout the motion, the maximum (downwards) acceleration of the oscillating body will be

A. $\frac{kA}{m}$

B. $\frac{kA}{2m}$

C. $\frac{g}{2}$

D. g

Answer: A

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33. A body of mass m is attached by an inelastic string to a suspended spring of spring constant k. Both the string and the spring have negligible mass and the string is inextensible and of length L. Initially, the mass m is at rest.

The largest amplitude A_{max}, for which the string will remain taut throughout the motion is

A. $\frac{mg}{2k}$

B. $\frac{mg}{k}$

C. $\frac{2mg}{3k}$

D. L

Answer: B

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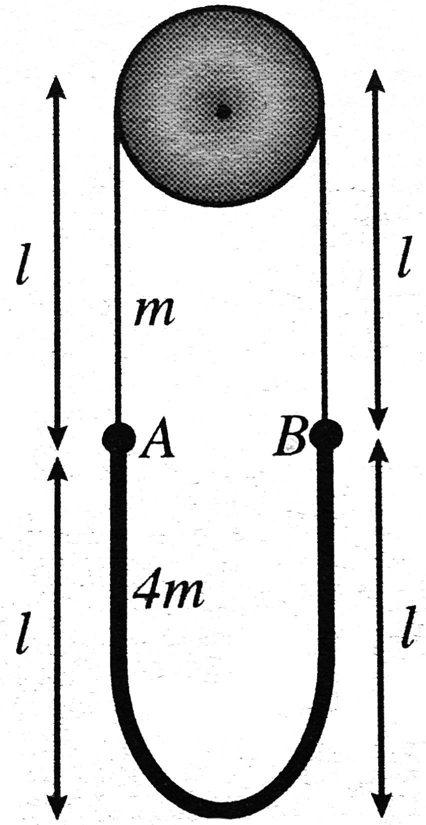
Integer



1.

Two uniform ropes having linear mass densities m and $4m$ are joined to form a closed loop. The loop is hanging over a fixed frictionless small pulley with the lighter rope above as shown in the fig. (in the figure equilibrium position is shown). Now if point A (joint) is slightly displaced in downward direction and released, it is found that the loop performs SHM with the period of oscillation equal to N. Find the value of N (take $l = \frac{150m}{4\pi^2}$, $g = 10\frac{m}{s^2}$).

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2. In the figure shown, mass $2m$ connected with a spring of force constant k is at rest and in equilibrium. A particle of mass m is released from height $4.5mg/k$ from $2m$. The particle stick to the block. Neglecting the duration of collision find time from the release of m to the moment when the spring has maximum compression.

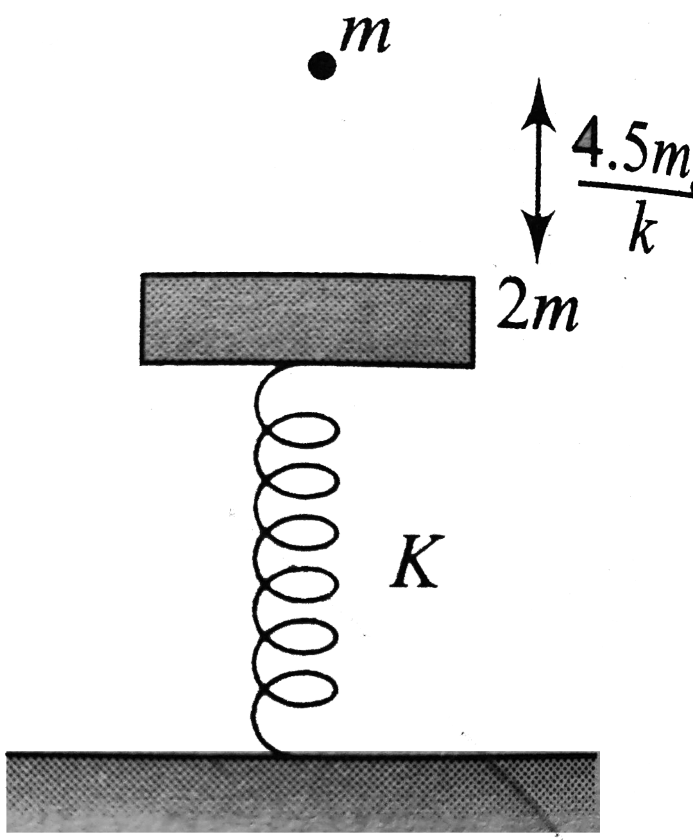

Fig. 4.141

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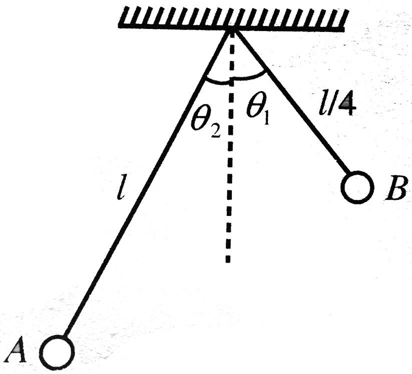
3.



Two simple pendulums A and B having lengths l and $\frac{l}{4}$ respectively are released from the position as shown in Fig. Calculate the time (in seconds) after which the two strings become parallel for the first time. (Take $l = \frac{90}{\pi^2}$m and $g = 10\frac{m}{s^2}$.

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alue of λ.

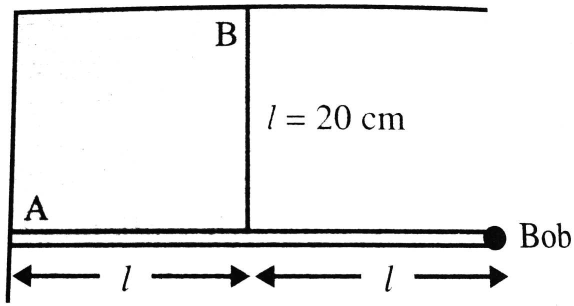

Fig. 4.207

4.

A weightless rigid rod with a small iron bob at the end is hinged at point A to the wall so that it can rotate in all directions. The rod is kept in the horizontal position by a vertical inextensible string of length $20 cm$, fixed at its midpoint. The bob is displaced slightly perpenducular to the plane of the rod and string. Find period of small oscillations of the system in the form $\frac{\pi X}{10} s$ and fill the value of X.

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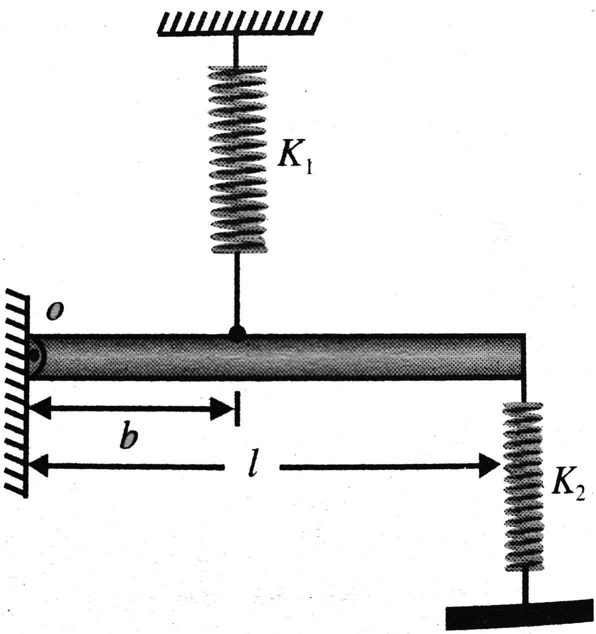
5. 

