PHYSICS

AAKASH INSTITUTE ENGLISH

OSCILLATIONS

EXAMPLE 1

1. Categorize the motion as periodic or oscillatory motion

(I) Motion of planets around the sun.

(ii) A weighted test tube floating in a liquid pressed down and released

(ii) Motion of hands of a clock.

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2. A nurse in a hospital , noted for a patient that heart was beating 75 times a minutes. Find its frequency and time period.

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3. Which of the following functions of time represented (a) periodic and (b) non-periodic motion ? Given the period for each case of periodic motion (ω is any positive constant(i)$\sin \omega t - \cos \omega t (ii) \log(2\omega)$

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4. Which of the following functions of time represent (a) simple harmonic motion and (b) periodic but not simple harmonic? Give the period for each case.

(1) $\sin \omega t = \cos \omega t$

(2) $\sin^2 \omega t$

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5. Categories the following function of time $3\sin\left(2\omega t - \frac{\pi}{4}\right)$ as

(a) SHM , (b) Periodic but not SHM. Also give the period.

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6.

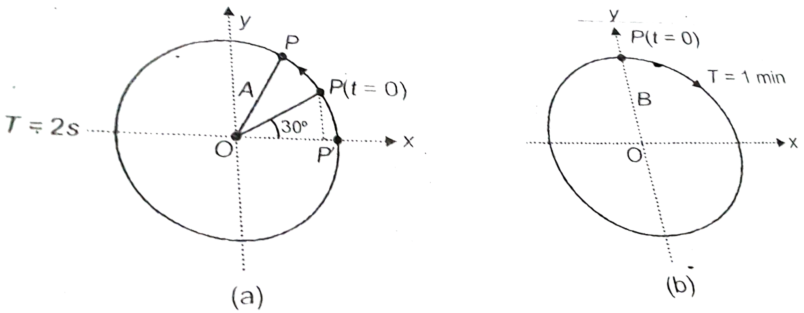

Figure depicts two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated on the figure. Obtain the SHMs of the x-projection of the radius vector of the rotating particle P in each case.

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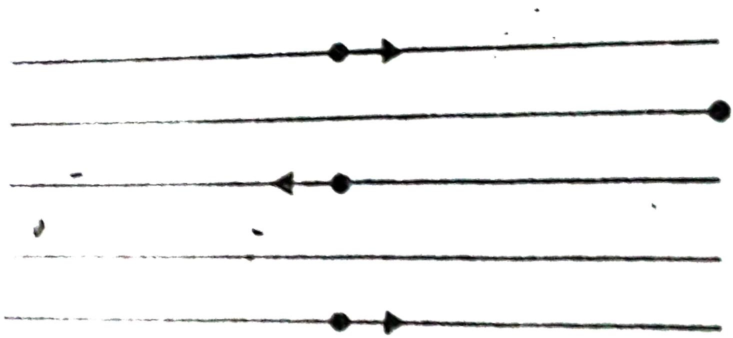
7. In the figure, dots and arrows show the position and the velocity of a paritcle executing SHM. What are the phases at the five indicated instants when the position at time t is given by

$x = A\sin(\omega t + \phi)$



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8. Plot the corresponding reference circle for given SHM, indicate the initial $(t = 0)$ position of the paritcle, the radius of the circle , and the angular speed of the rotating paritcle. Consider anticlockwise direction for rotation. $x = -3\sin\left(2t + \frac{\pi}{4}\right)$ (Express in the form , $x =$ Acos (omega t + phi))`.

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9. Find the time taken by the paritcle in going from $x = 0$ to $x = \frac{A}{2}$ where A is the amplitude.

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10. A particle executes SHM with a time period of 2s and amplitude 10 cm . Find its (i) Displacement (ii) Velocity (iii) Acceleration after 1/6 s, Starting from mean position.

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11. A particle of mass 2 kg executing SHM has amplitude 10 cm and time period is 1 s.Find (i) the angular frequency (ii) the maximum speed (ii) the maximum acceleration (iv) the maximum restoring force (v) the speed when the displacement from the mean position is 8 cm (vi) the speed after $\frac{1}{12}$ s the particle was at the extreme position (vii) the time taken by the particle to go directly from its mean position to half the amplitude

(viii) the time taken by the particle to go directly from its exterme position to half the amplitude.

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12. The speed of a particle executing SHM with amplitude of displacement 5 cm is $3cm / s$ at a distance 2.5 cm from mean position. What will be its speed at a distance $2.5\sqrt{3}$ from mean position?

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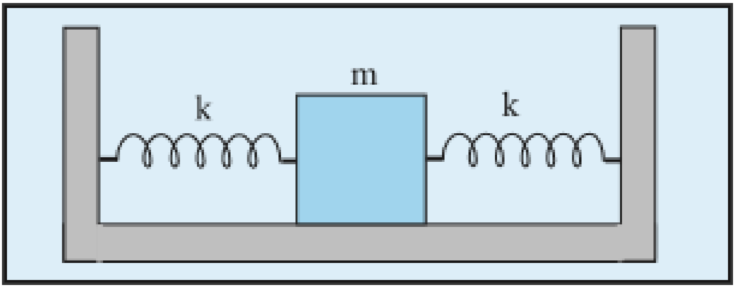
13. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as shown in Fig. 14.14. Show that when the mass is displaced from its equilibrium position on either side, it executes a simple harmonic motion. Find the period of oscillations.



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14. Howdoes the huge ball $\left(5.4 \times 10^5 kg\right)$ hanging on the 22^{nd} floor of one of the world's tallest building (chapter opening question mentioned in the introduction) counter the sway of the building?

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15. A block whose mass is 2 kg is fastened on a spring whose spring constant is 100 Nm^{-1} . It is pulled to a distance of 0.1 m from over a frictionless surface and is released at t=0. Calculate the kinetic eneryg of the block when it is 0.05 m away from its mean position.

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16. A particle executes SHM with amplitude A and time period T. When the displacement from the equilibrium position is half the amplitude , what fractions of the total energy are kinetic and potential energy?

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17. A particle of mass 0.2 kg is excuting SHM of amplitude 0.2 m. When it passes through the mean position its kinetic energy is $64 \times 10^{-3} J$. Obtain the equation of motion of this particle if the initial phase of oscillation is $\pi / 4$.

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18. A 5 kg collar is attached to a spring of spring constant $500 \mathrm{N\,m}^{-1}$. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by 10.0 cm and released. Calculate

(a) the period of oscillation,

(b) the maximum speed and

(c) maximum acceleration of the collar.

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19. What is the length of a simple pendulum, which ticks seconds ?

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20. If the length of a simple pendulum is increased by 2%, then the time period

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21. For the damped oscillator shown in Figure, the mass m of the block is 400 g, $k = 45Nm^{-1}$ and the damping constant b is $80gs^{-1}$. Calculate .

(a) The period of osciallation ,

(b) Time taken for its amplitude of vibrations to drop to half of its initial value and

(c) The time taken for its mechanical energy to drop to half its initial value.

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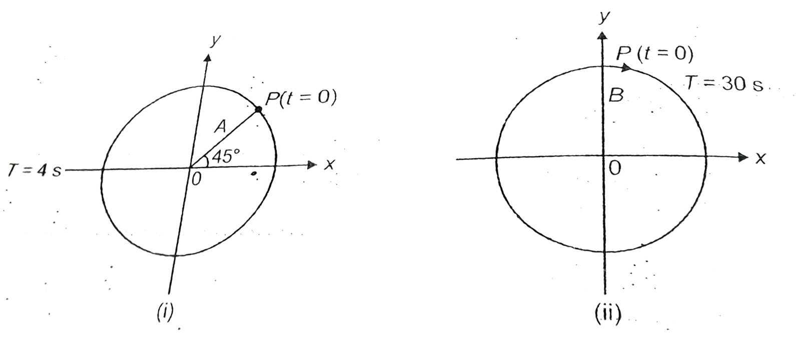
22. The following figure depicts two circular motions. The radius of the circle, the period of revolutin the initial position and the sense of revolution are indicated on the figure. Obtain the simple harmoic motion of the x-projection of the radius vector of the rotating particle P in each case.



