PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

SIMPLE HARMONIC MOTION

Examples

1. A particle executes $SHM x = A\sin(\omega t + \phi)$. At $t = 0$, the position of the particle is $x = \frac{\sqrt{3}A}{2}$ and it moves along the positive x-direction. Find

(a) phase constant ϕ

(b) velocity at $t = \frac{\pi}{\omega}$

(c) acceleration at $t = \frac{\pi}{\omega}$

2. (a) A particle executes simple harmonnic motion with an amplitude of $10cm$. At what distance from the mean position are the kinetic and potential energies equal?

(b) The maximum speed and acceleration of a particle executing simple harmonic motion are $10m/s$ and $50cm/s$. Find the position(s) of the particle when the speed is $8cm/s$.

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3. The equation of motion of a particle started at $t=0$ is given by $x=5\sin(20t+\pi/3)$ where x is in centimeter and t in second. When does particle

(a) first come to rest

(b) first have zero acceleration

(c) first have maximum speed?

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4. Consider a simple harmonic motion of time period T. Calculate the time taken for the displacement to change value from half the amplitude to the amplitude.

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5. A particle executing simple harmonic motion has angular frequence $6.28s^{-1}$ and amplityude 10 cm. Find a the time period, b the maximum speed c. the maximum acceleration d. the speed when thedisplacement is 6 cm from the mean position e. the speed t $t = \frac{1}{6}s$ assuming that the motion starts from rest t t=0.

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

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7. Two particles execute simple harmonic motion of the same amplitude and frequency along close parallel lines. They pass each other moving in opposite directions each time their displacement is half their amplitude. Their phase difference is

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8. A body makes angular simple harmonic motion of amplitude $\pi/10 rad$ and time period $0.05s$. If the body is at a displacement $\theta = \pi/10 rad$ at $t = 0$, write the equation giving angular displacement as a function of time.

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9. 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 strig makes 0.02 rad with the vertical and d. the angular acceleration when the bob is in moemntary rest. Take $g = 10ms^{-2}$.

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10. A simple pendulum is taken at a place where its separation from the earth's surface is equal t the radius of the earth. Calculate the time period of small oscillations if the length of the string is 1.0m. Take $g = \pi^2 ms^{-2}$ at the surface of the earth.

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11. A particle suspended from a vetical spring oscillastes 10 times per sencon. At the highest point of oscillation the spring becomes unstretched. A. Find the maximum speed of the block. B. Find the speed when the spring is stretche by 0.20 cm. Take $g = \pi^2 ms^{-2}$

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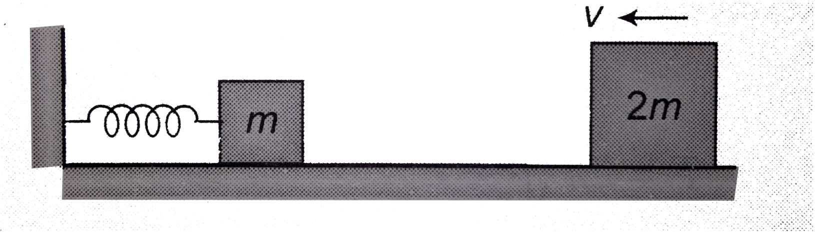
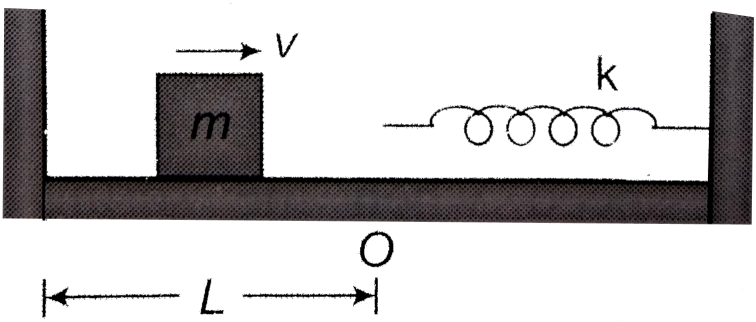
12. (a) The right block collides with left block and sticks to it. Find amplitude of the resulting SHM.



(b) The block starts from left wall and moves with constant speed v. All collisions are elastic. Find time period of periodic motion.



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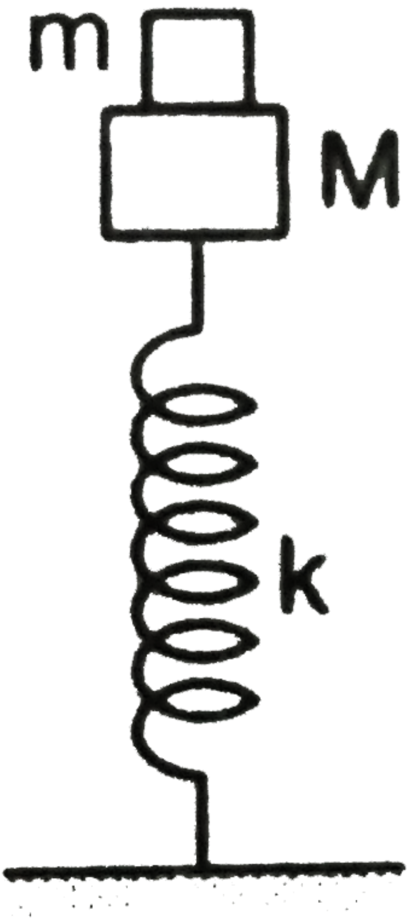
13. A small block of mass m is kept on a bigger block of mass M which is attached to a vertical spring of spring constant k as shown in the figure. The system oscilates verticaly. a.Find the resultant force on the smaller block when it is displaced through a distance x above its equilibrium position. b. find the normal force on the smaller blok at this position. When is this force smallest smaller block at this position. When is this force smallest in magnitude? c. What can be the maximum amplitude with which the two blocks may oscillate together?



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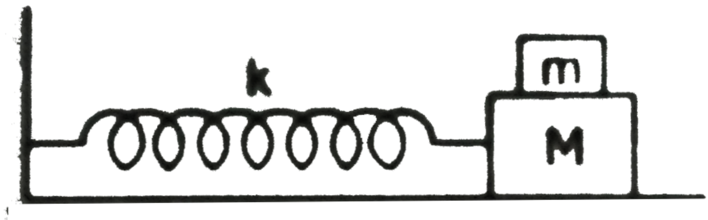
14. The friction coeficeint betweenteh tow blocks shown in figure is μ and the horizontal plance is smooth. A. If the system is slightly diplaced and released find the time period. B. find the magnitude of the frictional force between the blocks when the displacement from the mean position is x. c. What can be the maximum amplitude if the upper block does not slip relative to the lower block?



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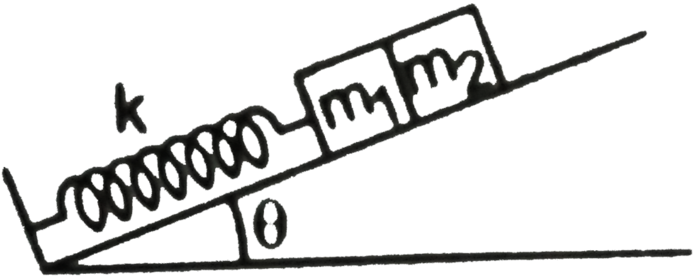
15. The block of mass m_1 shown in figure is fastened to the spring and the block of mass m_2 is placed asgainst ilt. A. Find the compression of the spring in the equilibrium position. b.The blocks are pushed a further distance $\left(\frac{2}{k}\right)(m_1 + m_2)g\sin\theta$ against the spring and released. Find the position where the two blocks separate. c. What is the common speed of blocks at the time of separation?



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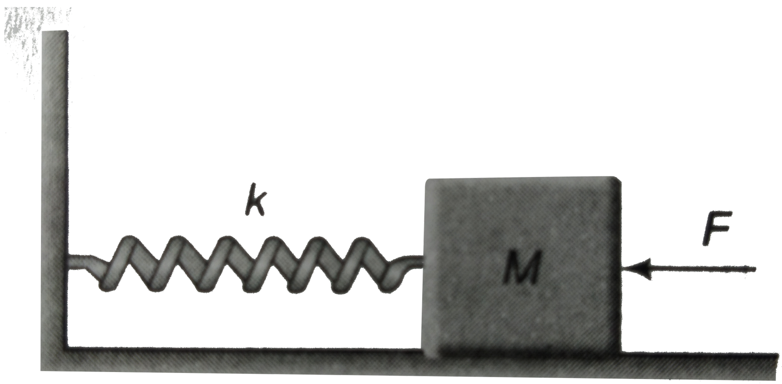
16. In figure, $k = 100N/m$, $M = 1kg$ and $F = 10N$



(a) Find the compression of the spring in the equilibrium position

(b) A sharp blow by some external agent imparts a speed of $2m/s$ to the block towards left. Find the sum of the potential energy of the spring and the kinetic energy of the block at this instant.

(c) Find the time period of the resulting simple harmonic motion.

(d) Find the amplitude.

(e) Write the potential energy of the spring when the block is at the left estreme.

(f) Write the potential energy of the spring when the block is at the right extreme.

The answers of (b), (e) and (f) are different. Explain why this does not violate the principle of conservation of energy ?

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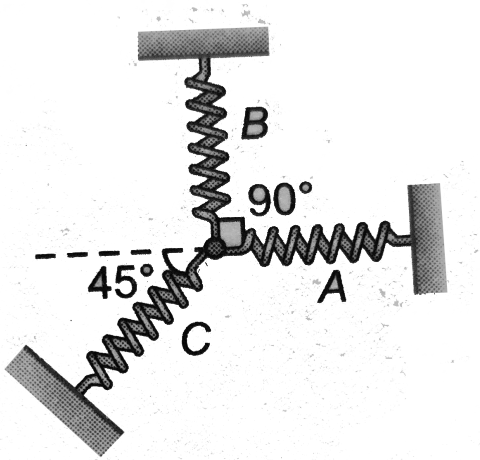
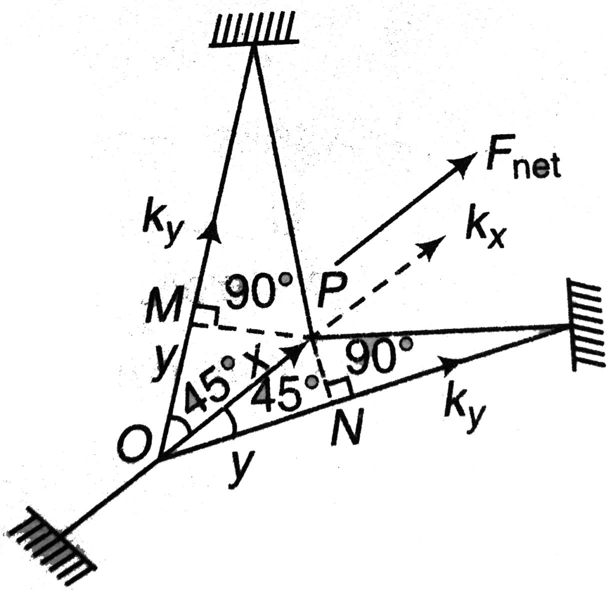
17. A particle of mass m is attached with three springs A, B and C of equal force constants k as shown in figure. The particle is pushed slightly against the spring C and released. Find the time period of oscillation.