A rod of mass m and length l hinged at one end is connected by two springs of spring constant k_1

and k_2 so that it is horizontal at equilibrium What is the angular frequency of the system? (in $\frac{rad}{s}$)

(Take $l = 1m$,$b = \frac{1}{4}m$,$K_1 = 16\frac{N}{m}$,$K_2 = 61\frac{N}{m}$.

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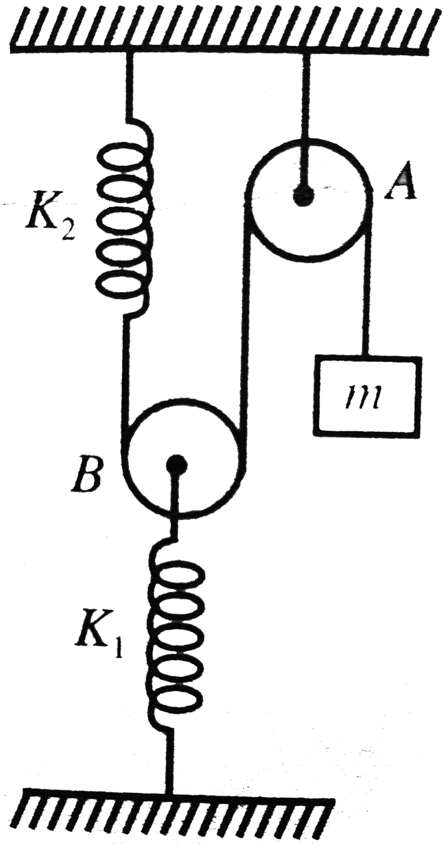
6.



A block of mass m is tied to one end of a spring which passes over a smooth fixed pulley A and under a light smooth movable pulley B. The other end of the string is attached to the lower end of a spring of spring constant K_2. Find the period of small oscillation of mass m about its equilibrium position (in second). (Take $m = \pi^2 kg, K_2 k = 4K_1$, $K_1 = 17\frac{N}{m}$.)

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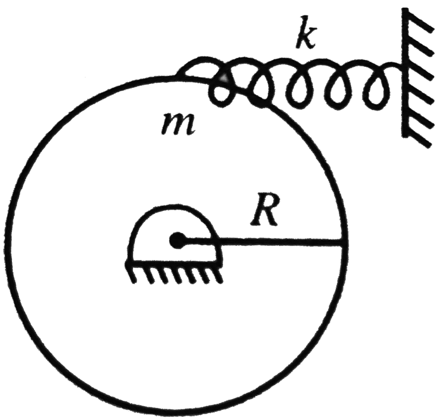

7.

A uniform disc of mass m and radius R is pivoted smoothly at its centre of mass. A light spring of stiffness k is attached with the dics tangentially as shown in the Fig. Find the angular frequency in $\frac{rad}{s}$ of torsional oscillation of the disc. (Take $m = 5kg$ and $K = 10\frac{N}{m}$.)

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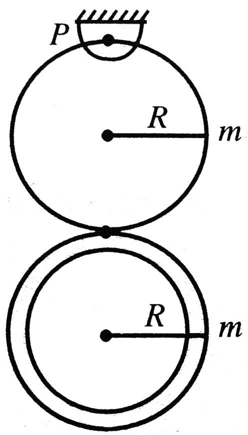

8.

A uniform dics of mass m and radius $R = \frac{80}{23\pi^2}$ m is pivoted smoothly at P. If a uniform disc of mass m and radius R is welded at the lowest point of the disc, find the period of SHM of the system (disc $+$ ring). (in seconds)

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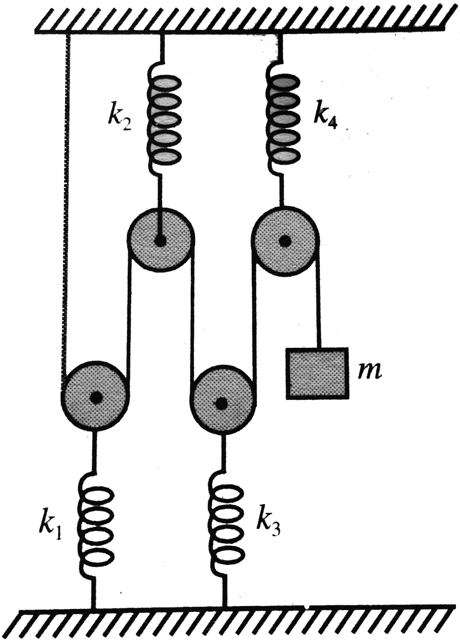

9.

In the arrangement shown if Fig. Pulleys are small and lught and spring are ideal and $K_1 = 25(\pi^2)\frac{N}{m}$, $K_2 = 2K_1$,$K_3 =$ and $K_4 = 4K_1$ are the force constant of the spring. Calculate the period of small vertical oscillation of block of mass $m = 3kg$.

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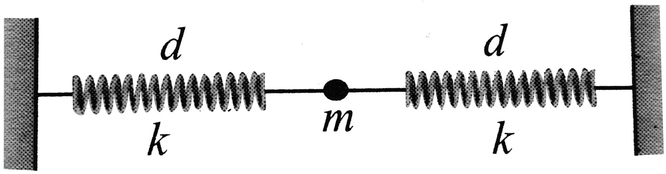
of the figure? Neglect effects of gravity.



10.

A small body of mass m is connected to two horizontal spring of elastic constant k, natural length $\frac{3d}{4}$. In the equilibrium position botgh springs are stretched to length d, as shown in Fig. What will be the ratio of perod of the motion $\left(\frac{T_b}{T_a}\right)$ If the body is displaced horizontally by a small distance where T_a is the time period when the particle owscillates along the line of spring T_b is time plane of the figure? Neglect effect of gravity.

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Subjective type

1. Describe the motion of a particle acted upon by the force:

A. $F = 3x + 3$

B. $F = -3x - 3$

C. $F = -3x + 3$

D. $F = -3x - 3$

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

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2. The potential energy (U) of a body of unit mass moving in a one-dimension foroce field is given by $U = (x^2 - 4x + 3)$. All untis are in S.L

A. a. Find the equilibrium position of the body

B. b. Show that oscilliations of the body about this equilibrium positon in sample harmonic motion and find its time period

C. c. Find the amplitude of oscilliations if speed of the body at equilibrium position is $2\sqrt{6}m/s$

D. d. Find the amplitude of oscillators if speed of the body at equilibrium position is $2\sqrt{6}m/s.$

Answer: A::B::C

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Single correct Answer Type

1. A boby is moving in a room with a velocity of $20m/s$ perpendicular to the two walls separated by 5 meters .There is no friction and the collisionnn with the walls are elastic.

A. Not periodic

B. Periodic but not smple harmonic

C. Periodic and simple harmonic

D. Periodic with variable time period

Answer: B

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2. The equation of motion of a particle is $x = a \quad \cos(\alpha t)^2$. The motion is

A. periodic but not oscillatory

B. periodic and oscillatory

C. oscillatory but not periodic

D. neither periodic nor oscillatory

Answer: C

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3. As the expression in ivolving sine function , which of the following equations does not represent a simple harmonic motion ?