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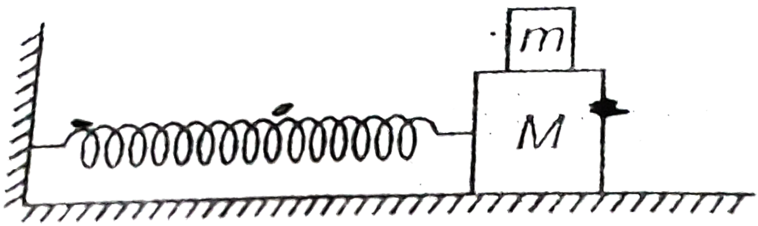
23. A block of mass M attached to the free end of a spring of force constant k is nounted on a smooth horizontal table as shown in figure.



The block executes SHM with amplitude A and frequency f . If an object of mass m is put on it, when the block is passing through its equilibium position and the two move together ,then what is the new amplitude and frequency of vibration?

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Try Yourself

1. Categorize the motion as periodic or oscillatory motion

(i) Motion of Halley 's comet around the sun

(ii) Motion osf the penedulum of a wall clock

(iii) Motion of liquid n a U-tube when liquid is once compresed in one limb and then left to itself

Hint : In oscallatory motion, there is to and fro motion about some mean position.

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2. Is circular motion an exampleos oscillatory motion ?

Hint : Think - is there to and fro motion about some mean position which is the basic concept for oscillatory motion ?

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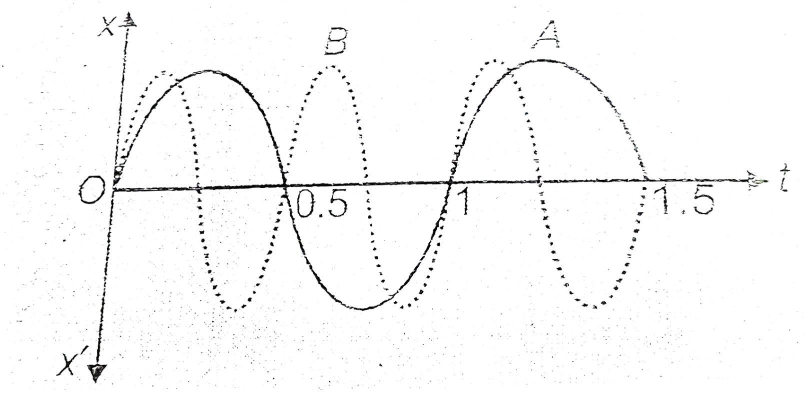
3. From the given graph , find time period and frequency for A and B.



Hint : Find the time after which the motion is repeated . This gives time period T. Frequency $v = \frac{1}{T0}$

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4. The beat frequency of heart of a person is 1.35 H z. How many times, does it beat in a minute ? What is the time period ?

Hint : Number of oscillations in $1s = 1.35$

Find number of oscillations in 60 s , and $T = \frac{1}{v}$

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5. Does $\cos \omega t + \sin 2\omega t + \cos 4\omega t$ represent periodic motion ? If yes, then find the period(ω is any positive constant) .

Hint : (Each term represents a periodic function with different angular freuency . Find the smallest interval of time after which the sum of three terms repeats) .

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6. Does $e^{\omega t}$ represent periodic motion ? Ifyes, then find the period (ω is any positive constant)

Hint : (Think , Does it repeat itself)

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7. Categorise the following function of time : $\cos^2 \omega t$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also , give the period

Hint : $\cos^2 \omega t = \frac{1}{2} + \frac{1}{2}\cos 2\omega t$

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8. Categorise the following function of time : $\cos^3 \omega t$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also find the period.

Hint : $\cos^3 \omega t = \frac{1}{4}(3 \cos \omega t - \cos 3\omega t)$

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9. Categorise the following function of time : $\sin \omega t + \sin 5\omega t$ as

(a) S.H.M.

(b) Periodic but no S.H.M. .Also give the period.

Hint : Find the smallest interval of time after which the sum of 2 terms repeats

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10. Categorise the following function of time $e^{\omega^2 t}$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also , give period if it is periodic motion.

Hint : Doest it repeat itself ?

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11. Obtain the equation of S.H.M. of a particle whose amplitude is 0.02,and whose frequency is 25 Hz. The initial phase is $\frac{\pi}{4}$

Hint : $x = A\sin(\omega t + \phi t)$

$\omega = 2\pi v$

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12. The shortest distance travelled by a particle executing S.H.M. from mean position in 4 seconds is eual to $\frac{1}{\sqrt{2}}$ times its amplitude. Find the time period.

Hint : $t = 4s, x = \frac{1}{\sqrt{2}}, T = ?$

$x = A \sin \omega t, \omega = \frac{2\pi}{T}$

Solve to get T.

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13. A harmonic osciallation is represented by $x = 0.25 \cos(6000t + 0.85)$,where x and t are in mm and second respectively . Deduce (i) amplitude , (ii) frequency (iii) angular frequency

Hint : Compare with $x = A \cos(\omega t + \phi)$ a is amplitude frequency , $v = \frac{\omega}{2\pi}, \omega = 6000 rads^{-1}$

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14. For Question $x = 0.25 \cos(6000t + 0.85)$,find (i) period and (ii) initial phase

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15. Plot the corresponding reference circle for given SHM $x = 2\cos\left(\frac{\pi}{3} - t\right)$ .Indicate the initial $(t - 0)$ position of the particle , the radius of the circle and the angular speed of the rotating particle .

Consider anticlockwise direction for rotation.

Hint : $x = 2\cos\left(\frac{\pi}{3} - t\right) = 2\cos\left(t - \frac{\pi}{3}\right)$ as $\cos(-\theta) = \cos\theta$.

Compare with $x = A\cos(\omega t + \phi)$

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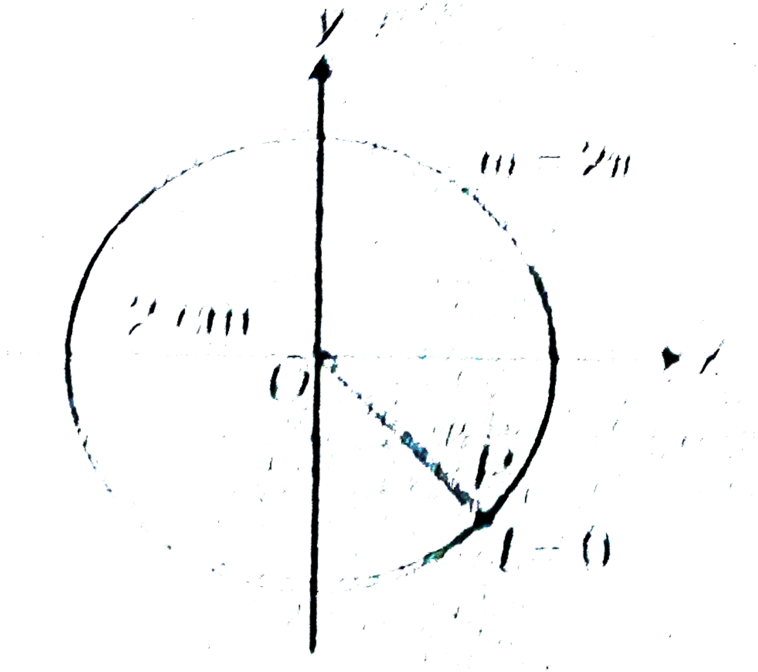
16. The corresponding reference circle for a given SHM has been shown in the figure. Given $\phi = \frac{7\pi}{4}$. Write the corresponding equation of SHM. Consider anticlockwise direction for rotation.



Hint : $x = 2\cos\left(2\pi t + \frac{7\pi}{4}\right)$

$2\cos\left(\frac{3\pi}{2} + \left(2\pi t + \frac{\pi}{4}\right)\right)$

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17. Find the time taken by the particle in going from x = (A)/2) to $x = A$

Hint :$Timetaken \rightarrow goom$x=0 $\rightarrow$ x =A Time taken to go from x=0 $\rightarrow$ x=

(A)/(2)$Requiredtime$= t_(1) - t_(2)`

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18. A particle startsits SHM at $t = 0$. At a particular instant on its way to extreme position , $x = \frac{A}{2}$. Find the time taken by the particle to come back to this point after passing through the extreme position.