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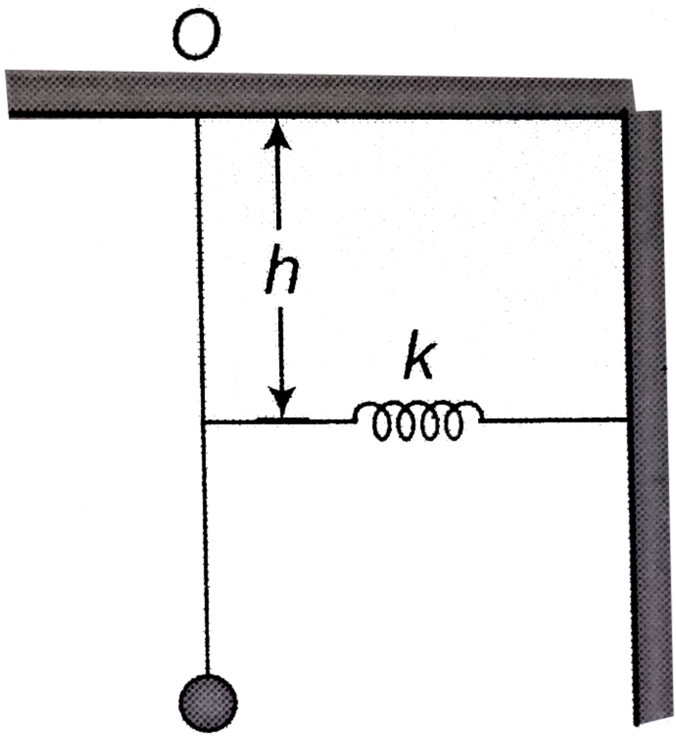
18. A simple pendulum of length L and mass m has a spring of force constant k connected to it at a distance h below its point of suspension. Find the frequency of vibrations of the system for small values of amplitude.



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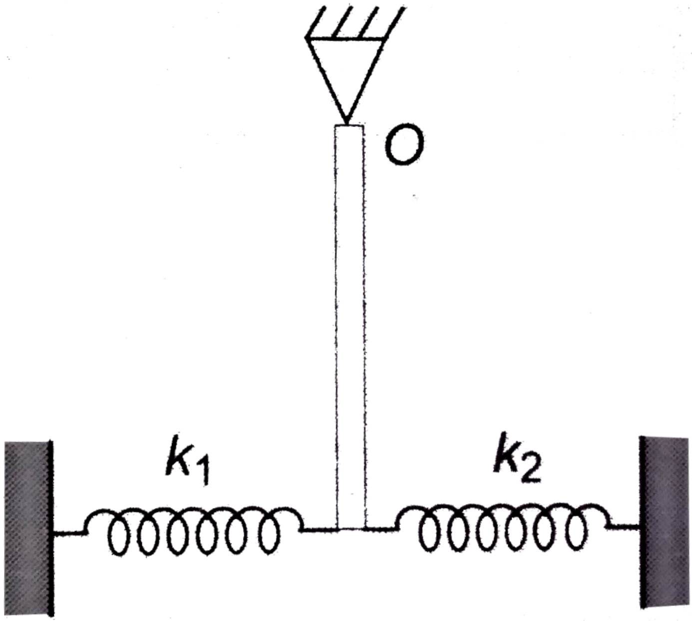
19. Find the frequency of small oscillations of thin uniform vertical rod of mass m and length l hinged at the point O.



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20. 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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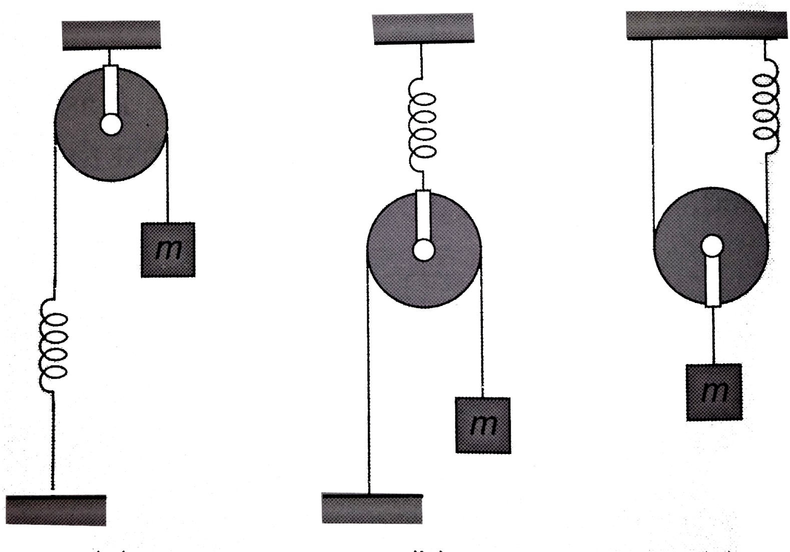
21. In the following arrangements, bock is slightly displaced vertically down from its equilibrium position and released. Find time period of vertical oscillations. The pulley is light.



(a) (b) (c)

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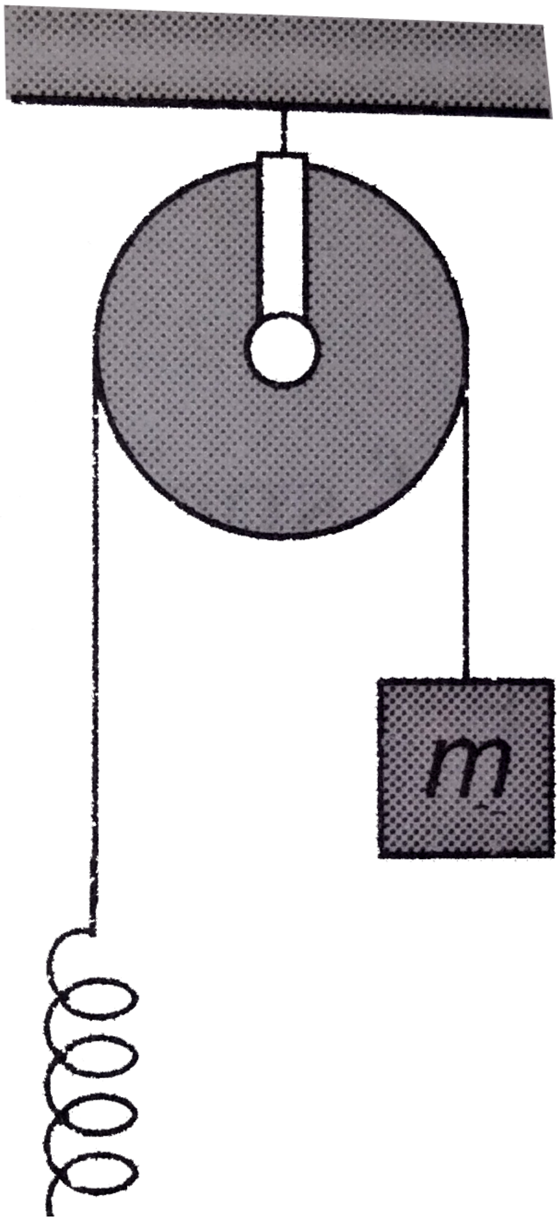
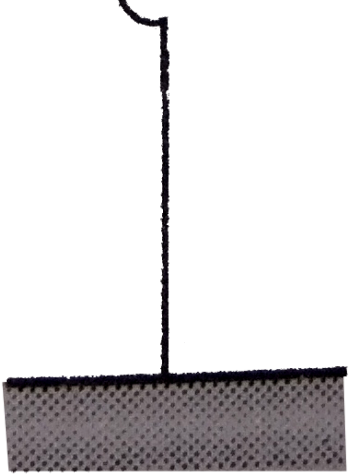
22. Consider the situation as shown. The pulley has a moment of inertia I, and radius r, the block is in equilibrium. Find the time period of mass m. Assume no slipping.





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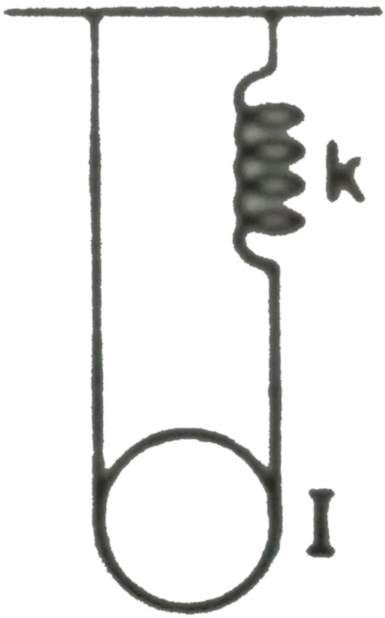
23. The pulley shown in figure has a moment of inertias I about its xis and mss m. find the tikme period of vertical oscillastion of its centre of mass. The spring has spring constant k and the string does not slip over the pulley.



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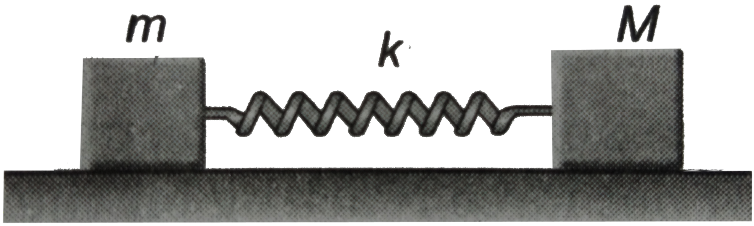
24. The spring as shown in figure is kept in a stretched position with extension x when the system is relesed. Assuming the horizontal surface to be frictionless, the frequency of oscillation is



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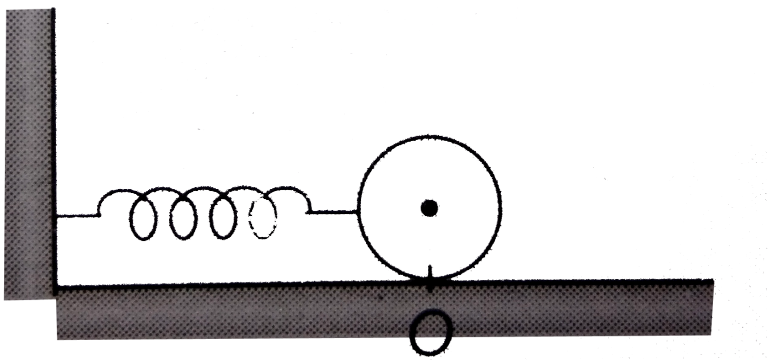
25. A solid sphere of mass m is attached to a light spring of force constant k so that it can roll without slipping along a horizontal surface. Calculate the period of oscillation made by sphere.