A. $y = a \sin \omega t$

B. $y = a \tan \omega t$

C. $y = a \cos \omega t$

D. $y = a \sin \omega t + b \cos \omega t$

Answer: D

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4. The displacement of a particle is repersented by the equation $y = \sin^3 \omega t$. The motion is

A. non-periodic

B. periodic but not simple harmonic

C. simple harmoic with period $2\pi / \omega$

D. simple harmoic with period π / ω

Answer: B

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5. The time taken by a particle performing SHM to pass from point A and B where it is velocities are same is 2s. After another 2 s it returns to B. The time period oscillation is (in seconds)

A. 2

B. 4

C. 6

D. 8

Answer: D

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6. A particle executing SHM of amplitude 4 cm and T=4 s . The time taken by it to move from positive extreme position to half the amplitude is

A. $1 \sec$

B. $1 / \sec$

C. $2 / 3 \sec$

D. $\sqrt{3 / 2} \sec$

Answer: C

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7. Two particles undergo SHM along parallel lines with the same time period (T) and equal amplitudes. At particular instant, one particle is at its extreme position while the other is at its mean position. The move in the same direction. They will cross each other after a further time.

A. $T/8$

B. $3T/8$

C. $T/6$

D. $4T/3$

Answer: B

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8. The maximum acceleration of a particle in SHM is made two times keeping the maximum speed to be constant. It is possible when

A. amplitude of oscillation is double while frequncey reamins constant

B. amplitude is doubled while frequency is halved

C. frequency is double while amplitude is halved

D. frequency is double while amplitude remains constant

Answer: C

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9. A particle executing SHM is described by the displacement function $x(t) = A\cos(\omega t + \phi)$, if the initial (t=0) position of the particle is 1 cm, its initial velocity is π cm s^{-1} and its angular frequency is πs^{-1}, then the amplitude of its motion is

A. 1 cm

B. $\sqrt{2}cm$

C. $2cm$

D. $2.5cm$

Answer: B

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10. A particle executes simple harmonic motion with an amplitude of 4 cm . At the mean position , the velocity of the particle is $10cms^{-1}$. The distance of the particle from the mean position when its speed becomes $5 cms^{-1}$ is

A. $\sqrt{3}$ cm

B. $\sqrt{5}$ cm

C. $2(\sqrt{3})$ cm

D. $2(\sqrt{5})$ cm

Answer: C

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11. A particle is executing SHM according to the equation x $= A\cos\omega t$. Average speed of the particle during the interval $0 \leftarrow t \leftarrow \frac{\pi}{6\omega}$

A. $\frac{\sqrt{3}A\omega}{2}$

B. $\frac{\sqrt{3}A\omega}{4}$

C. $\frac{3A\omega}{\pi}$

D. $\frac{3A\omega}{\pi}(2-\sqrt{3})$

Answer: D

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12. The total energy of the body executing S.H.M. is E. Then the kinetic energy when the displacement is half of the amplitude is

A. $\frac{E}{2}$

B. $\frac{E}{4}$

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

D. $\frac{\sqrt{3}}{4}E$

Answer: C

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13. A body is executing simple harmonic motion. At a displacement x (from its mean position) its potential energy is E_1 and at a displacement y its potential energy is E_2. The potential energy is E at displacement (x+y) . Then:

A. $\sqrt{E} = \sqrt{E}_1 - \sqrt{E}_2$

B. $\sqrt{E} = \sqrt{E}_1 + \sqrt{E}_2$

C. $E = E_1 + E_2$

D. $E = E_1 - E_2$

Answer: B

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14. 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).

A. 0.05

B. 0.06

C. 0.01

D. None of these

Answer: B

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15. A particle of mass (m) is executing oscillations about the origin on the (x) axis. Its potential energy is $V(x) = k|x|^3$ where (k) is a positive constant. If the amplitude of oscillation is a, then its time period (T) is.

A. (a)Propertional to $\frac{1}{\sqrt{a}}$

B. (b)Independent of a.

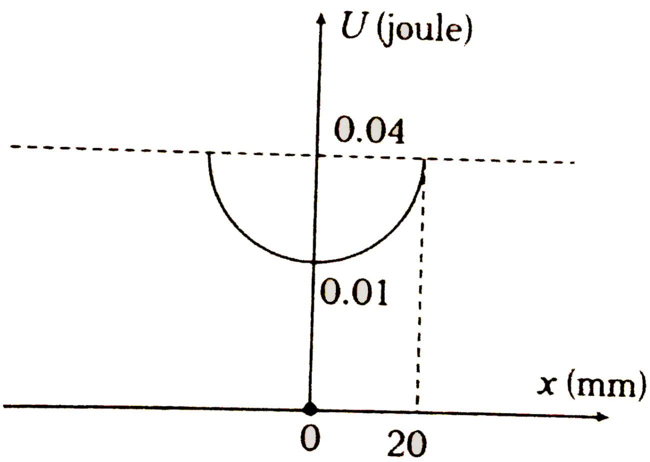
C. (c)Propertional to $\sqrt{a}$

D. (d)Propertional to $a^{3/2}$

Answer: A

Watch Video Solution

16. The variation of PEE of harmonic oscillator is as shown in figure. The spring constant is



A. $1 \times 10^2 N/m$

B. $150 N/m$

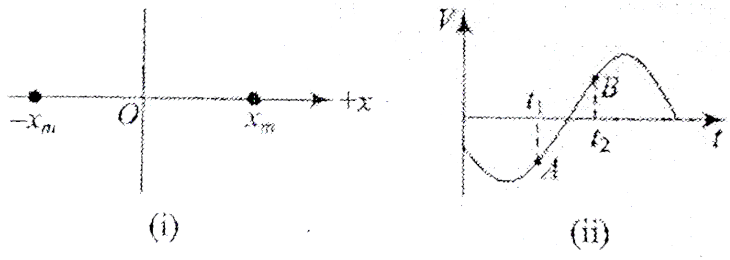
C. $0.667 \times 10^2 N/m$

D. $3 \times 10^2 N/m$

Answer: B

Watch Video Solution

17. A particle is executing SHM between points- X_m and X_m, as shown in figure(i). The velocity V(t) of the particle is partially graphed and shown in figure (ii). Two points A and B corresponding to time t_1 and time t_2 respectively are marked on the V(t) curve.



A. At time t_1, it ios going towards X_m.

B. At time t_1, its speed is decreasing

C. At time t_2, its position lies in between $-X_m$ and O

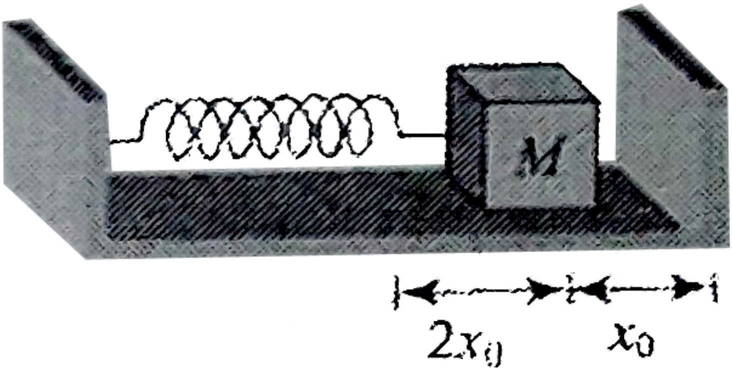
D. The phase difference $\Delta\phi$ between points A and B must be expressed as $90^\circ < \Delta\phi < 180^\circ$.