Hint : $t_1 =$ time taken to go from $x = 0$ to $x = \frac{A}{2}$

$t_2 =$ time taken to go to extreme position and come back to mean position $= \frac{T}{2}$

Required time $= \frac{T}{2} - t_1$

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19. A particle executes SHM on a straight line path. The amplitude of oscialltion is 3 cm. Magnitude of its acceleration is eqal to that of its velocity when its displacement from the mean position is 1 cm. Find the time period of S.H.M.

Hint : $A = 3cm$

When$x = 1cm$, magnitude of velocity $=$ magnitude of acceleration

i.e., $\omega(A^2 - x^2)\left(\frac{1}{2}\right) = \omega^2 x$

Find ω

$T = (2\pi)(\omega)$

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20. For Question , find maximum velocity and maximum acceleration

Hint : Maximum velocity $= A\omega$

Maximum acceleration $= A\omega^2$

A particle executes SHM on a straight line path. The amplitude of oscillation is 3cm . magnitude of its acceleration is equal to that of its velocity when its displacement from the mean position is 1cm.

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21. The acceleration of a particle performing SHM is$12cm/s^2$ at a distance of 3 cm from the mean position . Calculate its time - period .

Hint : $a = \omega^2 x$

$a = 12cm/s^2, x = 3cm$

Find ω

$$T = \frac{\pi}{\omega}$$

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22. A particle executes simple harmonic motion about $x = 0$ along x-axis. The position of the particle at an instant is given by $x = (5cm)\sin \pi t$. Find the average velocity and average acceleration for a time interval $0 - 0.5s$.

Hint : Average velocity $= \dfrac{x_2 - x_1}{t_2 - t_1}$

$$x_1 = 5 \sin 0$$

$$x_2 = 5 \sin(\pi \times 0.5)$$

$$t_2 - t_1 = 0.5$$

Average acceleration $= \dfrac{v_2 - v_1}{t_2 - t_1}$

$$v = \frac{dx}{dt} = 5\pi \cos \pi t$$

$$\Rightarrow a_{av} = \frac{5\pi \cos(\pi \times 0.5) - 5\pi \cos \theta}{0.5}$$

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23. If maximum speed and acceleration of a particle executing SHM be $10cm/s$ and $100\pi cm/s^2$ respectively ,then find its time period.

Hint : $v_{\max} = A\omega = 10$

$a_{\max} = A\omega^2 = 100\pi$

Solve to get ω

$T = \dfrac{2\pi}{\omega}$

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24. A particle of mass 2 kg is moving with SHM. Its greatest velocity is $40ms^{-1}$ and its amplitude is 20m. Find the time period and the force of attraction towards the centre when the particles is at its greates distance.

Hint : Maximum velocity ,$A\omega = 40ms^{-1}$, $A = 20cm$, find ω .

Then find $T = \dfrac{2\pi}{\omega}$ Force of attractino towards centre $=$ Restoring force $= m\omega^2 A$

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25. The vertical motion of a huge piston in a machine is approximately SHM with a frequency of 1Hz.A block of mass 20 kg is placed on the piston . What is the maximum amplitude of the piston's SHM for the block and the piston to remain together .

Hint : $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Find k

For maximum displacement $x_{\max} = A$

For maximum restoring force , $F = -kA = -mg$

$\therefore A = \frac{mg}{k} = \frac{mg}{m\omega^2} = \frac{g}{\omega^2}$

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26. The vertical motion of a huge piston in a machine is approximately SHM. A block of 5 kg is placed on the piston. The maximum amplitude of the piston's SHM for the block and the piston to remains together is 0.99m. Find the frequency .

Hint : $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Find k

For maximum displacement $x_{\max} = A$

For maximum restoring force , $F = -kA = -mg$

$\therefore k = \frac{mg}{A}$. Put the valeu of K in $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ to find v .

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27. Many builidings have other types of mass dampersas antisway devices (Refers of Example 14) some like the Johns Honacock building in Boston,have a larger block oscillating at the end of spring and an a lubricated track. .Suppose the block has $m = 5.44 \times 10^5 kg$ and is designed to oscillate at a frequency of$5\sqrt{2}$ Hz and with amplitude $x_m = 0.40m$. Find the total mechanical energy E of the spring block system.

Hint : $K = m\omega^2 = m(2\pi v)^2$

$E = K + U = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

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28. For Question , calculate the block's speed asit passes through the equilibrium point ?

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29. If force constant = 100 N/m, find the potential energy of the block at 0.05 m from the mean position

Hint : $P.\ E.\ = \frac{1}{2}kx^2$

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30. For examples 15, find the total energy of the block at 0.05 m from the mean position. Also,show that it issame as the P.E.

Hint : Total energy $= KE + PE$ at maximum displacement , $KE = 0$,hence , total energy $= PE$

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31. At what displacement the kinetic is equal to the potential energy ?

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32. For example , at the time $t=0$, the particle is at its mean position, then at which times, the particle will have potential energy 50% of its total energy within $t=0$ to $t=T$?

Hint : When PE is 50% of total energy $\frac{1}{2}kx^2=\frac{1}{2}.\frac{1}{2}kA^2$

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33. Is it possible for a body executing linear SHM to have a velocity of 0.03 ms^{-1} when its displacement is 0.04 m and a velocity of $0.04ms^{-1}$, when its displacement is$0.03m$? Given amplitude and period of the oscillation are 0.05 m and 6.284 s.

Hint : $v\omega\sqrt{A^2-x^2}$

or $v^2=\omega^2(A^2-x^2)$

$0.03^2=\omega^2(A^2-0.04^2)$ ....(1)

$0.04^2 = \omega^2 (A^2 - 0.03^2)$ ....(2)

Solve equation (1) and(2) to find a and $\omega. T = \frac{2\pi}{\omega}$. The values of A and T should be same as given values.

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34. Find the total energy of oscillations if mass of the body is 100g

A=1m , ω= 2

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35. A 10 kg collar is attached to a spring of spring constant $1000 Nm^{-1}$. It slides without friction over a horizontal surface. If is displaced from its equilibrium position by 20 cm and released . Calculate

(a) The period of oscillation (b) The maximum speed

Hint : $T = 2\pi\sqrt{\frac{m}{k}}, v_m = A\omega = A\sqrt{\frac{k}{m}}$

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36. A 5kg collar is attached to a spring . It slides without friction over a horizontal surface. It is displaced from its equilibrium position by 10 cm and released , its maximum speed is $1ms^{-1}$ Calculate

(a) Spring constant

(b) The period of oscillation

(c) Maximum acceleration of the collar

Hint : $m = 5kg, \ A = 0.1m, \ k = ?, T = ?$ or $a = ?, v_m = 1ms^{-1}$

$$v_m = A\omega = A\sqrt{\frac{k}{m}}$$

Find k,

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

$$a_{\max} = \omega^2 A = \frac{k}{m}A$$

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37. What will be the time period of a pendulum which beats seconds (i.e.,it passes through the mean position after every one second) it its length is doubled ?

Hint : $T = 2\pi\sqrt{\frac{L}{g}} = 2$ ....(i)

$$T' = 2\pi\sqrt{\frac{2L}{g}}$$

Fin T' using equation (i)

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38. The acceleration due to gravity on the surface of earth is $9.8ms^{-2}$ .Time period of a simple pendulum on earth and moon are 3.5 second and 8.4 second respectively. Find the acceleration due to gravity on the moon .

Hint : $T_e = 2\pi\sqrt{\frac{L}{g_e}} T_m = 2\pi\sqrt{\frac{L}{g_m}}$

$$\frac{T_e^2}{T_m^2} = \frac{g_m}{g_e}$$

$$g_m = \frac{T_e^2}{T_m^2} g_e$$

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39. A simple pendulum with a metallic bob has a time period T.The bob is now immersed in a non-viscous liquid and oscillated . If the density of the liuid is $\frac{1}{4}$ that of metal , what will be the time period of the same pendulum?

Hint : If the solid bob of the pendulum has relative densty D and has been submerged in a non-viscous liquid of relative density ρ then effective acceleration due to gravity $g' = g - \frac{g}{n}$ where $n = \frac{D}{\rho}$

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40. Calculate the time period of a simple pendulum whose length is equal to radius of earth.