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26. Find the time period of small oscillations of the following systems.

(a) A uniform rod of mass m and length L is suspended through a pin hole at distance $L/4$ from top as shown.

(b) A ring of mass m and radius r suspended through a point on its periphery.

(c) A uniform disc of mass m and radius r suspended through a point $r/2$ away from centre.

(d) A uniform square plate of edge a suspended through a corner.

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27. A uniform rod of length l is suspended by end and is made to undego small oscillations. Find the length of the simple pendulum having the time period equal to that of the rod.

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28. A uniform disc of radius r is to be suspended through a small hole made in te disc. Find the minimum possible time period of the disc for small oscillations. What should be the distance of the hole from the centre for it to have minimum time period?

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29. A closed circular wire hung on a nail in a wall undergoes small oscillations of amplitude 2° and time period 2s. Find a the radius of the circular wire. b. the speed of the particle farthest away from the point of suspension as it goes though its mean position c. the aceleration of this particle as ilt goes through its mean position and extreme position. Take $g = \pi^2 sms^{-2}$

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30. (a) A uniform disc of radius $5 \cdot 0cm$ 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.

(b) In the previous part, another disc is placed over the first one and the time period of the system become 0.65. Find the M.I. of the second disc about the wire.

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31. The potential energy of a particle of mass m is given by $U(x) = U_0(1 - \cos cx)$ where U_0 and c are constants. Find the time period of small oscillations of the particle.

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32. A small block oscillates back and forth on a smooth concave surface of radius R. Find the time period of small oscillation.

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33. Asume that as narrow tunnel is dug between two diametricaly opposite points of the earth. Treat the earth as a solid sphere of uniform density. Show that ilf a particle is relesed in this tunel, ilt wil execute a simple harmonic motion. Calculate the time period of this motion.

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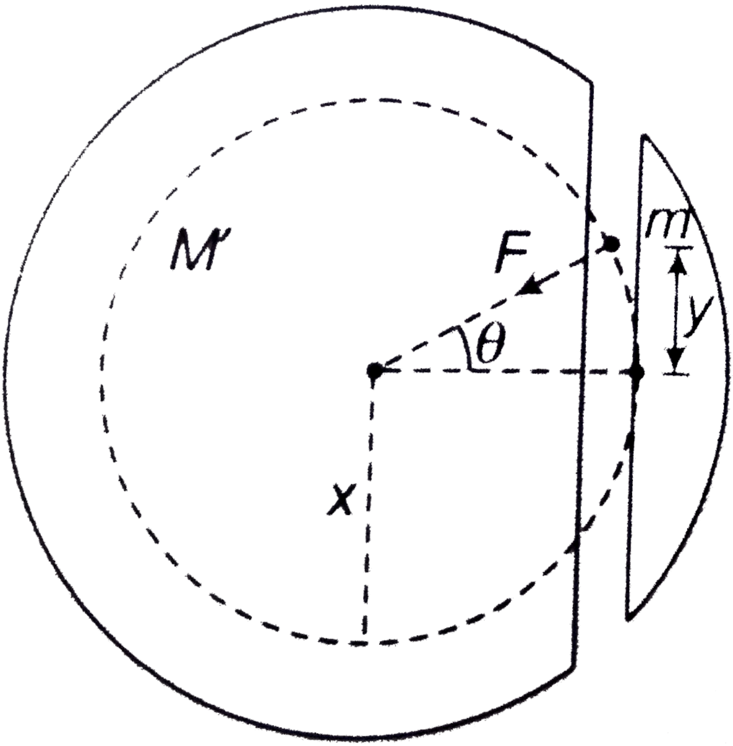
34. In the previous problem, if tunnel is dug along a chord, find time period.



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35. Assume that a tunnel is dug along a chord of the earth, at a perpendicular distance $R/2$ from the earth's centre where R is the radius of the earth. The wall of the tunnel is frictionless.

(a) Find the gravitational force exerted by the earth on a particle of mass m placed in the tunnel at a distance x from the centre of the tunnel.

(b) Find the component of this force along the tunnel and perpendicular to the tunnel.

(c) Find the normal force exerted by the wall on the particle.

(d) Find the resultant force on the particles.

(e) Show that the motion of the particle in the tunnel is simple harmonic and find the time period.

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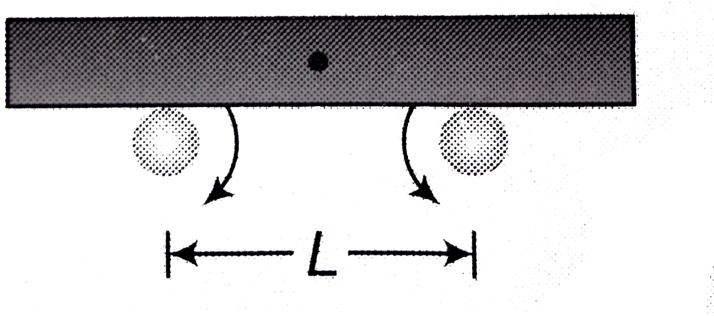
36. A uniform plate of mass M stays horizontally symmetrically on two wheels rotating in opposite directions. The separation between the wheels is L. the friction coefficient between each and the plate is μ. Find the time period of oscillation of the plate if it is slightly displaced along its length and released.



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37. Two simple harmonic motions are represented by the following equations

$y_1 = 10\frac{\sin\pi}{4}(12t + 1)$

$y_2 = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$

Find out the ratio of their amplitudes. What are the time periods of two motions?

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38. (a) A particle is subjected to two SHMs of same time period in the same direction. If $A_1 = 6cm$, $A_2 = 8cm$, find the resultant amplitude if the phase difference between the motions is (a) 0°, (b) 60°, (c) 90° and (d) 120°.

(b) In the previous problem if $A_1 = A_2 = a$ and resultant amplitude is also a, find phase difference between them.

(c) Three SHMs of equal amplitude A and equal time periods in the same direction combine. The phase of the second motion is 120° ahead of first and the phase of the third motion is 120° ahead of the second. Find the amplitude of the resultant motion.

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39. (a) A particle is subjected to two simple harmonic motions

$x_1 = A_1 \sin \omega t$ and $x_2 = A_2 \sin(\omega t + \pi/3)$.

Find (i) the displacement at $t = 0$, (ii) the maximum speed of the particle and (iii) the maximum acceleration of the particle.

(b) A particle is subjected to two simple harmonic motions, one along the x-axis and the other on a line making an angle of 45° with the x-axis. The two motions are given by

$xy = x_0 \sin \omega t$ and $s = s_0 \sin \omega t$

Find the amplitude of the resultant motion.

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40. Two linear SHM of equal amplitudes A and frequencies ω and 2ω are impressed on a particle along x and $y - axes$ respectively. If the initial phase difference between them is $\pi / 2$. Find the resultant path followed by the particle.

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Exercises

1. Select the correct statements.

(i) A simple harmonic motion is necessarily periodic

(ii) A simple harmonic motion is necessarily oscillatory

(iii) An oscillatory motion is necessarily periodic

(iv) A periodic motion is necessarily oscillatory

A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. (i), (iv)

Answer: A

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2. A student says that he had applied a force $F = -k\sqrt{x}$ on a particle and the particle moved in simple harmonic motion. He refuses to tell whether k is a constant or not. Assume that he has worked only with positive x and no other force acted on the particle

A. As x increases k increases

B. As x increases k decreases

C. As x increases k remains constant

D. The motion cannot be simple harmonic

Answer: A

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3. Which of the following quantities are always negative in a simple harmonic motion?

A. (i),(ii)

B. (i),(iii)

C. (ii),(iii)

D. (iii), (iv)

Answer: D

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4. Which of the followign quantities are always zero in a simple harmonic motion?

A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. All

Answer: D

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5. The time period of a particle in simple harmonic motion is equal to the time between consecutive appearances of the particle at a particular point in its motion. This point is

A. the mean position

B. an extreme position

C. between the mean position and the positive extreme

D. between the mean position and the negative extreme

Answer: B

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6. The average acceleration in one tiome period in a simple harmonic motion is

A. $A\omega^2$

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

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

D. zero

Answer: D

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7. A partilce is executive simple harmonic motion given by

$x = 5\sin\left(4t - \frac{\pi}{6}\right)$

The velocity of the particle when its displacement is 3 units is

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

B. $\frac{5\pi}{6}$ units

C. 20 units

D. 16 units

Answer: D

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8. A particle starts SHM from the mean position. Its amplitude is A and time period is T. At the time when its speed is half of the maximum speed, its displacement y is

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

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

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

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

Answer: C

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9. A body of mass $5g$ is executing SHM with amplitude $10cm$, its velocity is $100cm/s$. Its velocity will be $50cm/s$ at a displacement from the mean position equal to

A. $5cm$

B. $5\sqrt{3}$

C. $10\sqrt{3}cm$

D. $15\sqrt{3}cm$

Answer: B

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10. A particle is vibrating in SHM. If its velocities are v_1 and v_2 when the displacements from the mean postion are y_1 and y_2, respectively, then its time period is

A. $2\pi\sqrt{\frac{y_1^2+y_2^2}{v_1^2+v_2^2}}$

B. $2\pi\sqrt{\frac{v_1^2+v_2^2}{y_1^2+y_2^2}}$

C. $2\pi\sqrt{\frac{v_1^2-v_2^2}{y_1^2-y_2^2}}$

D. $2\pi\sqrt{\frac{y_1^2-y_2^2}{v_1^2-v_2^2}}$

Answer: D

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11. The phase (at a time t) of a particle in simple harmonic motion tells

A. only th position of the particle at time t

B. only the direction of motion of the particle at time t

C. both the position and direction of motion of the particle at time t

D. neither the position of the particle nor its direction of motion at time t

Answer: C

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12. Which of the following equation does not represent a simple harmonic motion