Answer: B::C

Watch Video Solution

18. One end of a spring of force constant k is fixed to a vertical wall and the other to a blcok of mass m resting on a smooth horizontal surface. There is another wall at distance x_0 from the block. The spring is then compressed by $2x_0$ and released.

The time taken to strike the wall is



A. $\frac{1}{6}\pi\sqrt{\frac{k}{m}}$

B. $\sqrt{\frac{k}{m}}$

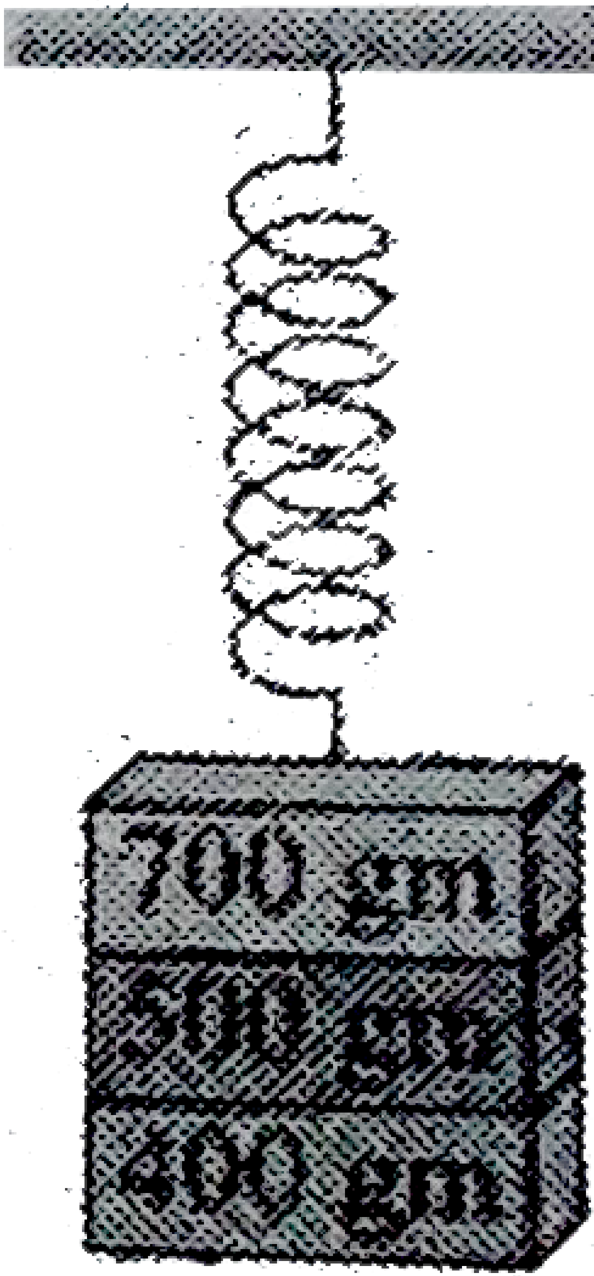
C. $\frac{2\pi}{3}\sqrt{\frac{k}{m}}$

D. $\frac{\pi}{4}\sqrt{\frac{k}{m}}$

Answer: C

Watch Video Solution

19. Three masses 700g, 500g, and 400 g are suspended at the end of a spring a shown and are in equilibrium. When the 700 g mass is removed, the system oscillacts with a period of 3 seconds, when the 500 gm mass is also removed, it will oscillate with a period of


700 gm
500 gm
400 gm

A. (a)1 s

B. (b)2 s

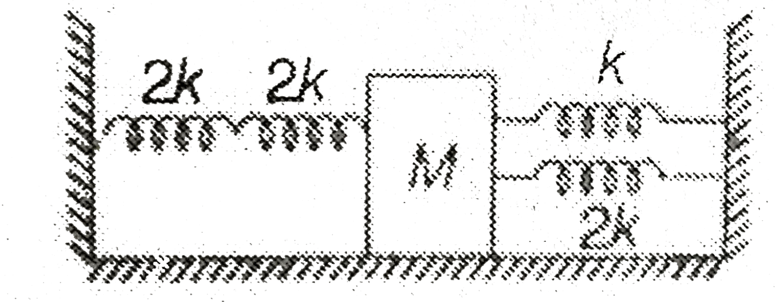
C. (c)3 s

D. (d)$\sqrt{\frac{12}{5}}s$

Answer: B

Watch Video Solution

20. Four massless springs whose force constants are 2k, 2k, k and 2k respectively are attached to a mass M kept on a frictionless plane (as shown in figure). If the mass M is displaced in the horizontal direction.



A. $\frac{1}{2\pi}\sqrt{\frac{k}{4M}}$

B. $\frac{1}{2\pi}\sqrt{\frac{4k}{M}}$

C. $\frac{1}{2\pi}\sqrt{\frac{k}{7M}}$

D. $\frac{1}{2\pi}\sqrt{\frac{7k}{M}}$

Answer: B

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21. A body at the end of a spring executes SHM with a period t_1, while the corresponding period for another spring is t_2, If the period of oscillation with the two spring in series is T, then

A. $T = t_1 + t_2$

B. $T^2 = t_1^2 + t_2^2$

C. $\frac{1}{T} = \frac{1}{t_1} + \frac{1}{t_2}$

D. $\frac{1}{T^2} = \frac{1}{t_1^2} + \frac{1}{t_2^2}$

Answer: B

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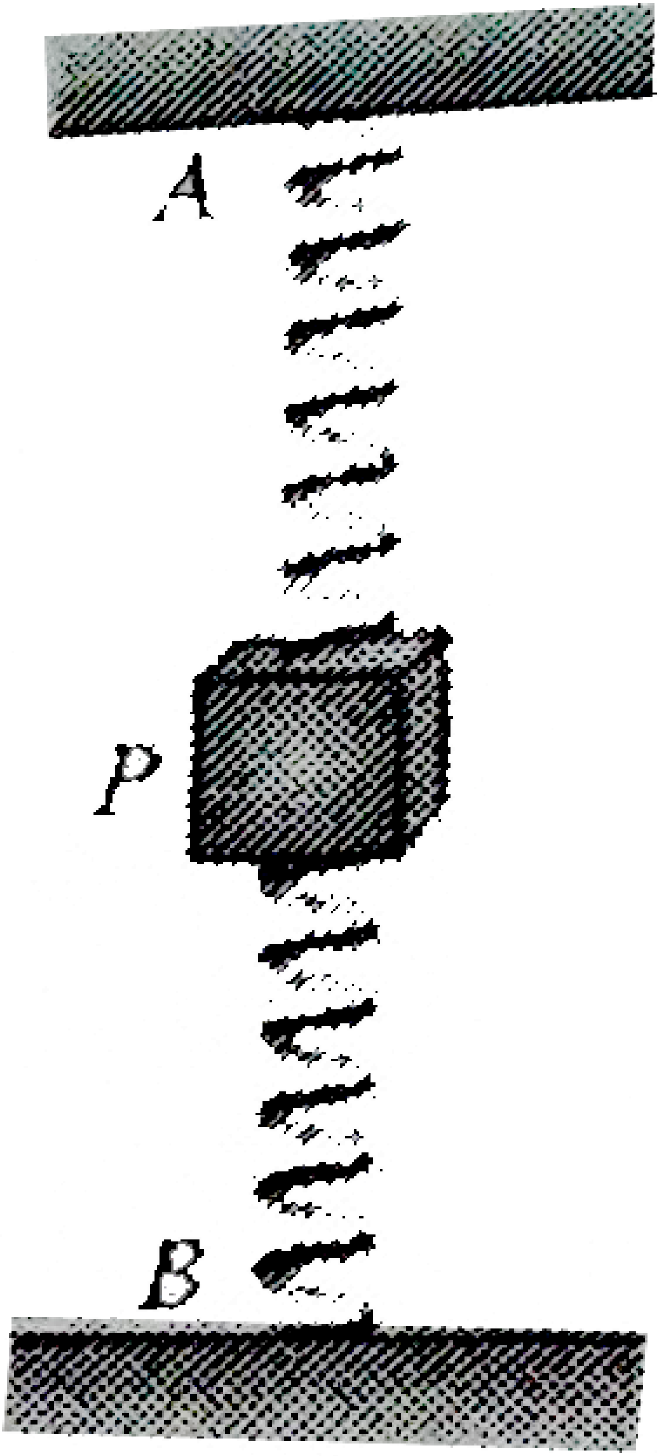
22. Two identical springs are attached to a small block P. The other ends of the springs are fixed at A and B, When P is in equilibrium the extension of bottom spring is 10 cm. The period of small vertical oscillations of P about is equilibrium position is $\left(useg = 9.8m/s^2\right)$