Hint : $L = R_e = 6.4 \times 10^6 m, g = 9.8 ms^{-2}$

$T' = 2\pi\sqrt{\frac{R_e}{2g}}$

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41. In dampled oscillation , the amplitude of oscillation is reduced to half of its initial value of 5 cm at the end of 25 osciallations. What will be its amplitude when the oscillator completes 50 oscillations ?

Hint : $A = A_0 e^{\frac{-bt}{2m}}$, let T be the time period of oscillation

Case -I : $\frac{A_0}{2} = A_0 e^{-bx\frac{25T}{2m}}$

or $\frac{1}{2} = e^{-25\frac{bT}{2m}}$ ......(i)

Case -II $A = A_0 e^{-b \times 50\frac{T}{2m}}$

$A_0\left(e^{-25\frac{bT}{2m}}\right)^2$

Use euation (i) to find a .

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42. For the damped oscillator shown in previous figure, $k = 180 Nm^{-1}$ and the damping constant b is $40 gs^{-1}$ .Period of oscillation is given as 0.3 s, find the mass of the block . (Assume b is much less than $\sqrt{km}$).

Hint : $T = 2\pi\sqrt{\frac{m}{k}}$

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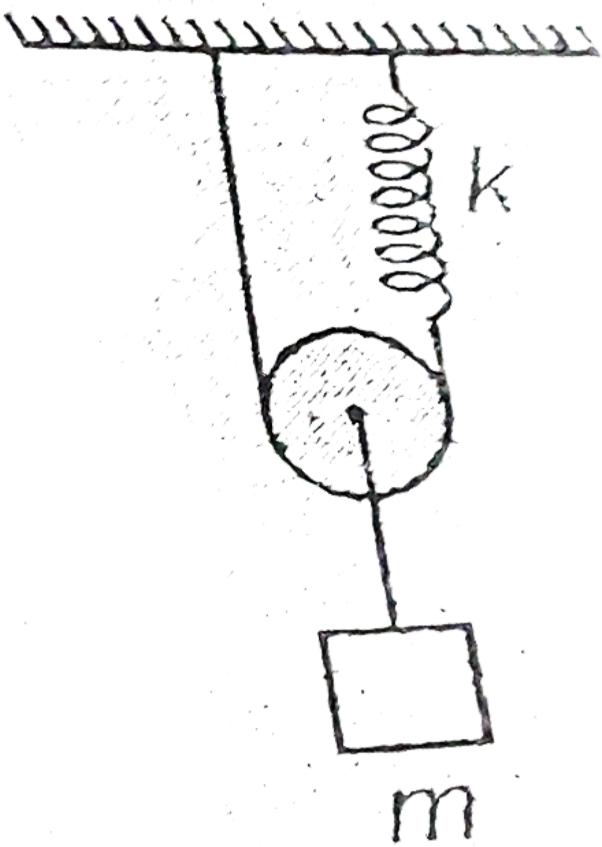
43. Find the time period of osciallation in the shown arrangement.



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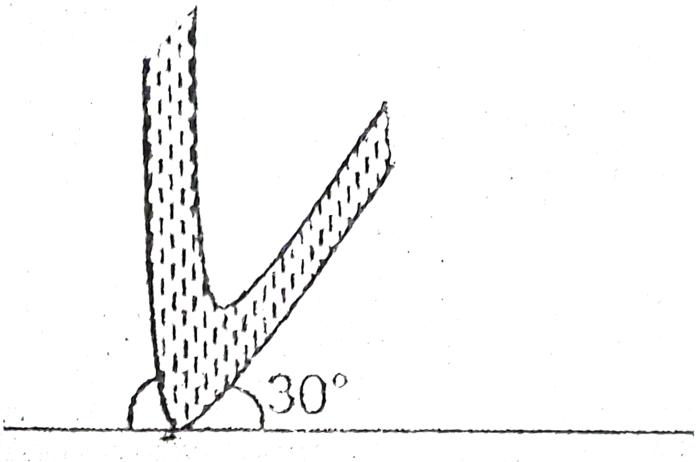
44. Find time period of liquid column of length l in the shown tube.



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45. Categorize the motion as periodic or oscillatory motion

(i) Motion of Halley 's comet around the sun

(ii) Motion osf the penedulum of a wall clock

(iii) Motion of liquid n a U-tube when liquid is once compresed in one limb and then left to itself

Hint : In oscallatory motion, there is to and fro motion about some mean position.

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46. Is circular motion an exampleos oscillatory motion ?

Hint : Think - is there to and fro motion about some mean position which is the basic concept for oscillatory motion ?

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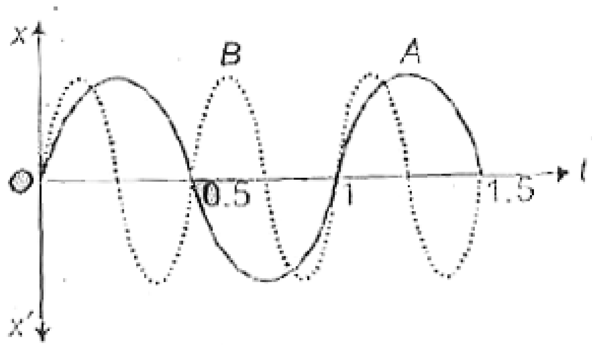
47. From the given graph , find time period and frequency for A and B.



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48. The beat frequency of heart of a person is 1.35 H z. How many times, does it beat in a minute ? What is the time period ?

Hint : Number of oscillations in $1s = 1.35$

Find number of oscillations in 60 s , and $T = \frac{1}{v}$

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49. Does $\cos \omega t + \sin 2\omega t + \cos 4\omega t$ represent periodic motion ? If yes, then find the period(ω is any positive constant) .

Hint : (Each term represents a periodic function with different angular freuency . Find the smallest interval of time after which the sum of three terms repeats) .

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50. Does $e^{\omega t}$ represent periodic motion ? Ifyes, then find the period (ω is any positive constant)

Hint : (Think , Does it repeat itself)

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51. Categorise the following function of time : $\cos^2 \omega t$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also , give the period

Hint : $\cos^2 \omega t = \frac{1}{2} + \frac{1}{2}\cos 2\omega t$

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52. Categorise the following function of time : $\cos^3 \omega t$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also find the period.

Hint : $\cos^3 \omega t = \frac{1}{4}(3\cos \omega t - \cos 3\omega t)$

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53. Categorise the following function oftime : $\sin \omega t + \cos \omega t$ as

(a) Simple harmonic motion

(b) Periodic but not simple harmonic. Also, give the period.

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54. Categorise the following function of time $e^{\omega^2 t}$ as

(a) S.H.M.

(b) Periodic but not S.H.M. Also , give period if it is periodic motion.

Hint : Doest it repeat itself ?

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55. Obtain the equation of S.H.M. of a particle whose amplitude is 0.02,and whose frequency is 25 Hz. The initial phase is $\frac{\pi}{4}$

Hint : $x = A\sin(\omega t + \phi t)$

$\omega = 2\pi v$

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56. The shortest distance travelled by a particle executing S.H.M. from mean position in 4 seconds is eual to $\frac{1}{\sqrt{2}}$ times its amplitude. Find the time period.

Hint : $t = 4s, x = \frac{1}{\sqrt{2}}, T = ?$

$x = A \sin \omega t, \omega = \frac{2\pi}{T}$

Solve to get T.

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57. A harmonic osciallation is represented by $x = 0.25 \cos(6000t + 0.85)$,where x and t are in mm and second respectively . Deduce (i) amplitude , (ii) frequency (iii) angular frequency

Hint : Compare with $x = A \cos(\omega t + \phi)$ a is amplitude frequency , $v = \frac{\omega}{2\pi}, \omega = 6000 rads^{-1}$

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58. For Question $x = A \cos(\omega t + \phi)$,find (i) period and (ii) initial phase

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59. Plot the corresponding reference circle for given SHM $x = 2\cos\left(\frac{\pi}{3} - t\right)$ .Indicate the initial $(t - 0)$ position of the particle , the radius of the circle and the angular speed of the rotating particle . Consider anticlockwise direction for rotation.

Hint : $x = 2\cos\left(\frac{\pi}{3} - t\right) = 2\cos\left(t - \frac{\pi}{3}\right)$ as $\cos(-\theta) = \cos\theta$.