A. $y = a \sin \omega t$

B. $y = a \cos \omega t$

C. $y = a \sin \omega t + b \cos \omega t$

D. $y = a \tan \omega t$

Answer: D

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13. Which of the following is a simple harmonic motion

A. Wave moving through a string fixed at both ends

B. Earth spinning about its own axis

C. Ball bouncing between two rigid vertical walls

D. Particle moving in a circle with uniform speed

Answer: A

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14. The equation of SHM of a particle is $\frac{d^2y}{dt^2} + ky = 0$, where k is a positive constant. The time period of motion is

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

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

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

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

Answer: A

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15. A particle is executing SHM. Then the graph of acceleration as a function of displacement is

A. straight line

B. circle

C. ellipse

D. hyperbola

Answer: A

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16. A particle is executing SHM. Then the graph of velocity as a function of displacement is

A. straight line

B. circle

C. ellipse

D. hyperbola

Answer: C

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17. For a simple pendulum the graph between length and time period will be

A. hyperbola

B. parabola

C. straight line

D. none of these

Answer: B

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18. Out of the following function reporesenting motion of a particle which represent SHM

(i) $y = \sin \omega t - \cos \omega t$

(ii) $y = \sin^3 \omega t$

(iii)$y = 5 \cos\left(\frac{3\pi}{4} - 3\omega t\right)$

(iv) $y = 1 + \omega t + \omega^2 t^2$

A. Only (a) and (b)

B. Only (a)

C. Only (d) does not represent SHM

D. Only (a) and (c)

Answer: D

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19. A particle excuting $S.H.M.$ of amplitude $4cm$and $T = 4$ sec .The time take by it to move position extreme position to half the amplitude is

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

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

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

D. $\frac{4}{3}s$

Answer: B

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20. A particle is executing SHM of amplitude $4cm$ and time period $12s$. The time taken by the particle in going from its mean position to a position of displacement equal to $2cm$ is T_1. The time taken from this displaced position to reach the extreme position on the same side is T_2. T_1 / T_2 is

A. 2

B. 1

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

D. $\frac{1}{3}$

Answer: C

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21. A simple harmonic oscillation has an amplitude A and time period T. The time required to travel from $x = A$ to $x = \frac{A}{2}$ is

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

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

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

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

Answer: A

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22. Time period of a particle executing SHM is 8 sec. At $t = 0$ it is at the mean position. The ratio of the distance covered by the particle in the $1st$ second to the $2nd$ second is:

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

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

C. $\sqrt{2}$

D. $\frac{1}{\sqrt{2}-1}$

Answer: D

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23. Two particles P and Q start from origin and execute simple harmonic motion along X-axis with same amplitude but with periods $3s$ and $6s$ respectively. The ratio of the velocities of P and Q when they meet is

A. $1:2$

B. $2:1$

C. $2:3$

D. $3:2$

Answer: B

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24. A particle executes simple harmonic motion with a period of $16s$. At time $t = 2s$, the particle crosses the mean position while at $t = 4s$, its velocity is $4ms^{-1}$ amplitude of motion in metre is

A. $\sqrt{2}\pi$

B. $16\sqrt{2}\pi$

C. $24\sqrt{2}\pi$

D. $32\sqrt{2}\pi$

Answer: D

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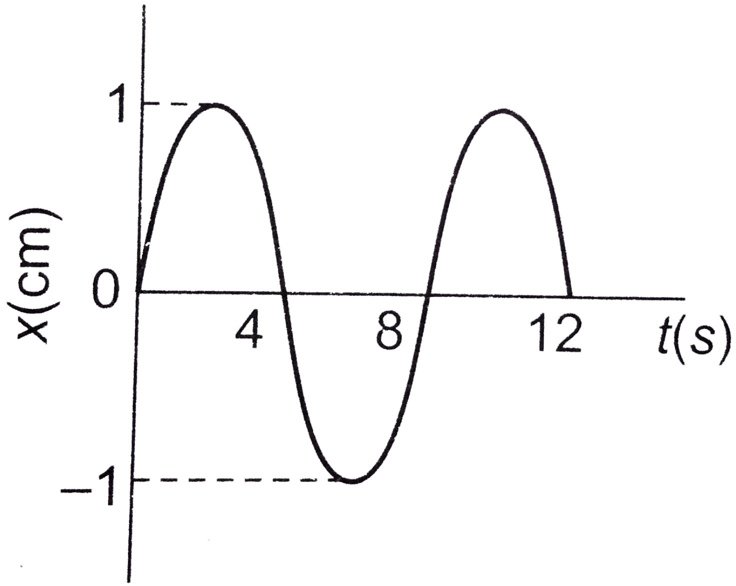
25. The x-t graph of a particle undergoing simple harmonic motion is shown below. The acceleration of the particle of $t = 4/3s$ is



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

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

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

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

Answer: D

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26. If x, and a denote the displacement, the velocity and the acceler of a particle executing simple harmonic motion of time period T, then, which of the following does not change with time?

A. $a^2T^2 + 4\pi^2v^2$

B. aT / x

C. $aT + 2\pi v$

D. aT / v

Answer: B

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27. Which one of the following equation at the represents simple harmonic motion ?

A. Acceleration $= - k_0 x + k_1 x^2$

B. Acceleration $= - k(x + a)$

C. Acceleration $= k(x + a)$

D. Acceleration $= kx$

Answer: B

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28. The potential energy of a particle with displacement X is $U(X)$. The motion is simple harmonic, when (K is a positive constant)

A. $U = -\frac{KX^2}{2}$

B. $U = KX^2$

C. $U = K$

D. $U = KX$

Answer: B

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29. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal, when displacement (amplitude $= a$) is

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

B. $a\sqrt{2}$

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

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

Answer: C

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30. The angular velocity and amplitude of simple pendulum are ω and r respectively. At a displacement x from the mean position, if its kinetic energy is T and potential energy is U, find the ration of T to U.

A. $X^2\omega^2 / (a^2 - X^2\omega^2)$

B. $X^2 / (a^2 - X^2)$

C. $(a^2 - X^2\omega^2) / X^2\omega^2$

D. $(a^2 - X^2) / X^2$

Answer: B

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31. A verticle mass-spring system executed simple harmonic ascillation with a period $2s$ quantity of this system which exhibits simple harmonic motion with a period of $1 \sec$ are

A. velocity

B. potential energy

C. phase difference between acceleration and displacement

D. difference between kinetic energy and potential energy

Answer: B

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32. A particle executes simple harmonic motion with a frequency. (f). The frequency with which its kinetic energy oscillates is.

A. $f/2$

B. f

C. $2f$

D. $4f$

Answer: C

Watch Video Solution

33. When a particle oscillates simple harmonically, its potential energy varies periodically. If the frequency of oscillation of the particle is n, the frequency of potential energy variation is

A. $n/2$

B. n

C. $2n$

D. $4n$

Answer: C

Watch Video Solution

34. There is a body having mass m and performing SHM amplitude a There is a restoring force $F = -Kx$ where x is the displacement The total energy of body depends upon

A. K, x

B. K, a

C. K, a, x

D. K, a, v

Answer: B

Watch Video Solution

35. A body is executing simple harmonic motion. At a displacement x its potential energy is E_1 and at a displacement y its potential energy is E_2 The potential energy E at displacement $(x + y)$ is

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

Watch Video Solution

36. Starting from the origin a body osillates simple harmonicall with a period of 2 s. A fter what time will its kinetic energy be 75% of the total energy?

A. $\frac{1}{4}s$

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

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

D. $\frac{1}{6}s$

Answer: D

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37. If a simple harmonic oscillator has got a displacement of $0.02m$ and acceleration equal to $2.0ms^{-2}$ at any time, the angular frequency of the oscillator is equal to

A. $10rads^{-1}$

B. $0.1rads^{-1}$

C. $100rads^{-1}$

D. $1rads^{-1}$

Answer: A

Watch Video Solution

38. A point simple harmonic oscillation of the period and the equation of motion is given by $xa\sin(\omega t + \pi / 6)$ after the step of friction of the time period the velocity of the part will be equal to half of its maximum velocity?

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

B. $\frac{T}{12}$

C. $\frac{T}{8}$

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

Answer: B

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39. Two simple harmonic are represented by the equation $y_1 = 0.1 \sin\left(100\pi + \frac{\pi}{3}\right)$ and $y_2 = 0.1 \cos \pi t.$

The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is.

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

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

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

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

Answer: C

Watch Video Solution

40. The time period of simple pendulum is T. If its length is increased by 2%, the new time period becomes

A. $0.98T$

B. $1.02T$

C. $0.99T$

D. $1.01T$

Answer: D

Watch Video Solution

41. The length of a simple pendulum is increased by 44%. The percentage increase in its time period will be

A. 0.44

B. 0.22

C. 0.2

D. 0.11

Answer: C

Watch Video Solution

42. A simple pendulum is oscillating in a lift. If the lift starts moving upwards with a uniform acceleration, the period will

A. remain unaffected

B. be shorter

C. be longer

D. may be shorter or longer, depending on the magnitude of acceleration

Answer: B

Watch Video Solution

43. A girl is swinging on a swing in the sitting position. How will the period of swing be affected if she stands up?

A. The period will now be shorter

B. The period will now longer

C. The period will remain unchanged

D. The period may become longer or shorter depending upon the height of girl

Answer: A

Watch Video Solution

44. A metallic sphere is filled with water and hung by a long thread. It is made to oscillate. If there is a small hole in the bottom through which water slowly flows out, the time period will

A. go on increasing till the sphere is empty

B. go on decreasing till the sphere is empty

C. remain unchanged throughout

D. first increase, then it will decrease till the sphere is empty and the period will now be the same as when the sphere was full of water

Answer: D

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45. A simple pendulum suspended from the ceiling of a trans has a time period T when the train is at rest. If the train is accelerating uniformly at a then its time period

A. increase

B. decrease

C. remain unaffected

D. become infinite

Answer: B

Watch Video Solution

46. A simple pendulum is set up in a trolley which moves to the right with an acceleration a on a horizontal plane. Then the thread of the pendulum in the mean position makes an angle θ with the vertical

A. $\tan^{-1}\left(\frac{a}{g}\right)$ in the forward direction

B. $\tan^{-1}\left(\frac{a}{g}\right)$ in the backward direction

C. $\tan^{-1}\left(\frac{g}{a}\right)$ in the backward direction

D. $\tan^{-1}\left(\frac{g}{a}\right)$ in the forward direction

Answer: B

Watch Video Solution

47. A simple pendulum of length l is suspended from the celing of a cart which is sliding without friction on as inclined plane of inclination theta . What will be the time period of the pendulum?