A
P
B

A. $\frac{2\pi}{7}\sec$

B. $\frac{\pi}{7}\sec$

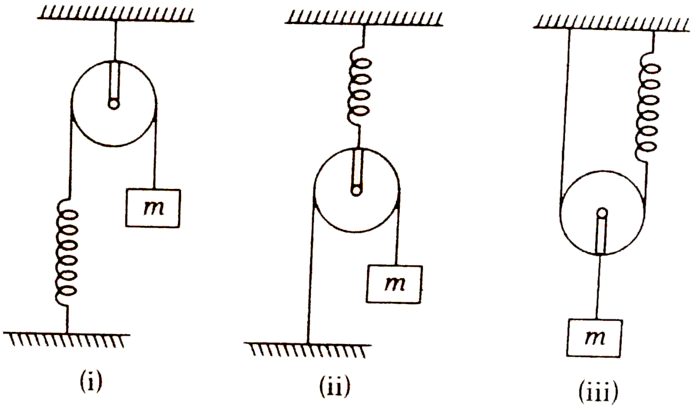
C. $\frac{2\pi}{5}\sec$

D. none of these

Answer: B

Watch Video Solution

23. In the following arrangements, block is slightly displaced vertically down from its equilibrium position and released. Find time period of vertical oscillations. Assume the pulley to be light.



A. $2\pi\sqrt{\frac{m}{K}}$

B. $\pi\sqrt{\frac{m}{4K}}$

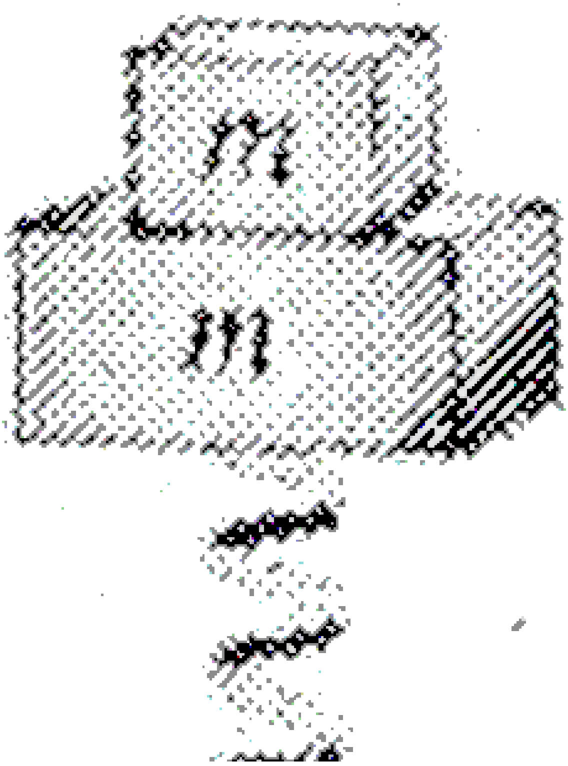
C. $\pi\sqrt{\frac{m}{K}}$

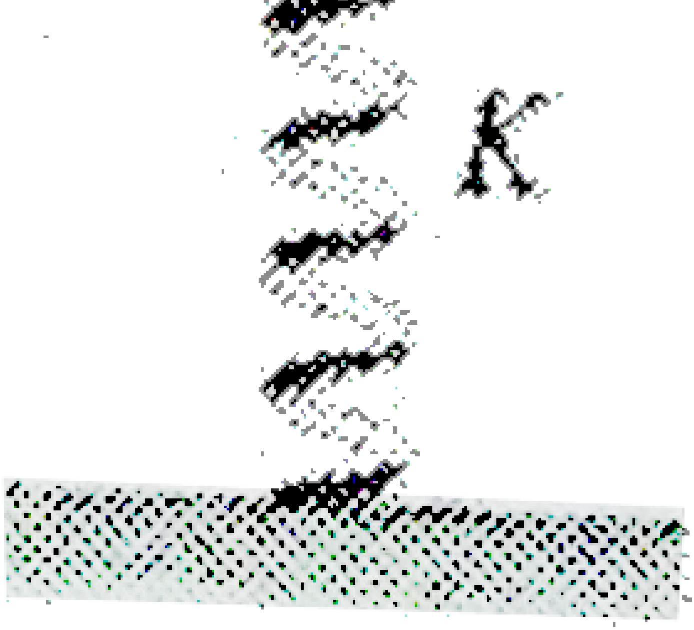
D. $4\pi\sqrt{\frac{m}{K}}$

Answer: D

Watch Video Solution

24. A block of mass m is at rest on the another blcok of same mass as shown in figure. Lower block is attached to the spring then the maximum amplitude of motion so that both the blcok will remain in contact is





A. $\dfrac{mg}{2k}$

B. $\dfrac{mg}{k}$

C. $\dfrac{2mg}{k}$

D. $\dfrac{3mg}{2k}$

Answer: C

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25. The displacement of a particle in simple harmonic motion in one time period is

A. Periodic but not S.H.M.

B. Non-periodic

C. Simple harmonic motion with period 0.1 s

D. Simple harmonic motion with period 0.2 s

Answer: C

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26. The displacement of a particle varies with time as $x = 12 \sin \omega t - 16 \sin^3 \omega t$ (in cm) it is motion is $S.H.M.$ then its maximum acceleration is

A. 12 ω^2

B. 36 ω^2

C. 144 ω^2

D. $\sqrt{192}\omega^2$

Answer: B

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27. A particle is acted simultaneously by matually perpendicular simple harmonic motion $x = a\cos\ \omega t$ and $y = a\sin\omega t$. The trajectory of motion of the particle will be

A. an ellipse

B. a parabola

C. a circle

D. a straight line

Answer: C

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28. A disc of radius R and mass M is pivoted at the rim and it set for small oscillations. If simple pendulum has to have the same period as that of the disc, the length of the simple pendulum should be