Compare with $x = A\cos(\omega t + \phi)$

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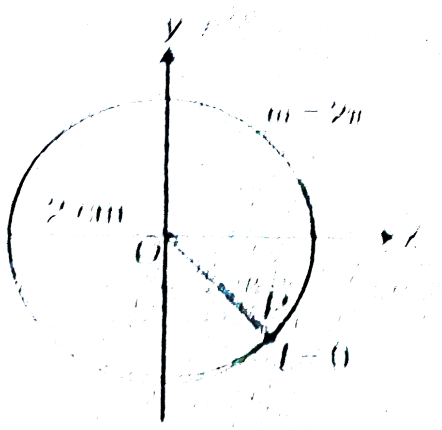
60. The corresponding reference circle for a given SHM has been shown in the figure. Given $\pi = \frac{7\pi}{4}$. Write the corresponding equation of SHM. Consider anticlockwise direction for rotation.



Hint : $x = 2\cos\left(2\pi t + \frac{7\pi}{4}\right)$

$2\cos\left(\frac{3\pi}{2} + \left(2\pi t + \frac{\pi}{4}\right)\right)$

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61. Find the time taken by the particle in going from x = (A)/2) to $x = A$

Hint :$Timetaken \rightarrow goom$x=0 $\rightarrow$ x =A Time taken to go from x=0 $\rightarrow$ x= (A)/(2)$Requiredtime$= t_(1) - t_(2)`

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62. A particle startsits SHM at $t = 0$. At a particular instant on its way to extreme position , $x = \frac{A}{2}$. Find the time taken by the particle to come back to this point after passing through the extreme position.

Hint : $t_1 =$ time taken to go from $x = 0$ to $x = \frac{A}{2}$

$t_2 =$ time taken to go to extreme position and come back to mean position $= \frac{T}{2}$

Required time $= \frac{T}{2} - t_1$

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63. A particle executes SHM on a straight line path. The amplitude of oscialltion is 3 cm. Magnitude of its acceleration is eqal to that of its velocity when its displacement from the mean position is 1 cm. Find the time period of S.H.M.

Hint : $A = 3cm$

When$x = 1cm$, magnitude of velocity $=$ magnitude of acceleration

i.e., $\omega(A^2 - x^2)\left(\frac{1}{2}\right) = \omega^2 x$

Find ω

$T = (2\pi)(\omega)$

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64. For Question , find maximum velocity and maximum acceleration

Hint : Maximum velocity $= A\omega$

Maximum acceleration $= A\omega^2$

A particle executes SHM on a straight line path. The amplitude of oscillation is 3cm . magnitude of its acceleration is equal to that of its velocity when its displacement from the mean position is 1cm.

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65. The acceleration of a particle performing SHM is$12cm/s^2$ at a distance of 3 cm from the mean position . Calculate its time - period .

Hint : $a=\omega^2x$

$a=12cm/s^2, x=3cm$

Find ω

$T=\frac{\pi}{\omega}$

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66. A particle executes simple harmonic motion about $x=0$ along x-axis. The position of the particle at an instant is given by $x=(5cm)\sin\pi t$. Find the average velocity and average acceleration for a time interval $0-0.5s$.

Hint : Average velocity $= \dfrac{x_2 - x_1}{t_2 - t_1}$

$x_1 = 5\sin 0$

$x_2 = 5\sin(\pi \times 0.5)$

$t_2 - t_1 = 0.5$

Average acceleration $= \dfrac{v_2 - v_1}{t_2 - t_1}$

$v = \dfrac{dx}{dt} = 5\pi\cos\pi t$

$$\Rightarrow a_{av} = \frac{5\pi\cos(\pi \times 0.5) - 5\pi\cos\theta}{0.5}$$

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67. If maximum speed and acceleration of a particle executing SHM be $10 cm/s$ and $100\pi cm/s^2$ respectively ,then find its time period.

Hint : $v_{\max} = A\omega = 10$

$a_{\max} = A\omega^2 = 100\pi$

Solve to get ω

$T = \dfrac{2\pi}{\omega}$

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68. A particle of mass 2 kg is moving with SHM. Its greatest velocity is $40ms^{-1}$ and its amplitude is 20m. Find the time period and the force of attraction towards the centre when the particles is at its greates distance.

Hint : Maximum velocity ,$A\omega = 40ms^{-1}$, $A = 20cm$, find ω .

Then find $T = \frac{2\pi}{\omega}$ Force of attractino towards centre $=$ Restoring force $= m\omega^2 A$

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69. The vertical motion of a huge piston in a machine is approximately SHM with a frequency of 1Hz.A block of mass 20 kg is placed on the piston . What is the maximum amplitude of the piston's SHM for the block and the piston to remain together .

Hint : $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Find k

For maximum displacement $x_{\max} = A$

For maximum restoring force , $F = -kA = -mg$

$$\therefore A = \frac{mg}{k} = \frac{mg}{m\omega^2} = \frac{g}{\omega^2}$$

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70. The vertical motion of a huge piston in a machine is approximately SHM. A block of 5 kg is placed on the piston. The maximum amplitude of the piston's SHM for the block and the piston to remains together is 0.99m. Find the frequency .

Hint : $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Find k

For maximum displacement $x_{\max} = A$

For maximum restoring force , $F = -kA = -mg$

$\therefore k = \frac{mg}{A}$. Put the valeu of K in $v = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ to find v .

Watch Video Solution

71. Many builidings have other types of mass dampersas antisway devices (Refers of Example 14) some like the Johns Honacock building in Boston,have a larger block oscillating at the end of spring and an a lubricated track. .Suppose the block has $m = 5.44 \times 10^5 kg$ and is

designed to oscillate at a frequency of$5\sqrt{2}$ Hz and with amplitude $x_m = 0.40m$. Find the total mechanical energy E of the spring block system.

Hint : $K = m\omega^2 = m(2\pi v)^2$

$E = K + U = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

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72. For Question , calculat the block's speed asit passes through the equilibrium point ?

Hint : $E = K + U = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}mv^2 + 0$. Calculate v

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73. find the potential energy of the block at 0.05 m from the mean position

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74. For examples , find the potential energy of the block at 0.05 m from the mean position

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75. At what displacement the kinetic is equal to the potential energy ?

Hint : $U = \frac{1}{2}kx^2, K = \frac{1}{2}(A^2 - x^2)$

$U = K$

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76. For example , at the time $t = 0$, the particle is at its mean position, then at which times, the particle will have potential energy 50% of its total energy within $t = 0$ to $t = T$?

Hint : When PE is 50% of total energy $\frac{1}{2}kx^2 = \frac{1}{2}. \frac{1}{2}kA^2$

Watch Video Solution

77. Is it possible for a body executing linear SHM to have a velocity of 0.03 ms^{-1} when its displacement is 0.04 m and a velocity of $0.04 ms^{-1}$, when its displacement is $0.03m$? Given amplitude and period of the oscillation are 0.05 m and 6.284 s.

Hint : $v\omega\sqrt{A^2 - x^2}$

or $v^2 = \omega^2(A^2 - x^2)$

$0.03^2 = \omega^2(A^2 - 0.04^2)$ ....(1)

$0.04^2 = \omega^2(A^2 - 0.03^2)$ ......(2)

Solve equation (1) and(2) to find a and ω. $T = \frac{2\pi}{\omega}$. The values of A and T should be same as given values.

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78. Find the total energy of oscillation if mass of the body is 100g and angular velocity 1 rad/sec and amplitude is 0.05 meter

Hint : $m = 100 \times 10^{-3} kg$

Energy $= \frac{1}{2} m A^2 \omega^2$

Watch Video Solution

79. A 10 kg collar is attached to a spring of spring constant $1000 Nm^{-1}$. It slides without friction over a horizontal surface. If is displaced from its equilibrium position by 20 cm and released . Calculate

(a) The period of oscillation (b) The maximum speed

Hint : $T = 2\pi\sqrt{\frac{m}{k}}, v_m = A\omega = A\sqrt{\frac{k}{m}}$

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80. A 5kg collar is attached to a spring . It slides without friction over a horizontal surface. It is displaced from its equilibrium position by 10 cm and released , its maximum speed is $1ms^{-1}$ Calculate

(a) Spring constant

(b) The period of oscillation

(c) Maximum acceleration of the collar

Hint : $m = 5kg, A = 0.1m, k = ?, T = ?$ or $a = ?, v_m = 1ms^{-1}$

$v_m = A\omega = A\sqrt{\frac{k}{m}}$

Find k,

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

$$a_{\max} = \omega^2 A = \frac{k}{m}A$$

Watch Video Solution

81. What will be the time period of a pendulum which beats seconds (i.e.,it passes through the mean position after every one second) it its length is doubled ?