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

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

C. $2\pi\sqrt{\frac{1}{g\sin\theta}}$

D. $2\pi\sqrt{\frac{1}{g\tan\theta}}$

Answer: B

Watch Video Solution

48. The length of a second's pendulum on the surface of the moon, where g is $1/6^{th}$ if the value of g on the surface of the

A. $1/36m$

B. $1/6m$

C. $6m$

D. $36m$

Answer: B

Watch Video Solution

49. A pendulum clock is taken $1km$ inside the earth from mean sea level. Then the pendulum clock

A. loses $13.5s$ per day

B. gains $13.5s$ per day

C. loses $7s$ per day

D. gains $7s$ per day

Answer: C

Watch Video Solution

50. A pendulum clock, which keeps correct time at sea level, loses $15s$ per day when taken to the top of a mountain. If the radius of the earth is $6400km$, the height of the mountain is

A. $1.1km$

B. $2.2km$

C. $3.3km$

D. $4.4km$

Answer: A

Watch Video Solution

51. The mass and diameter of a planet are twice those of earth. What will be the period of oscillation of a pendulum on this plenet. If it is a 2 second's pendulum on earth?

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

B. $2\sqrt{2}s$

C. $2s$

D. $\frac{1}{2}s$

Answer: B

Watch Video Solution

52. A second's pendulum is placed in a space laboratory orbiting around the earth at a height $3R$, where R is the radius of the earth. The time period of the pendulum is

A. zero

B. $2\sqrt{3}s$

C. $4s$

D. infinite

Answer: D

Watch Video Solution

53. For a particle executing $S.H.M.$, the kinetic energy K is given $K = K_0 \cos^2 \omega t$. The maximum value of potential energy is:

A. E_0

B. $\frac{E_0}{\sqrt{2}}$

C. $E_0 / 2$

D. undeterminable from the given

Answer: A

Watch Video Solution

54. A linear harmonic oscillator of force constant $2 \times 106 Nm^{-1}$ and amplitude $0.01m$ has a total mechanical energy $160J$. Among the followinhg statement , which are correct?

i Maximum $PE$is $100J$

ii Maximum $KE$is $100J$

iii Maximum PE is $160J$

iv Maximum PE is zero

A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. (i), (iv)

Answer: C

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55. The total mechanicla energy of a spring mass sytem in simple harmonic motion is $E = \frac{1}{2} m\omega^2 A^2$. Suppose the oscillating particle is replaced by another particle of double the mass while the amplitude A remains the same. The new mechanical energy will

A. becomes $2E$

B. become $E/2$

C. become $\sqrt{2}E$

D. remain E

Answer: B

Watch Video Solution

56. The average energy in one time period in simple harmonic motion is

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

B. $m\omega^2 A^2 / 4$

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

D. zero

Answer: A

Watch Video Solution

57. In a simple harmonic motion

A. the potential energy is always equal to the kinetic energy

B. the potential energy is never equal to the kinetic energy

C. the average potential energy in any time interval is equal to the average kinetic energy in that interval

D. the average potential energy in one time period equal to the average kinetic energy in this period

Answer: A

Watch Video Solution

58. In a simple harmonic motion

(i) the maximum potential energy equal the maximum kinetic energy

(ii) the minimum potential energy equals the minimum kinetic energy

(iii) the minimum potential energy equals the maximum kinetic energy

(iv) the maximum potential energy equals the minimum kinetic energy

A. (i),(ii)

B. (i),(iii)

C. (ii),(iii)

D. (i), (iv)

Answer: A

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59. A mass m attached to a spring oscillates with a period of $3s$. If the mass is increased by $1kg$ the period increases by $1s$. The initial mass m is

A. $\frac{7}{9}kg$

B. $\frac{9}{7}kg$

C. $\frac{14}{7}kg$

D. $\frac{18}{7}kg$

Answer: B

Watch Video Solution

60. A mass M is suspended from a massless spring. An additional mass m stretches the spring further by a distance x. The combined mass will oscillate with a period

A. $T = 2\pi\sqrt{mg/x(M+m)}$

B. $T = 2\pi\sqrt{((M+m)x/mg)}$

C. $T = (\pi/2)\sqrt{(mg/x)(M+m)}$

D. $T = 2\pi\sqrt{((M+m)/mgx)}$

Answer: B

Watch Video Solution

61. A mass suspended on a vertical spring oscillates with a period of $0.5s$. When the mass is allowed to hang at rest, the spring is stretched by

A. $3.1cm$

B. $6.2cm$

C. $9.3cm$

D. $12.4cm$

Answer: B

Watch Video Solution

62. A pan with a set of weights is attached to a light spring. The period of vertical oscillations is $0.5s$. When some additional weights are put in pan, the period of oscillations increases by $0.1s$. The extension caused by the additional weights is

A. $1.3cm$

B. $2.7cm$

C. $3.8cm$

D. $5.5cm$

Answer: B

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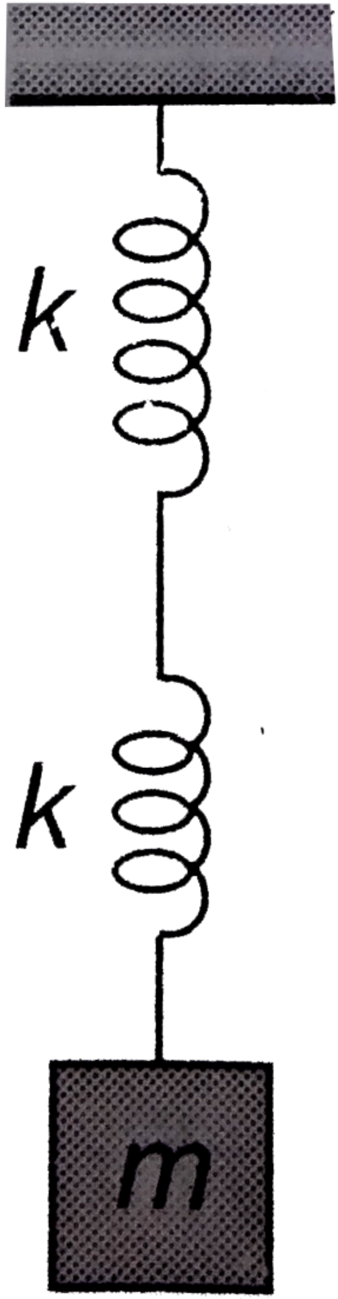
63. The two spring-mass system, shown in the figure, oscillates with a period T. If only one spring is used, the time period will be


k
k
m

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

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

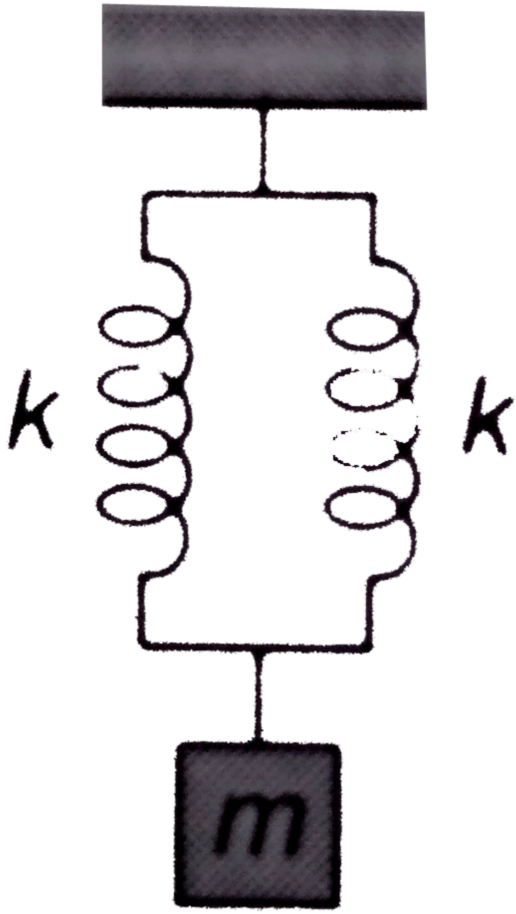
C. $\sqrt{2}T$

D. $2T$

Answer: A

Watch Video Solution

64. The two spring-mass system, shown in the figure, oscillates with a period T. If only one spring is used, the time period will be



A. $\dfrac{T}{\sqrt{2}}$

B. $\dfrac{T}{2}$

C. $\sqrt{2}T$

D. $2T$

Answer: C

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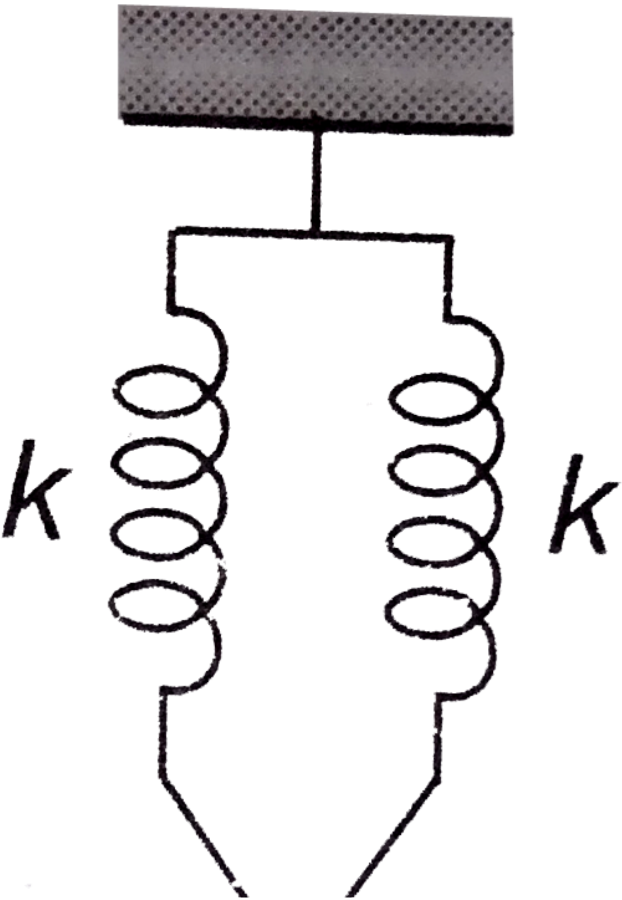
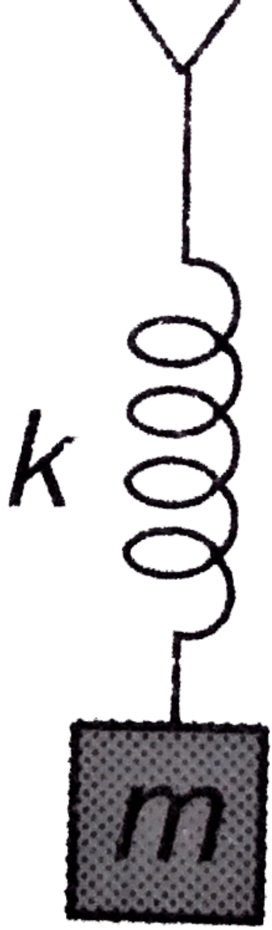
65. The frequency of vertical oscillations of the three spring-mass system, shown in figure, is