A. $\frac{5}{4}R$

B. $\frac{2}{3}R$

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

D. $\frac{3}{2}R$

Answer: D

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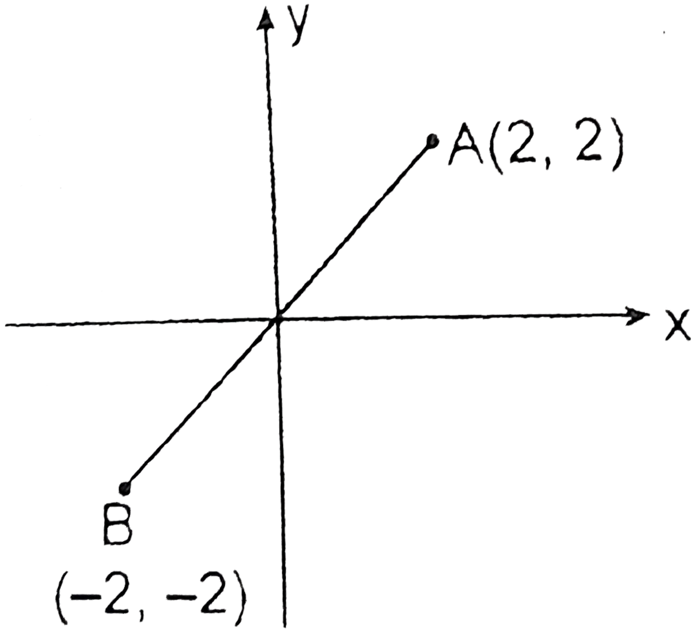
29. A particle of mass $m = 2kg$ executes SHM in xy- plane between point A and B under action of force $\overrightarrow{F} = F_x\hat{i} + F_y\hat{j}$. Minimum time taken by particle to move from A to B is 1 sec. At $t = 0$ the particle is at $x = 2$ and $y = 2$. Then F_x as function of time t is



A. $-4\pi^2 \sin \pi t$

B. $-4\pi^2 \cos \pi t$

C. $4\pi^2 \cos \pi t$

D. None of these

Answer: B

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Multiple Correct Answer Type

1. A particle is in linear simple harmonic motion between two points A and B, 10 cm apart (figure). Take the direction from A to B as the +ve direction. Which of the following statements is correct?

$AO = OB = 5$ cm
$BC = 8$ cm

A. The sign of velocity , acceleration and force on the particle when it is 3 cm away from A going towards B are positive

B. The sign of velocity of the particle at C given towards B is negative

C. The sign of velocity , accelecration and force on the particle when it sis 4 cm away from B going towards A are negative

D. The sign of acceleration and from ao nt particle when it si at ponts B is negative

Answer: A::C::D

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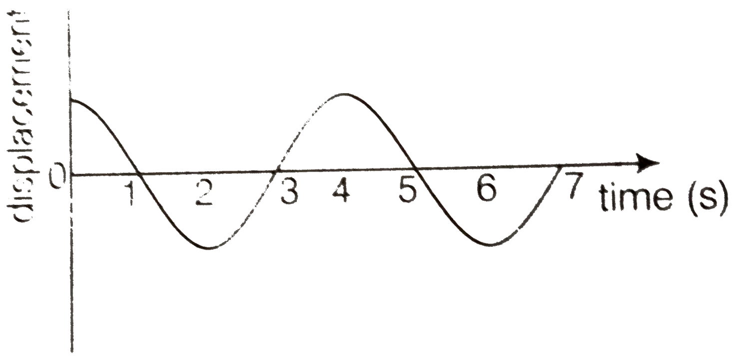
2. Displacement versus time curve for a particle executing SHM is shown in figure. Choose the correct statements.



A. Phases of the oscillator is same at $t = 0s$ and $t = 2s$

B. Phases of the oscillator is same at $t = 2s$ and $t = 6s$

C. Phases of the oscillator is same at $t = 1s$ and $t = 7s$

D. Phases of the oscillator is same at $t = 1s$ and $t = 5s$

Answer: B::D

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3. Which of the following statements is/are true for a simple harmonic oscillator ?

A. Force acting is directly proportional to displacement from the mean position and oppposite to it

B. motion is periodic

C. Acceleration of the oscillator is constant

D. the velocity is periodic

Answer: A::B::D

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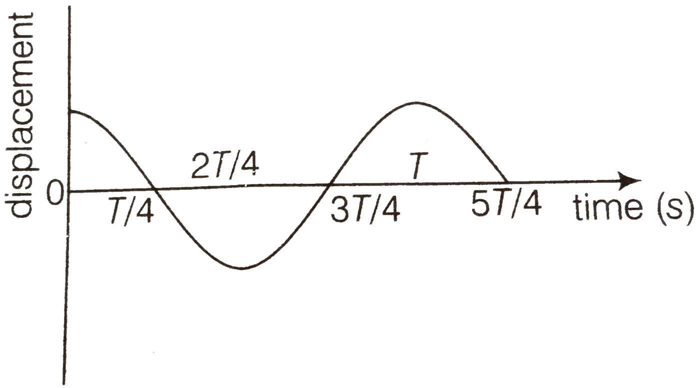
4. The displacement-time graph of a particle executing SHM is shown in figure. Which of the following statement is/are true ?



A. The force is zero at $t = \frac{3T}{4}$

B. The acceleration is maximum at $t = \frac{4T}{4}$

C. The velocity is maximum at $t = \frac{T}{4}$

D. The PE is equal to KE of oscillation at $t = \frac{T}{2}$

Answer: A::B::C

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5. A linear harmonic oscillator of force constant $2 \times 10^6 Nm^{-1}$ and amplitude 0.01 m has a total mechanical energy of 160 J. Its

A. Maximum P.E is 100 J.

B. Maximum K.E is 100J

C. Maximum P.E is 160 J

D. Minimum P.E is zero

Answer: B::C

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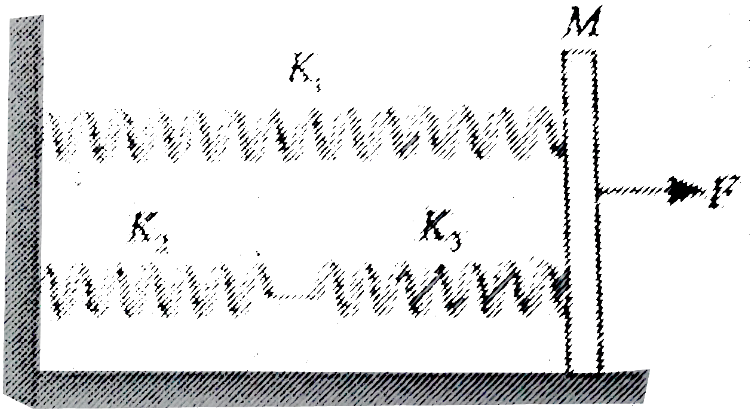
Multiple Correct Answer Type

1. The springs shown in the figure are all upstretched in the beginning when a man starts pulling the block. The man exerts a constant force

F on the block.



A. (a)the amplitude of oscillation is

$$\frac{(K_2 + K_3)F}{K_1K_2 + K_2K_3 + K_3K_1}$$

B. (b)the oscillation frequency is

$$\frac{1}{2\pi}\left[\frac{K_1K_2 + K_2K_3 + K_3K_1}{M(K_2 + K_3)}\right]^{1/2}$$

C. (c)the amplitude of oscillation is

$$\frac{2(K_2 + K_3)F}{K_1K_2 + K_2K_3 + K_3K_1}$$

D. (d)the oscillation frequency is $\frac{1}{\pi}\left[\frac{K_1K_2+K_2K_3+K_3K_1}{M(K_2+K_3)}\right]^{1/2}$

Answer: A::B

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2. A spring has natural length $40cm$ and spring constant $500N/m$. A block of mass $1kg$ is attached at one end of the spring and other end of the spring is attached to a ceiling. The block is relesed from the position, where the spring has length $45cm$.