Hint : $T = 2\pi\sqrt{\frac{L}{g}} = 2$ ....(i)

$$T' = 2\pi\sqrt{\frac{2L}{g}}$$

Fin T' using equation (i)

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82. The acceleration due to gravity on the surface of earth is $9.8ms^{-2}$ .Time period of a simple pendulum on earth and moon are 3.5 second and 8.4 second respectively. Find the acceleration due to gravity on the moon

.

Hint : $T_e = 2\pi\sqrt{\frac{L}{g_e}} T_m = 2\pi\sqrt{\frac{L}{g_m}}$

$$\frac{T_e^2}{T_m^2} = \frac{g_m}{g_e}$$

$$g_m = \frac{T_e^2}{T_m^2} g_e$$

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83. A simple pendulum with a metallic bob has a time period T.The bob is now immersed in a non-viscous liquid and oscillated . If the density of the liuid is $\frac{1}{4}$ that of metal , what will be the time period of the same pendulum?

Hint : If the solid bob of the pendulum has relative densty D and has been submerged in a non-viscous liquid of relative density ρ then effective acceleration due to gravity $g' = g - \frac{g}{n}$ where $n = \frac{D}{\rho}$

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84. Calculate the time period of a simple pendulum whose length is equal to radius of earth.

Hint : $L = R_e = 6.4 \times 10^6 m, g = 9.8 ms^{-2}$

$$T' = 2\pi\sqrt{\frac{R_e}{2g}}$$

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85. In dampled oscillation , the amplitude of oscillation is reduced to half of its initial value of 5 cm at the end of 25 osciallations. What will be its amplitude when the oscillator completes 50 oscillations ?

Hint : $A = A_0 e^{\frac{-bt}{2m}}$, let T be the time period of oscillation

Case -I : $\frac{A_0}{2} = A_0 e^{-bx\frac{25T}{2m}}$

or $\frac{1}{2} = e^{-25\frac{bT}{2m}}$ ......(i)

Case -II$A = A_0 e^{-b \times 50\frac{T}{2m}}$

$$A_0\left(e^{-25\frac{bT}{2m}}\right)^2$$

Use euation (i) to find a .

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86. For the damped oscillator shown in previous figure, $k = 180 Nm^{-1}$ and the damping constant b is $40 gs^{-1}$ .Period of oscillation is given as 0.3 s, find the mass of the block . (Assume b is much less than $\sqrt{km}$).

Hint : $T = 2\pi\sqrt{\frac{m}{k}}$

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ASSIGNMENT (SECTION -A)

1. Choose the correct statement regarding SHM

A. Acceleration is ahead of displacement by phase single of $\frac{\pi}{2}$

B. Acceleration is ahead of displacement by phase angle of π

C. Acceleration is behind displacement by phase angle of π

D. Acceleration is behind displacement by phase angle of $\frac{\pi}{2}$

Answer: 2

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2. Choose the correct statement regarding SHM

A. Acceleration is behind of displacement by phase single of π

B. Acceleration is ahead of velocity by a phase angle of $\frac{\pi}{2}$

C. Acceleration is behind velocity by a phase angle $\frac{\pi}{2}$

D. Acceleration is behind velocity by a phase angle of π

Answer: 2

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3. Choose the correct statement regarding SHM

A. The velocity is ahead of displacement by a phase angle of π

B. The velocity of ahead of displacement by a phase angle of $\frac{\pi}{2}$

C. The velocity is behind displacement by a phase angle of $\frac{\pi}{2}$

D. The velocity is behind displacement by a phase angle of π.

Answer: 2

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4. Choose the correct statement(s) regarding SHM

A. All the three quantities displacement , velocity and acceleration show harmonic variation with time, having same periods

B. The velocity amplitude is ω times the displacement amplitude.

C. The acceleration amplitude is ω times the displacement amplitude

D. All of these

Answer: 4

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5. A particle moves under force $F = 5(x-2)^3$ .Motion of the particle is

A. Translatory

B. Oscillatory

C. SHM

D. All of these

Answer: 2

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6. For a particle showing motion under forces $F = -5(x-2)^2$, the motion is

A. Translatory

B. Oscillatory

C. SHM

D. All of these

Answer: 1

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7. For a particle showing motion under forces $F = -5(x-2)$, the motion is

A. Translatory

B. Oscillatory

C. SHM

D. Both (2) & (3)

Answer: 4

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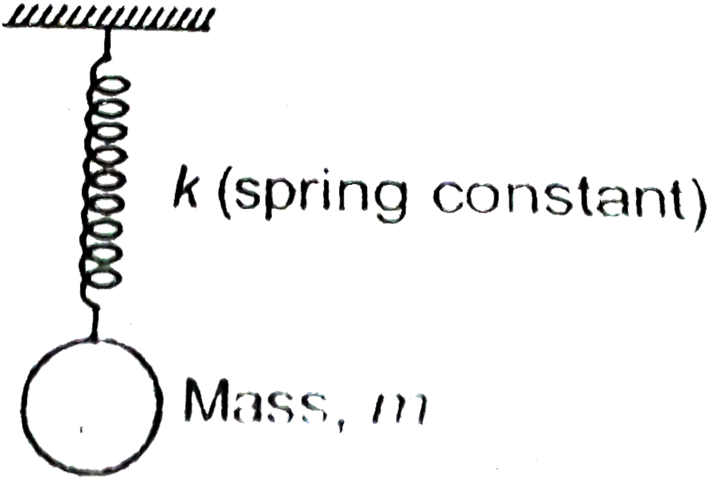
8. Time period of a spring pendulum when lift moves downward with constant velocity v is T second. When the lift moves upward with constant acceleration $= \dfrac{g}{3}$, the time period will be



A. $\dfrac{\sqrt{3}T}{2}$

B. $\dfrac{2T}{\sqrt{3}}$

C. $2T$

D. T

Answer: 4

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9. A hollow sphere is taken as bob of a simple pendulum. This hollow sphere is filled with fine sand. There is a small hole at the bottom of this sphere through which the fine sand leaks out. How does the time period of this simple pendulum alter? Discuss.

A. First decreases,then increases

B. First increases , then decreases

C. Increases

D. Remains same

Answer: 2

Watch Video Solution

10. Mass suspended to a spring is pulled down by 2.5 cm and let go. The mass oscillates with an amplitude of

A. 2.5 cm

B. 5 cm

C. 7.5 cm

D. 10 cm

Answer: 1

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11. A simple pendulum is taken from the equator to the pole. Its period

A. First increases, then decreases

B. Increases

C. Decreases

D. Remains same

Answer: 4

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12. The periodic time of a simple pendulum of length 1 m and amplitude 2 cm is 5 seconds. If the amplitude is made 4 cm , its periodic time in seconds will be

A. $4\sqrt{2}s$

B. 8s

C. 2s

D. 4s

Answer: 4

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13. A particle shows uniform circular motion. Its motion is .

A. Vibratory

B. Periodic and SHM

C. Periodic

D. Periodic but not SHM

Answer: 4

Watch Video Solution

14. A boy is swinging in a swing. If he stands , the time period will

A. First decreases,then increases

B. Decreases

C. Increases

D. Remains same

Answer: 2

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15. Time period of a simple pendulum in a freely falling lift will be

A. Finite

B. Inifinite

C. Zero

D. All of these

Answer: 2

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16. Effective length of a seconds pendulum is about.

A. $0.5m$

B. $1m$

C. $1.5m$

D. 2m

Answer: 2

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17. If the length of a simple pendulum is equal to the radius of the earth, its time period will be

A. $T = \pi\sqrt{\frac{R}{g}}$

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

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

D. $T = 2\pi\sqrt{\frac{R}{2g}}$

Answer: 4

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18. 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.