A. $\frac{1}{2\pi}\sqrt{\frac{3k}{2m}}$

B. $\frac{1}{2\pi}\sqrt{\frac{2k}{3m}}$

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

D. $\frac{1}{2\pi}\sqrt{\frac{k}{3m}}$

Answer: B

Watch Video Solution

66. When a body is suspended from two light springs separately, the periods of vertical oscillations are T_1 and T_2. When the same body is suspended from the two spring connected in series, the period will be

A. $T_1 + T_2$

B. $\sqrt{T_1 T_2}$

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

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

Answer: D

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67. In previous problem, if the body is suspended from the two springs connected in parallel, the time period will be

A. $\sqrt{T_1 T_2}$

B. $\dfrac{T_1 T_2}{\sqrt{T_1^2 + T_2^2}}$

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

D. $\dfrac{2T_1 T_2}{\sqrt{T_1^2 + T_2^2}}$

Answer: B

Watch Video Solution

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

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

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

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

D. $\sqrt{\frac{k_2}{k_1}}$

Answer: D

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69. Springs of constants k, 2k, 4k, 8k,........,2048k are connected in series. A mass m is attached to one end and the system is allowed to oscillate. The time period is approximately

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

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

C. $2\pi\sqrt{\frac{m}{4k}}$

D. $2\pi\sqrt{\frac{4m}{k}}$

Answer: B

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70. A spring mass system oscillates in a car. If the car accelerates on a horizontal road, the frequency of oscillation will

A. increase

B. decrease

C. remain same

D. become zero

Answer: C

Watch Video Solution

71. A massless spring, having force constant k, oscillates with frequency n when a mass m is suspended from it. The spring is cut into two equal halves and a mass $2m$ is suspended from one half. The frequency of oscillation will now be

A. n

B. $n/2$

C. $n/\sqrt{2}$

D. $2n$

Answer: A

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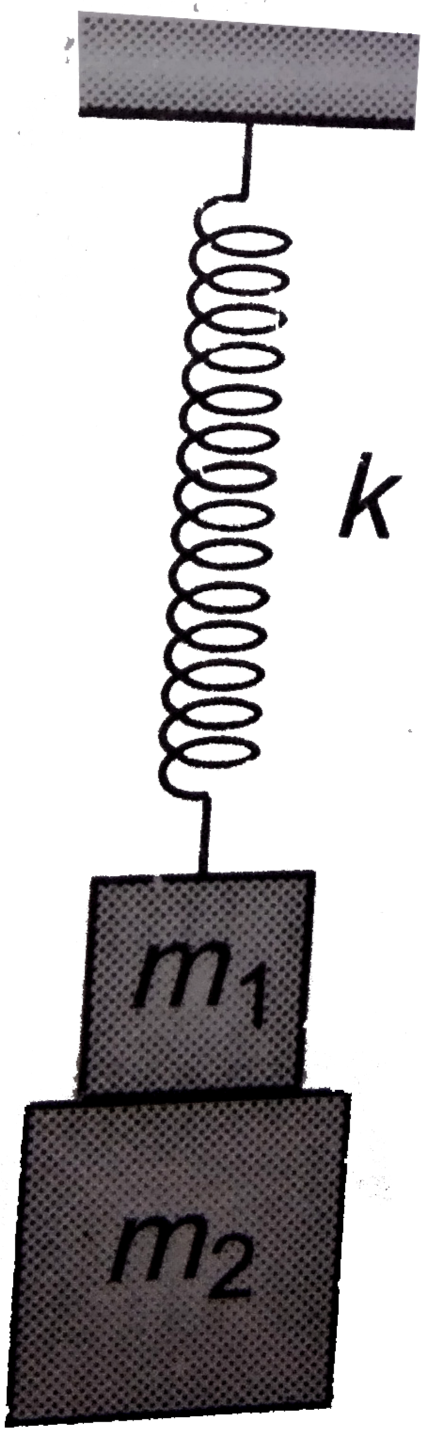
72. Two blocks of masses m_1 and m_2 are attached to the lower end of a light vertical spring of force constant k. The upper end of the spring is fixed. When the system is in equilibrium, the lower block (m_2) drops off.

The other block (m_1) will


k
m1
m2

A. remain undistrubed

B. move through a distance $\frac{m_2 g}{k}$ and come to rest

C. undergo vertical SHM with a time period of $2\pi\sqrt{\frac{m_1}{k}}$

D. undergo vertical SHM with a time period of

$2\pi\sqrt{\frac{m_1 + m_2}{k}}$

Answer: C

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73. In previous question, the amplitude of vibration is

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

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

C. $\frac{(m_1 - m_2)g}{k}$

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

Answer: B

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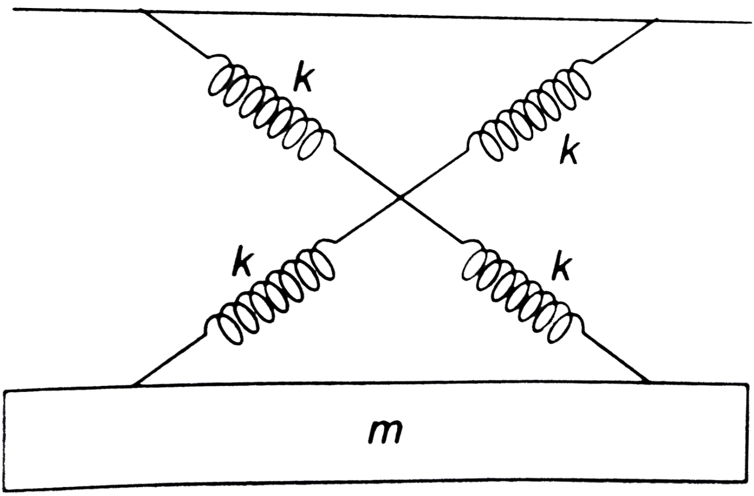
74. As shown in figure in a simple harmonic motion oscillator having identical four springs has time period



A. $T=2\pi\sqrt{\frac{m}{4k}}$

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

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

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

Answer: C

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75. 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, $Take g = 10m/\sec^2$.

A. (i),(iii)

B. (ii), (iii)

C. (i), (iv)

D. (ii), (iv)

Answer: A

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76. A body is on a rough horizontal surface which is moving horizontally in SHM of frequency $2Hz$. The coefficient of static friction between the body and the surface is 0.5. The maximum value of the amplitude for which the body will not slip along the surface is approximately

A. $9cm$

B. $6cm$

C. $4.5cm$

D. $3cm$

Answer: D

Watch Video Solution

77. A coin is placed on a horizontal platform, which undergoes horizontal simple harmonic motion about a mean position O. The coin does not slip on the platform. The force of friction acting on the coin is F.

(i) F is always directed towards O

(ii) F is directed towards O when the coin is moving away from O, and away from O when the coin moves towards O

(iii) $F = 0$ when the coin and platform come to rest momentarily at the extreme position of the harmonic motion

(iv) F is maximum when the coin and platform come to rest momentarily at the extreme position of the harmonic motion

A. F is always directed towards O

B. F is directed towards O when the coin is moving away from O, and away from O when the coin moves towards O

C. $F = 0$ when the coin and platform come to rest momentarily at the extreme position of the harmonic motion

D. F is maximum when the coin and platform come to rest momentarily at the extreme position of the harmonic motion

Answer: C

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78. In the previous question, the angular frequency of the simple harmonic motion is ω. The coefficient of friction between the coin and the platform is μ. The amplitude of oscillation is gradually increased. The coin will begin to slip on the platform for the first time

(i) at the extreme positions of oscillations

(ii) at the mean position

(iii) for an amplitude of $\frac{\mu g}{\omega^2}$

(iv) for an amplitude of $\frac{g}{\mu \omega^2}$

A. (i),(iii)

B. (ii), (iii)

C. (i), (iv)

D. (ii),(iv)

Answer: A

Watch Video Solution

79. 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. (i),(iii)

B. (ii), (iii)

C. (i), (iv)

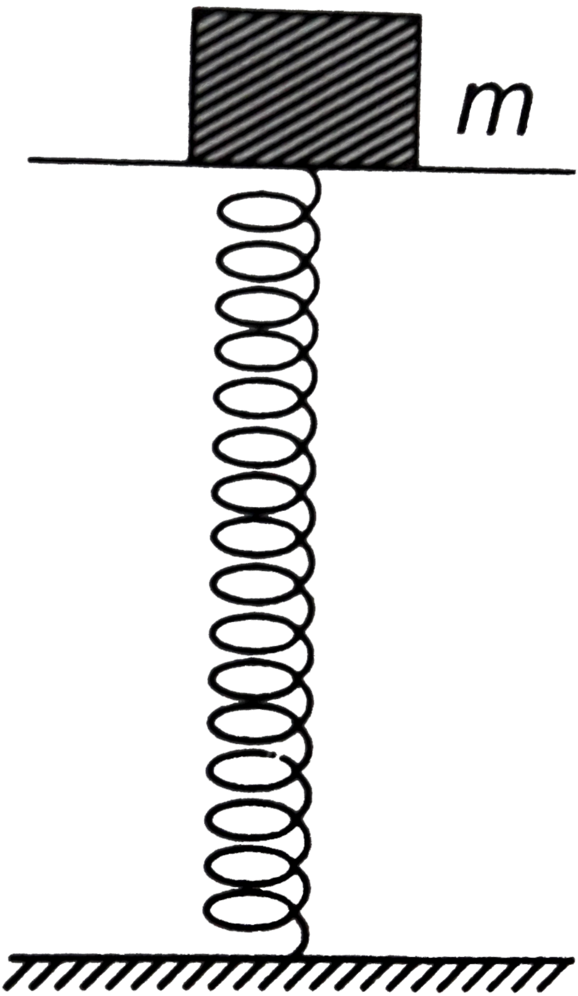
D. (ii),(iv)

Answer: A

Watch Video Solution

80. A mass of $2.0kg$ is put on a flat pan attached to a vertical spring fixed on the ground as shown in figure. The mass of the spring and the pan is negligible. When pressed slightly and realeased the mass executes a simple contant is $200N/m$. What should be the minimum amplitude of the motion, so that the mass gets the detached from the pan?