A. the block will perform SHM of amplitude 5 cm.

B. the block will have maximum velocity $30\sqrt{5}.\ cm / \sec.$

C. the block will have maximum acceleration 15 $m / s^2,$

D. the minimum potential energy of the spring will be zero.

Answer: B::C::D

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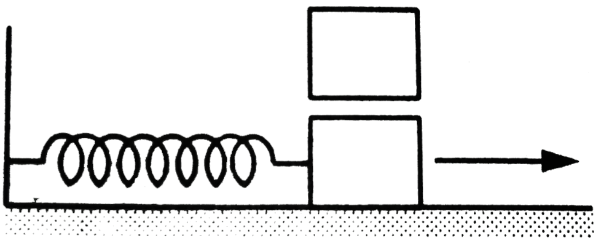
3. A 1kg block is executing simple harmonic motion of amplitude 0.1 m on a smooth horizontal surface under the restoring force of a spring constant $100Nm^{-1}$. A block of mass 3 kg is gently placed on it at the instant it passes through the mean position. Assuming that the two blocks move together, find the frequency and the amplitude of the motion.



A. amplitude of the motion is 5 cm

B. the oscillation frequency is $\frac{5}{2\pi}Hz$

C. amplitude of the motion is 10 cm

D. the oscillation frequency is $\frac{5}{\pi}Hz$

Answer: A::B

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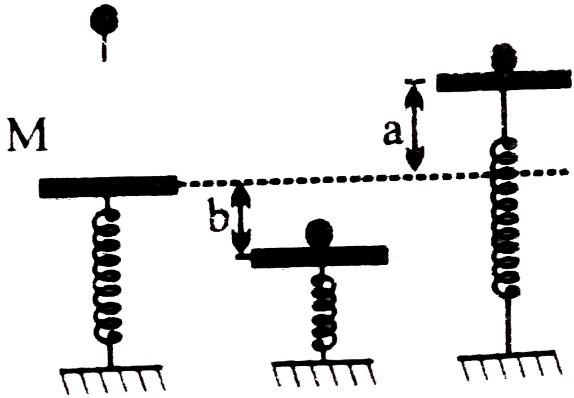
4. A mass M is in static equilibrium on a massless vertical spring as shown in the figure. A ball of mass m dropped from certain height sticks to the mass M after colliding with it.

The oscillations they perform reach to height'a' above the original level of scales & depth $'b'$

below it.



(a) Find the constant of force of the spring.,

(b) Find the oscillation frequency.

(c) What is the height above the initial level from

which the mass m was dropped?

A. the force constant of the spring is $\dfrac{2mg}{b-a}$

B. the oscillation frequency is $\frac{1}{2\pi}\sqrt{\frac{2mg}{(b-a)(M+m)}}$

C. the force constant of the spring is $\frac{mg}{b-a}$

D. the oscillation frequency is $\frac{1}{2\pi}\sqrt{\frac{mg}{(b-a)(M+m)}}$

Answer: A::B

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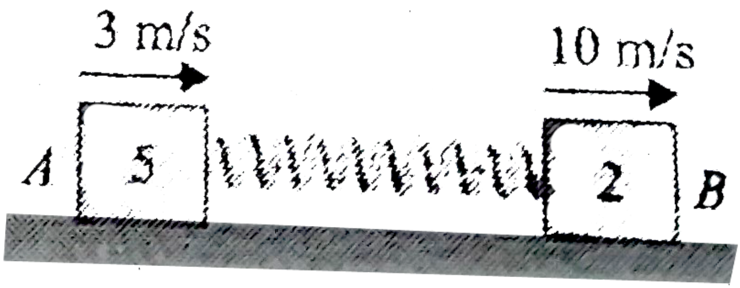
5. Two blocks A (5kg) and B (2kg) attached to the ends of a spring constant 1120 N/m are placed on a smooth horizontal plane with the spring unreformed. Simulataneously velocities of 3 m/s and 10 m/s along the line of the spring in the same direction are imparted to A and B then



A. the maximum extension of the spring is 0.25 m

B. the first maximum compression occurs after start at $\frac{3\pi}{56}s$

C. the maximum extension of the spring is 0.50 m

D. Time period of oscillation is $\frac{\pi}{14}s$

Answer: B::D

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6. The diplacement of a particle varies with time according to the relation $y = a\sin\omega t + b \ \cos\omega t$.

A. The motion is SHM

B. The motion is SHM with amplitude a+b

C. The motion is SHM with amplitude $a^2 + b^2$

D. The motion is SHM with amplitude $\sqrt{a^2 + b^2}$

Answer: A::D

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7. 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 first is 90°.

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

D. the resulting motion is not simple harmonic.

Answer: A::C

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8. Funcation

$x = A\sin^2\omega t + B\cos^2\omega t + C\sin\omega t\cos\omega t$

Represents SHM.

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

B. If A=B,C=2B and amplitude= $\left|B\sqrt{2}\right|$

C. If A=B,C=0

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

Answer: B::D

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9. The x-coordinate of a particle moving on x-axis is given by $x = 3\sin 100t + 8\cos^2 50t$, where x is in cm and t is time in seconds. Which of the following is/are correct about this motion

A. the motion of the particle is not S.H.M.

B. the amplitude of the S.H.M. of the particle is 5 units

C. the amplitude of the resultant S.H.M. is $\sqrt{73}$ units

D. the maximum displacement of the particle from the origin is 9 units.

Answer: B::D

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Subjective type

1. Consider a pair of identical pendulums, which oscillate with equal amplitude independently such that when one pendulum is at its extreme position making an angle of 2° to the right with the vertical, the other pendulum makes an angle of 1° to the left of the vertical. What is the left of the vertical. What is the phase difference between the pendulums?

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2. A uniform square plate at side a is hinged at one at its comes it is suspended such than it can rotate about horizontal axis. The time period of small oscillation about its equilibrium position.

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3. A particle of mass 'm' is moving in the x-y plane such that its x and y coordinate vary according to the law x= a sin ωt and y= a cos ωt where 'a' and 'omega' are positive constants and 't' is time. Find

(a) equation of the path. Name the trajectory (path).

(b) whether the particle moves in clockwise or anticlockwise direction

(c) magnitude of the force on the particle at any time t.

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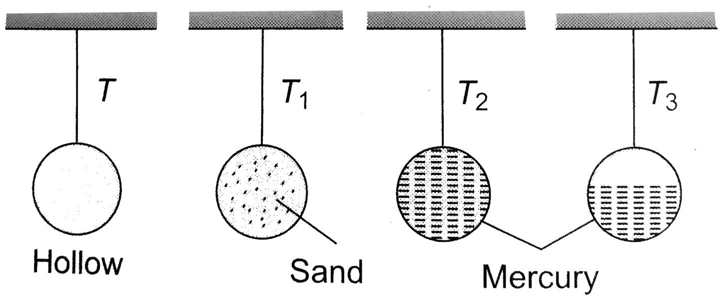
Single correct anwer type

1. The period of a simple pendulum whose bob is hollow metallic sphere is T. The period is T_1 when the bob is filled with sand, T_2 where it is filled with mercury and T_3 when it is half filled with mercury Which of the following is true?