A. 1s

B. 2s

C. 3s

D. 4s

Answer: 4

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19. Different lengths of pendulum are taken from Earth's surface to $h = R$. Time period remains same for

A. Conical pendulum

B. Simple pendulum

C. Physical pendulum

D. Spring pendulum

Answer: 4

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20. Choose the incorrect statement

A. Phase constant of SHM depends upon initial conditions

B. Total energy $\propto (\text{amplitude})^2$

C. All motions having same time period are SHM

D. All SHMs have fixed time period

Answer: 3

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

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

D. A

Answer: 2

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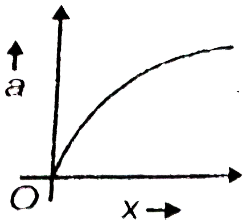
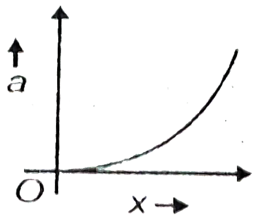
22. Variation of acceleration a of a particle executing SHM with displacement x is



A.



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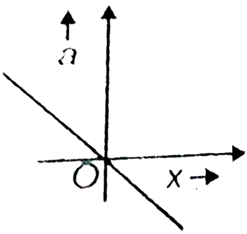
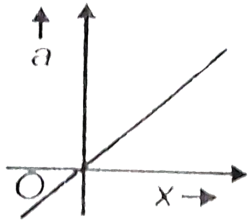


C.

D. 

Answer: 3

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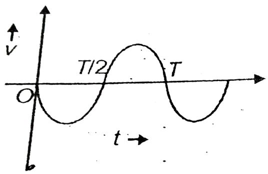
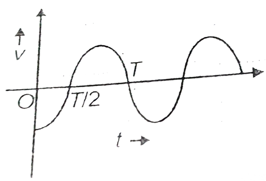
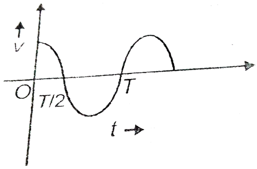
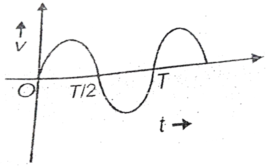
23. Variation of velocity v versus time t in SHM is (Given $x =$ Asinomegat)`

A. 

B. 

C. 

D. 

Answer: 3

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24. If $y = \alpha \cos \omega t + b \sin \omega t$, show that it represents SHM. Determine its amplitude.

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25. A particle executes SHM with frequency 4 Hz. Frequency with which its PE oscillates is

A. 4 Hz

B. 2 Hz

C. 6 Hz

D. 8 Hz

Answer: 4

Watch Video Solution

26. Displacement of a particle executing SHM s $x = 10(\cos \pi t + \sin \pi t)$.

Its maximum speed is

A. $5\pi m / s$

B. $10\pi m / s$

C. $10\sqrt{2}\pi m / s$

D. $5\sqrt{2}\pi m / s$

Answer: 3

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

A. Linear oscillation

B. Forces oscillations

C. Damped oscilation

D. SHM

Answer: 3

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28. Amplitude of vibration is $A = \dfrac{F_0}{p - q + r}$. Resonance will occur when

A. $p = 0, q = r$

B. $p = q = r$

C. $p = \ -r, q = 0$

D. Both (1) & (3)

Answer: 4

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29. A particle is executing SHM with time period T. If time period of its total mechanical energy isT' then $\frac{T'}{T}$ is

A. 2

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

C. Zero

D. Infinite

Answer: 4

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30. Amplitude of a particle executing SHM is a and its time period is T. Its maximum speed is

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

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

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

D. $4aT$

Answer: 3

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31. A particle osciallates with SHM according to the equation $x = (2.5m)\cos\left[(2\pi t) + \frac{\pi}{4}\right]$. Its speed at $t = 1.5$ s is

A. $11.1ms^{-1}$

B. $22.2ms^{-1}$

C. $33.3ms^{-1}$

D. $44.4ms^{-1}$

Answer: 1

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32. The periodic time of a particle executing S.H.M. is12 second.After how much intervalfrom$t = 0$ will its displacement be half of its amplitude ?

A. 1s

B. 2s

C. 6s

D. 3s

Answer: 1

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33. A body executing S.H.M.along a straight line has a velocity of $3ms^{-1}$ when it is at a distance of 4m from its mean position and$4ms^{-1}$ when it is at a distance of 3m from its mean position.Its angular frequency and amplitude are

A. $2rads^{-1}\&5m$

B. $1rads^{-1}\&10m$

C. $2rads^{-1}\&10m$

D. $1rads^{-1}\&5m$

Answer: 4

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34. A particle oscillates with S.H.M. according to the equation $x=10\cos\left(2\pi t+\frac{\pi}{4}\right)$. Its acceleration at $t=1.5s$ is

A. $69.78ms^{-2}$

B. $139.56ms^{-2}$

C. $279.12ms^{-2}$

D. 0

Answer: 3

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35. The time period of a particle executing S.H.M.is 12 s. The shortest distance travelledby it from mean position in 2 second is (amplitude is a)

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

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

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

D. a

Answer: 3

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36. Time period of a particle executing SHM is 16s.At time $t = 2s$, it crosses the mean position . Its amplitude of motion is $\frac{32\sqrt{2}}{\pi}m$. Its velocity at $t = 4s$ is

A. $1ms^{-1}$

B. $2ms^{-1}$

C. $4ms^{-1}$

D. $8ms^{-1}$

Answer: 3

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37. Maximum K.E. of a mass of 1 kg executing SHM is18 J . Amplitude of motion is6 cm , its angular frequency is

A. $25rads^{-1}$

B. $50rads^{-1}$

C. $75rads^{-1}$

D. $100rads^{-1}$

Answer: 4

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38. A body of mass 8 kg performs S.H.M. of amplitude 60 cm. The restoring force is 120 N, when the displacement is 60 cm. The time period is

A. $0.628s$

B. $1.256s$

C. $1.884s$

D. $2.512s$

Answer: 2

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39. A body of mass 8 kg performs S.H.M. of amplitude 60 cm. The restoring force is 120 N, when the displacement is 60 cm. The time period is

A. $3ms^{-2}, 0.36J, 0$

B. $1.5ms^{-2}, 0.18J, 0$

C. $1.5ms^{-2}, 0.36J, 0.18J$

D. $15ms^{-2}, 36J, 0$

Answer: 4

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40. A spring of force constant $600Nm^{-1}$ is mounted on a horizontal table. A mass of 1.5 kg is attached to the free end of the spring,pulled sideways to a distance of 2 cm and released . The speed of the mass when the spring is compressed by 1 cm is

A. $0.175ms^{-1}$

B. $0.\ 35ms^{-1}$

C. $0.7ms^{-1}$

D. $1.4ms^{-1}$

Answer: 2

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41. A spring of force constant $600Nm^{-1}$ is mounted on a horizontal table. A mass of 1.5 kg is attached to the free end of the spring, pulled sideways to a distance of 2 cm and released .P.E. of the mass when it momentarily comes to rest and total energy are

A. $0.12J, 0$

B. $0, 0.12J$

C. $0, 0$

D. $0.12J, 0.12J$

Answer: 4

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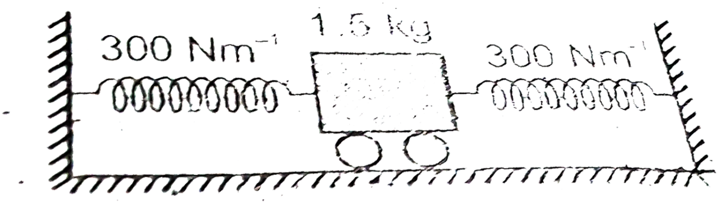
42. A mass of 1.5 kg is connected to two identical springs each of force constant $300 Nm^{-1}$ as shown in the figure. If the mass is displaced from its equilibrium position by 10cm, then the period of oscillation is