$(Take g = 10 m/s^2)$



A. $8.0cm$

B. $10.0cm$

C. any value less than $12.0cm$

D. $4.0cm$

Answer: B

Watch Video Solution

81. A mass (M), attached to a horizontal spring, executes S.H.M. whith amplitude

$A_1. Whenthemass(M)passesthroghitsmeanpositionthenshal \leq rmass($

A_(2). The ration of.

A. $\frac{M}{M+m}$

B. $\frac{M+m}{M}$

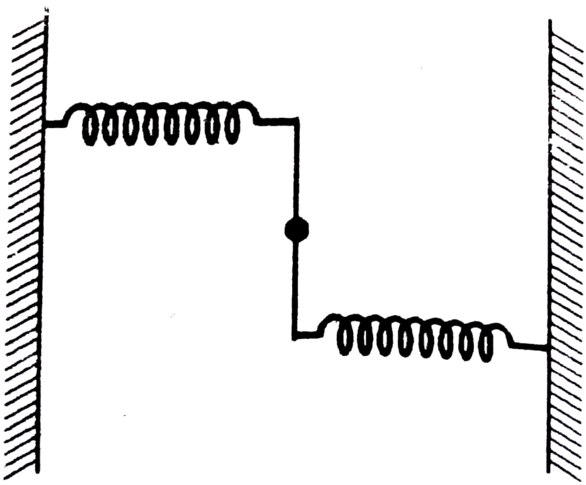
C. $\left(\frac{M}{M+m}\right)^{1/2}$

D. $\left(\frac{M+m}{M}\right)^{1/2}$

Answer: D

Watch Video Solution

82. A uniform rod of length L and mass M is pivotedat the centre. Its two ends are attached to two springs of equal spring constants. k. The springs as shown in the figure, and the rod is free to oscillate in hte horizontal plane. the rod is gently pushed through a small angle θ in one direction and released. the frequency of oscilllation is-



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

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

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

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

Answer: C

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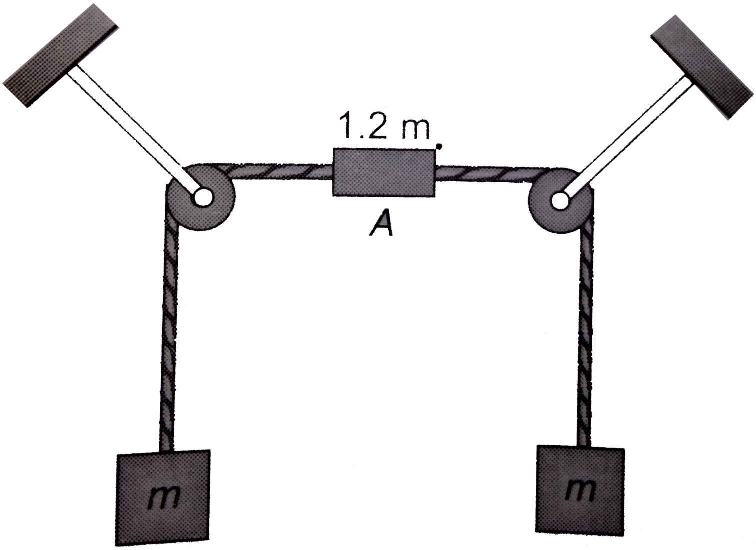
83. In the figure, the vertical sections of the string are long. A is released from rest from the position shown. Then



A. the system will remain equilibrium

B. the central block will move down continuosly

C. the central block will undergo simple harmonic motion

D. the central block will undergo periodic motion but not simple harmonic motion

Answer: A

View Text Solution

84. If a hole is bored along a diameter of the earth and a stone is dipped into the hole, it will

A. reach the centre of the earth and stop there

B. reach the other side of the earth and stop here

C. execute SHM about the centre of the earth

D. execute oscillatory, but not simple harmonic, motion about the centre of the earth

Answer: A

View Text Solution

85. A hole is bored along a diameter of the earth and a particle is dropped into it. If R is the radius of the earth and g is the acceleration due to gravity at the surface of the earth, then the time period of oscillation of the particle is

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

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

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

D. none of these

Answer: A

View Text Solution

86. A particle moves in x-y plane according to rule $x = a\sin\omega t$ and $y = -a\cos\omega t$. The particle follows

A. an elliptical path

B. a circular path

C. a parabolic path

D. a straight line path inclined equal to x and y-axis

Answer: B

Watch Video Solution

87. The motion of a particle is given by $x = A\sin\omega t + B\cos\omega t$. The motion of the particle is

A. not simple harmonic

B. SHM with amplitude $A + B$

C. SHM with amplitude $(A + B)/2$

D. SHM with amplitude $\sqrt{(A^2 + B^2)}$

Answer: D

Watch Video Solution

88. A particle moves on the X-axis according to the equation $x = A + B\sin\omega t$. Let motion is simple harmonic with amplitude

A. A

B. B

C. $A + B$

D. $A + B$

Answer: A

Watch Video Solution

89. The ratio of the amplitudes of the simple harmonic oscillations given by $y_1 = A \sin \omega t$ and

A. 1

B. 2

C. $1/\sqrt{2}$

D. $\sqrt{2}$

Answer: D

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90. The minimum phase difference between the two simple harmonic oscillations $y_1 = \frac{1}{2}\sin\omega t + \left(\frac{\sqrt{3}}{2}\right)\cos\omega t$ and $y_2 = \sin\omega t + \cos\omega t$ is

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

B. $-\frac{\pi}{6}$

C. $\frac{\pi}{12}$

D. $\frac{7\pi}{12}$

Answer: C

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91. A body executes SHM of period $3s$ under the influence of one force, and SHM of period $4s$ under the influence of a second force. When both the forces act simultaneously in the same direction, the period of oscillation will be

A. $7s$

B. $5s$

C. $2\sqrt{3}s$

D. $2.4s$

Answer: D

Watch Video Solution

92. The displacement of a particle is given by $r = A\left(\hat{i}\cos\omega t + \hat{j}\sin\omega t\right)$. The motion of the particle is

A. simple harmonic

B. on a straight line

C. on a circle

D. with constant acceleration

Answer: C

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93. Electrons in an oscilloscope are deflected by two mutually perpendicular oscillating electric field such that at any time the displacement due to them are given by $x = A\cos\omega t$, $y = A\sin\left(\omega t + \frac{\pi}{6}\right)$. Then the path of the electron is

A. a straight line having the equation $x = y$

B. a circle having the equation

C. an ellipse having the equation

$$x^2 - \sqrt{3}xy + y^2 = \frac{A^2}{4}$$

D. an ellipse having the equation

$$x^2 - xy + y^2 = \frac{3A^2}{4}$$

Answer: D

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94. Two particles A and B execute simple harmonic motions of period T and $5T/4$. They start from mean position. The phase difference between them when the particle A complete an oscillation will be

A. $\pi/2$

B. 0

C. $2\pi/5$

D. $\pi/4$

Answer: C

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95. Two simple pendulum of length $5m$ and $20m$ respectively are given small displacement in one direction at the same time. They will again be in the same phase when the pendulum of shorter length has completed oscillation.

A. 5

B. 1

C. 2

D. 3

Answer: C

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96. Two simple pandulum 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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97. Two particles execute SHM of the same time period along the same straight lines. They cross each other at the mean position while going in opposite directions. Their phase difference is

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

B. π

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

D. 2π

Answer: B

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98. Two pendulum of lengths $1m$ and $16m$ are in phase at the mean position at a certain instant of time. If T is the time period of the shorter pendulum, then the minimum time after which they will again be in phase is

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

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

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

D. $\frac{8T}{3}$

Answer: C

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99. Time period of is simple pendulum of length L is T_1 and the point time peirod of a uniform rod of the same length L pivotal about one end and oscillating in vertical plane is T_2. Amplitude of oscillation in both the cased is small. The T_1 / T_2 is:

A. $\frac{1}{\sqrt{3}}$

B. 1

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

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

Answer: D

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100. A disc of radius R and mass M is plvoted at the rim and is set for small oscillation. if simple pendlum has to have the same period as that the of the disc, the length of the simple pendlum should to

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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101. The composition of two simple harmonic motions of equal periods at right angle to each other and with a phase difference of π result in the displacement of the particle along

A. straight line

B. circle

C. ellipse

D. figure of eight

Answer: A

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102. The amplitude and maximum velocity will be respectively $X = 3\sin 2t + 4\cos 2t$The amplitude and maximum velocity will be respectively

A. $5, 10$

B. $3, 2$

C. $4, 2$

D. $3, 4$

Answer: A

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103. A particle moves on the X-axis according to the equation $x = x_0 \sin^2 \omega t$. The motion simple harmonic

A. with amplitude x_0

B. with amplitude $2x_0$

C. with time period $2\pi / \omega$

D. with time period π / ω

Answer: D

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104. A particle moves in the X-Y plane according to the equation $\vec{r} = \left(\vec{i} + 2\vec{j}\right) A \cos \omega t$. The motion of the particle is

A. (i), (ii)

B. (i), (iii)

C. (i), (iii), (iv)

D. (iii), (iv)

Answer: C

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105. A point mass is subjected to two simultaneous sinusoidal displacements in $x - direction, x_1(t) = A\sin(\omega)t$ and $x_2(t) = A\sin\left(\left(\omega t + \frac{2\pi}{3}\right)\right.$.

Adding a third sinusoidal displacement $x_3(t) = B\sin(\omega t + \phi)$ brings the mas to a complete rest. The values of (B) and (phi) are.

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

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

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

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

Answer: B

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106. Three simle harmionic motions in the same direction having the same amplitude (a) and same period are superposed. If each differs in phase from the next by 45°, then.

A. (i), (ii)

B. (ii), (iii)

C. (i), (iii)

D. (i), (iv)

Answer: C

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107. Function $x = A\sin^2\omega t + B\cos^2\omega t + C\sin\omega t\cos\omega t$ represents SHM

(i) For any value of A, B and C(except $C = 0$)

(ii) If $A = -B, C = 2B$, amplitude $= \left|B\sqrt{2}\right|$

(iii) If $A = B, C = 0$

(iv) If $A = B, C = 2B$, amplitude $= |B|$

A. (i), (ii)

B. (ii), (iii)

C. (i), (ii), (iii)

D. (i), (ii), (iv)

Answer: D

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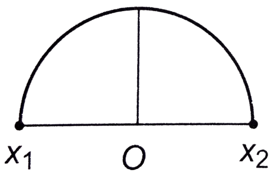
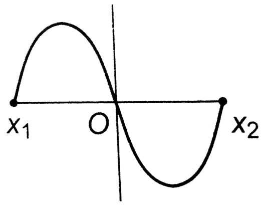
108. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2 the equilibrium position being O its potential energy in plotted it will be as given bellow in the graph



A.