A. $T = T_1 = T_2 > T_3$

B. $T_1 = T_1 = T_3 > T$

C. $T > T_3 > T_1 = T_2$

D. $T = T_1 = T_2 < T_3$

Answer: D

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2. A pendulum has time period T in air when it is made to oscillate in water it acquired a time period $T = \sqrt{2}T$ The density of the pendulum bob is equal to (density) of water $= 1)$

A. $\sqrt{2}$

B. 2

C. $2\sqrt{2}$

D. none of these

Answer: B

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3. A sphere of radius r is kept on a concave mirror of radius of curation R. The arrangement is kept on a horizontal surface (the surface of concave mirror is friction less and sliding not rolling). If the sphere is displaced from its equilibrium position and left, then it executes $S.h.M.$ The period of oscillation will be

A. $2\pi\sqrt{\left(\frac{(R-r)1.4}{g}\right)}$

B. $2\pi\sqrt{\left(\frac{R-r}{g}\right)}$

C. $2\pi\sqrt{\left(\frac{rR}{a}\right)}$

D. $2\pi\sqrt{\left(\frac{R}{gr}\right)}$

Answer: B

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4. Two simple pendulums of length $0.5m$ and $0.2m$ respectively are given small linear displacement in one direction at the same time. They will again be in the same phase when the pendulum of shorter length has completed oscillations

A. 5

B. 1

C. 2

D. 3

Answer: C

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5. The bob of a simple pendulum is displaced from its equilibrium position 'O' to a position 'Q' which is at a height 'h' above 'O' and the bob is then released. Assuming the mass of the bob to be 'm' and time period of oscillation to be $2.0s$, the tension in the string when the bob passes through 'O' is

A. $m\left(g+\pi\sqrt{2gh}\right)$

B. $m\left(g+\sqrt{\pi^2 gh}\right)$

C. $m\left(g+\sqrt{\frac{\pi^2}{2}gh}\right)$

D. $m\left(g+\sqrt{\frac{\pi^2}{3}gh}\right)$

Answer: A

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6. Two simple pendulum whose lengths are $100cm$ and $121cm$ are suspended side by side. Then bobs are pulled together and then released. After how many minimum oscillations of the longer pendulum will two be in phase again. ?

A. 11

B. 10

C. 21

D. 20

Answer: B

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7. Two pendulum have time period T and 5T/4 . They starts SHM at the same time from the mean position. What will be the phase difference between them after the bigger pendulum completed one oscillation ?

A. 45°

B. 90°

C. 60°

D. 30°

Answer: B

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8. Two simple pendulum first of bob mass M_1 and length L_1 second of bob mass M_2 and length $L_2 M_1 = M_2$ and L_1 = 2L_(2)`. if the vibrational energy of both is same which is correct?

A. Amplitude of B greater than A

B. Amplitude of B smaller than A

C. Amplitudes will be same

D. none of these

Answer: B

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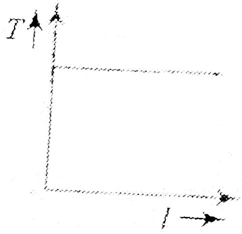
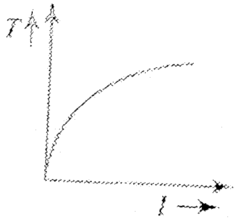
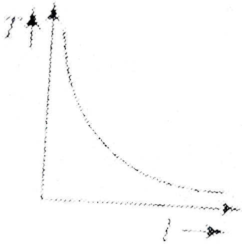
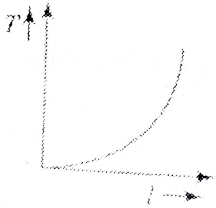
9. The case of a simple pendulum, time period verus length is depicted by

A. 

B. 

C. 

D. 

Answer: B

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10. A U tube pf uniform born of cross sectional area A has been set up vertically with open ends facing up Now mgm of a liquid of density d is poured into it. The column of liquid in this tube will oscillation with a period T such that

A. $T = 2\pi\sqrt{\frac{M}{g}}$

B. $T = 2\pi\sqrt{\frac{MA}{gd}}$

C. $T = 2\pi\sqrt{\frac{M}{gdA}}$

D. $T = 2\pi\sqrt{\frac{M}{2Agd}}$

Answer: D

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11. A horizontal platform with an object placed on it is executing S.H.M. in the vertical direction. The amplitude of oscillation is 3.92×10^{-3} m. what must ve the least period of these oscillations. So that the object is not detached from the platform

A. 0.1256 sec

B. 0.1356 sec

C. 0.1456 sec

D. 0.1556 sec

Answer: A

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12. The matallic bob of a simple pendulum has the relative density ρ. The time period of this pendulum is T it the metallic bob is immersed in water the new time period is given by

A. $T\frac{\rho - 1}{\rho}$

B. $T\frac{\rho}{\rho - 1}$

C. $T\sqrt{\frac{\rho - 1}{\rho}}$

D. $T\sqrt{\frac{\rho}{\rho - 1}}$

Answer: D

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13. A brass cube of side a and density $\sigma$is floating in mercury of density ρ. If the cube is displaced a bit vertically, it executes S.H.M. Its time period will be

A. $2\pi\sqrt{\frac{\sigma a}{\rho g}}$

B. $2\pi\sqrt{\frac{\rho a}{\sigma g}}$

C. $2\pi\sqrt{\frac{\rho g}{\sigma a}}$

D. $2\pi\sqrt{\frac{\sigma g}{\rho a}}$

Answer: A

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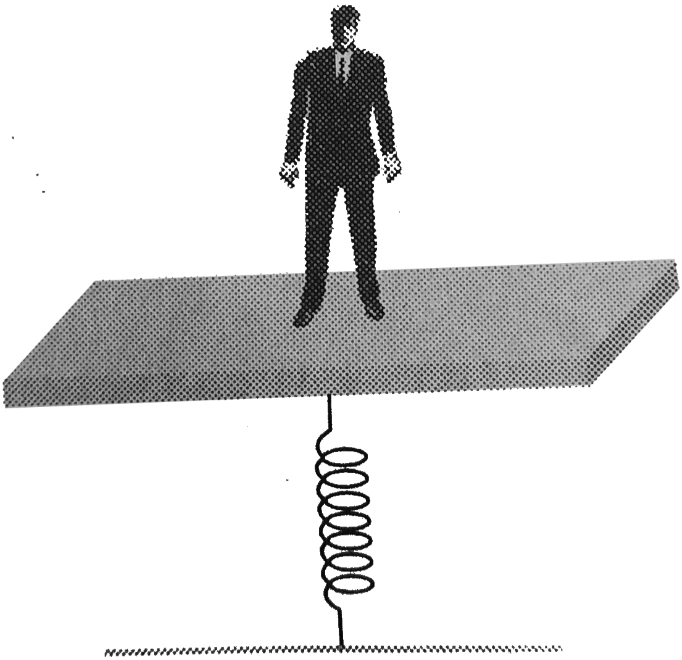
14. A man weighing $60kg$ stands on the horizontal platform of a spring balance. The platform starts executing simple harmonic motion of amplitude $0.1m$ and frequency $\frac{2}{\pi}$. its which of the following statement is correct ?



A. The spring balance reads the weight of man as 60 kg

B. The spring balance reading fluctuates between 60 kg and 70 kg.

C. The spring balance reading fluctuates between 50 kg and 60 kg.

D. The spring balance reading fluctuates between 50 kg and 70 kg.

Answer: D

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