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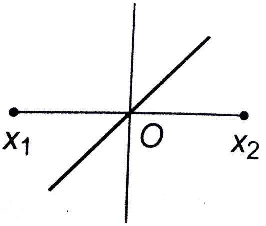

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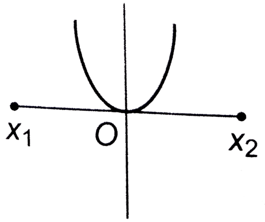

D.

Answer: D

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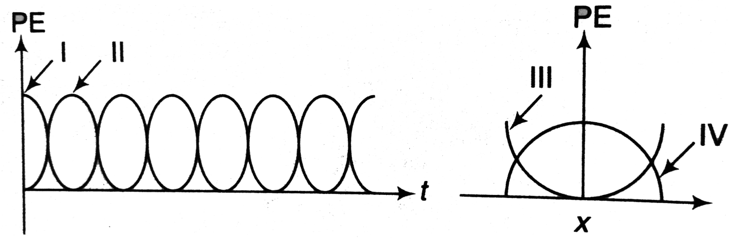
109. For a particle executing SHM, the displacement x is given by $x = A\cos\omega t$. Identify the graph which represents the variation of potential energy (PE) as a function of time t and displacement x.



(a) I, III

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

(d) I, IV

A. I, III

B. II, Iv

C. II, III

D. I, IV

Answer: A

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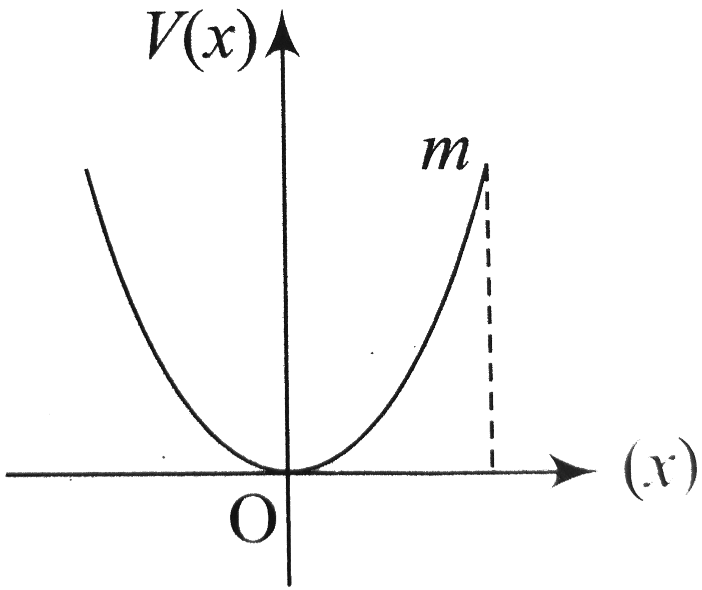
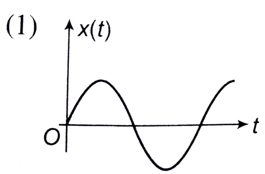
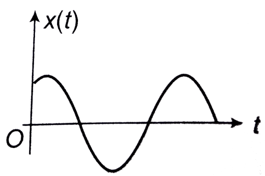
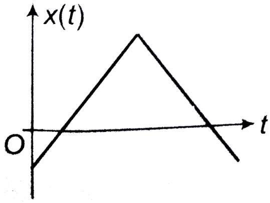
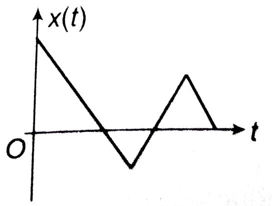
110. A particle of mass m is released from rest and follow a particle part as shown Assuming that the displacement of the mass from the origin is small which graph correctly depicts the position of the particle as a function of time?



A. 

B. 

C. 

D. 

Answer: B

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111. The free and of a simple pendulum is attached to the ceiling of a box. The box is taken to a height and the pendulum is oscillated. When the bob is at its lowest point the box is released to fall freely. As sen from the box during this period the bob will

A. continue its oscillation as before

B. stop

C. will go in a circular path

D. move on a straight line

Answer: C

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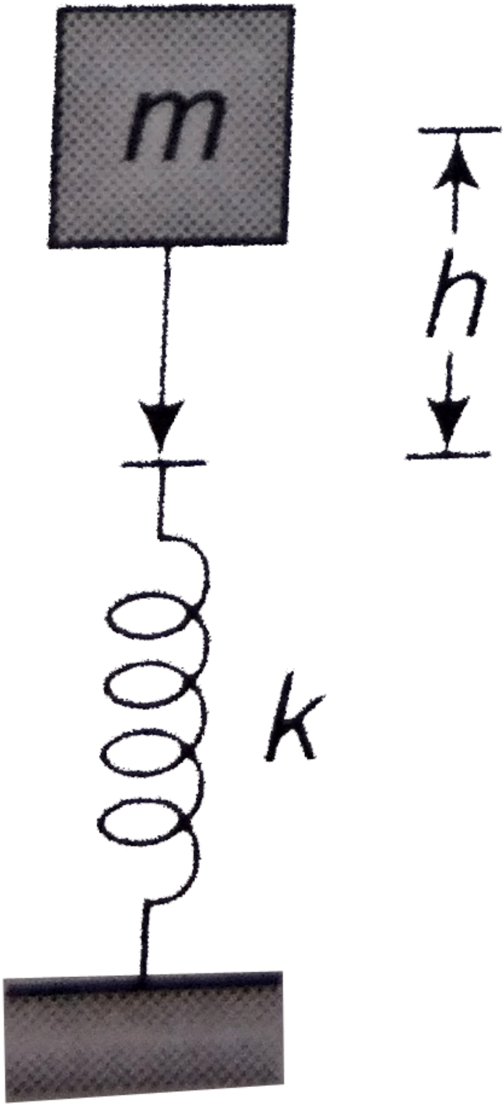
112. A body of mass m falls from a height h onto the pan of a spring balance. The masses of the pan and spring are negligible. The force constant of the spring is k. The body sticks to the pan and oscillates simple harmonically. The amplitude of oscillation is



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

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

C. $\frac{mg}{k}\left(1+\sqrt{1+\frac{2hk}{mg}}\right)$

D. $\frac{mg}{k}\sqrt{1+\left(\frac{2hk}{mg}\right)-1}$

Answer: B

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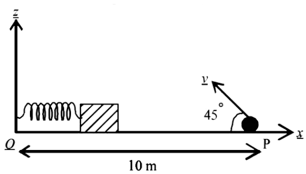
113. A small block is connected to one end of a massless spring of un - stretched length $4.9m$. The other end of the spring (see the figure) is fixed. The system lies on a horizontal frictionless surface. The block is stretched by $0.2m$ and released from rest at $t=0$. It then executes simple harmonic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



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

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

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

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

Answer: A

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

A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. (iii), (iv)

Answer: D

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115. A simple pendulum has time period (T_1). The point of suspension is now moved upward according to the relation $y = Kt^2, (K = 1m/s^2)$ where (y) is the vertical displacement. The time period now becomes (T_2). The ratio of $\frac{T_1^2}{T_2^2}$ is $(g = 10m/s^2)$.

A. $2/3$

B. $5/6$

C. $6/5$

D. $3/2$

Answer: C

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116. 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. proportional to $\frac{1}{\sqrt{a}}$

B. independent of a

C. proportional to $\sqrt{a}$

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

Answer: A

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117. A particle oscillating under a force $\vec{F} = -k\vec{x} - b\vec{v}$ is a (k and b are constants)

A. simple harmonic oscillator

B. non-linear oscillator

C. damped oscillator

D. forced oscillator

Answer: C

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118. The amplitude of a vibrating body situated in a resisting medium

A. decreases linearly with time decreases exponentially with time

B. decreases exponentially with time

C. decreases with time in some other manner

D. remains constant with time

Answer: B

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119. The amplitude of a damped oscillator becomes half in one minutes. The amplitude after 3 minutes will be 1/x times of the original . Determine the value of x.

A. 6

B. 2^3

C. 3^2

D. 1

Answer: B

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120. In case of a forced vibration the resonance wave becomes very sharp when the

A. restoring force is small

B. applied periodic force is small

C. quality factor is small

D. damping force is small

Answer: D

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121. A particle with restoring force proportional to displacement and resisting force proportional to velocity is subjected to force $F \sin \omega t$. If the amplitude of the particle is maximum for $\omega = \omega_1$ and the energy of the particle is maximum for $\omega = \omega_2$, then (where ω_0 natural frequency of oscillation of particle)

A. $\omega_1 = \omega_0$ and $\omega_2 \neq \omega_0$

B. $\omega_1 = \omega_0$ and $\omega_2 = \omega_0$

C. $\omega_1 \neq \omega_0$ and $\omega_2 = \omega_0$

D. $\omega_1 \neq \omega_0$ and $\omega_2 \neq \omega_0$

Answer: C

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122. A weakly damped harmonic oscillator of frequency n_1 is driven by an external periodic force of frequency n_2. When the steady state is reached, the frequency of the oscillator will be

A. n_1

B. n_2

C. $\frac{n_1 + n_2}{2}$

D. $(n_1 + n_2)$

Answer: A

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123. The amplitude of vibration of a particle is given by $a_m = (a_0) / (a\omega^2 - b\omega + c)$, where a_0, a, b and c are positive. The condition for a single resonant frequency is

A. $b^2 = 4ac$

B. $b^2 > 4ac$

C. $b^2 = 5ac$

D. $b^2 = 7ac$

Answer: A

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124. The equation

$$\frac{d^2y}{dt^2} + b\frac{dy}{dt} + \omega^2 y = 0$$

represents the equation of motion for a

A. free vibration

B. damped vibration

C. forced vibration

D. resonant vibration

Answer: A

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125. The equation of a damped simple harmonic motion is $m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$. Then the angular frequency of oscillation is

A. $\omega = \left(\frac{k}{m} - \frac{b^2}{4m^2}\right)^{1/2}$

B. $\omega = \left(\frac{k}{m} - \frac{b}{4m}\right)^{1/2}$

C. $\omega = \left(\frac{k}{m} - \frac{b^2}{4m}\right)^{1/2}$

D. $\omega = \left(\frac{k}{m} - \frac{b^2}{4m^2}\right)^{1/2}$

Answer: A

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