A. $0.157s$

B. $0.314s$

C. $0.471s$

D. $0.628s$

Answer: 2

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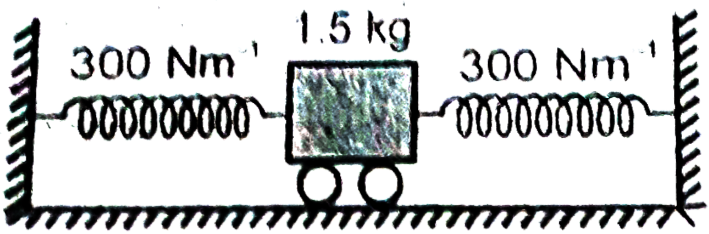
43. A mass of 1.5 kg is connected to two identical springs each of force constant $300 Nm^{-1}$ as shown in the figure. If the mass is displaced from its equilibrium position by 10 cm, then maximum speed of the trolley is



A. $0.5 ms^{-1}$

B. $1 ms^{-1}$

C. $1.5 ms^{-1}$

D. $2 ms^{-1}$

Answer: 4

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44. A spring of spring constant k is cut in three equal pieces. The spring constant of each part will be

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

B. $3k$

C. k

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

Answer: 2

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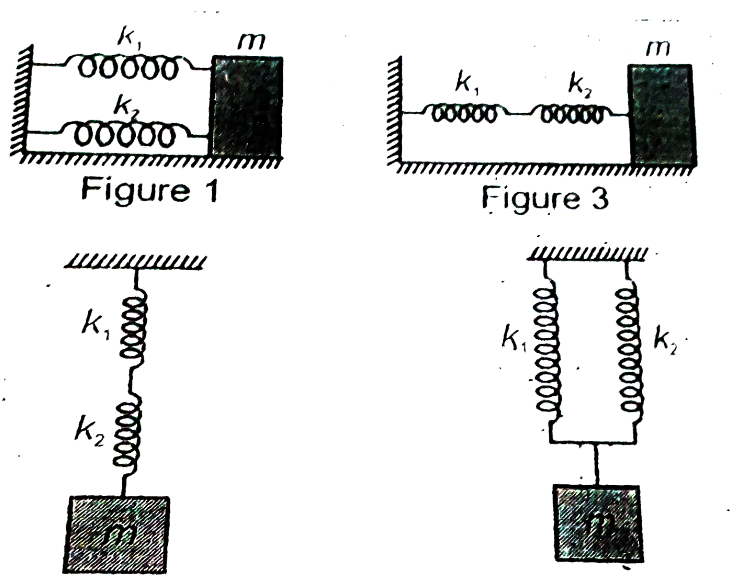
45. Figure-1 to Figure -4 shows four different spring arrangements . Mass m in each arrangement is displacement from its equilibrium position and released Neglec mass of the springs. Choose the correct statement (s)



A. a. Figure-1 and figure -4 shows springs connected in parallel, effective spring constant $= k_1, k_2$

B. b. Figure-2 and figure -3 show spring connected in series , effective spring constant $= \frac{k_1 k_2}{k_1 + k_2}$

C. c. For Figure-1 and Figure -4 frequency of oscillation $= \frac{1}{2\pi}\sqrt{\frac{k_1 + k_2}{m}}$ and for figure-2 and figure-3, frequency of oscillation) $= \frac{1}{2\pi}\sqrt{\frac{k_1 k_2}{m(k_1 + k_2)}}$

D. d. All of these

Answer: 4

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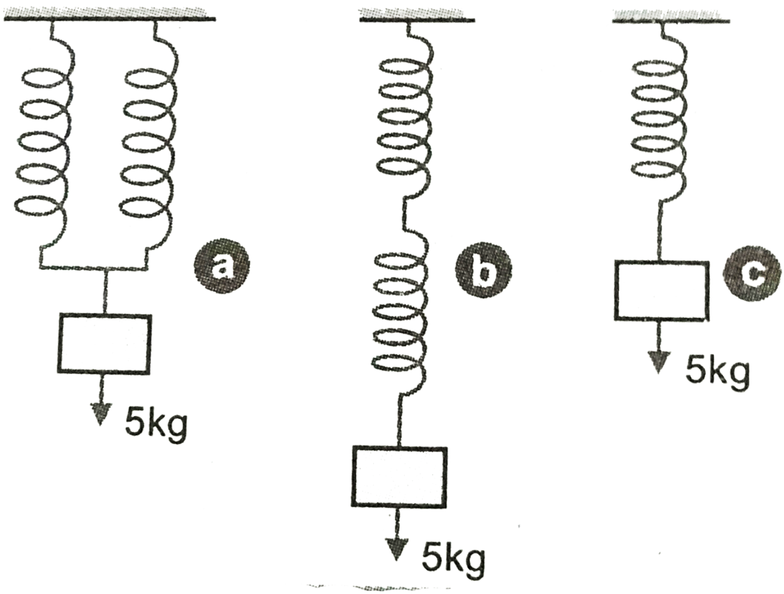
46. Two identical springs have the same force constant of $147 Nm^{-1}$. What elongation will be produced in each spring in each case shown in figure? $g = 9.8 ms^{-2}$.



A. $\frac{1}{6}m, \frac{2}{3}m, \frac{1}{3}m$

B. $\frac{1}{3}m, \frac{1}{3}m, \frac{1}{3}m$

C. $\frac{2}{3}m, \frac{1}{3}m, \frac{1}{6}m$

D. $\frac{1}{3}m, \frac{2}{3}m, \frac{2}{3}m$

Answer: 4

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47. The frequency of oscillation of amass m suspended by a spring is v_1. If length of spring is cut to one third then the same mass oscillations with frequency v_2. Then

A. $v_2 = 3v_1$

B. $3v_2 = v_1$

C. $v_2 = \sqrt{3}v_1$

D. $\sqrt{3}v_2 = v_1$

Answer: 4

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48. The total energy of a simple pendulum is x. When the displacement is half of amplitude,its KE will be

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

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

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

D. x

Answer: 3

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49. The acceleration of a body in SHM is

A. Maximum at the extreme position

B. Maximum at the equilibrium positon

C. Always same

D. Always zero.

Answer: 1

Watch Video Solution

50. In SHM, the plot of acceleration y at time t and displacement x for one complete oscillation will be

A. Ellipse

B. Sinusoidal curve

C. Circle

D. Straight line

Answer: 4

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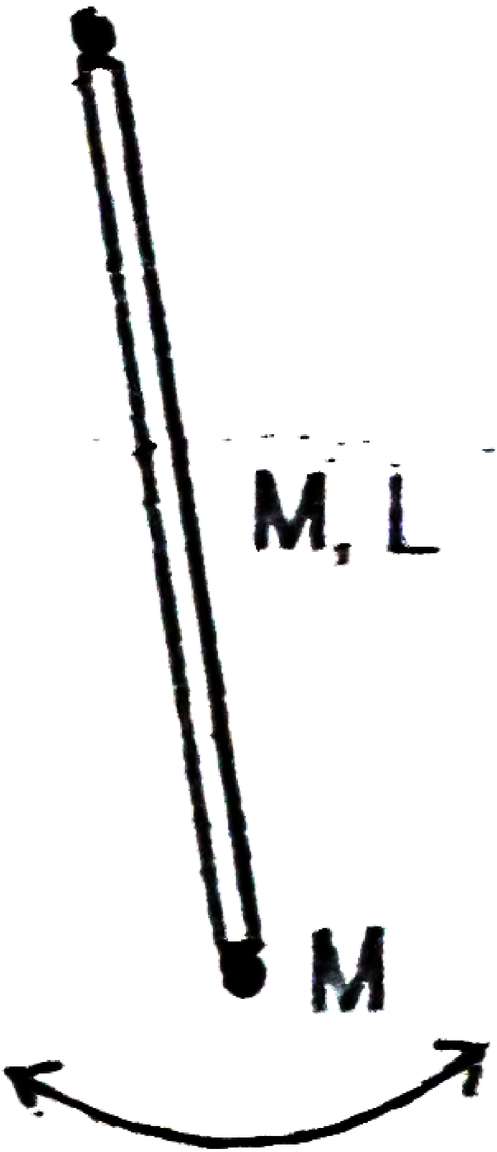
51. A uniform rod ofmass M and length L is hanging from its one end free to rotate in a veritcal plane.A small ball of equal mass is attached of the lowe end as shown. Time period of small oscillations of the rod is



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

B. $2\pi\sqrt{\frac{4L}{3g}}$

C. $2\pi\sqrt{\frac{8L}{3g}}$

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

Answer: 4

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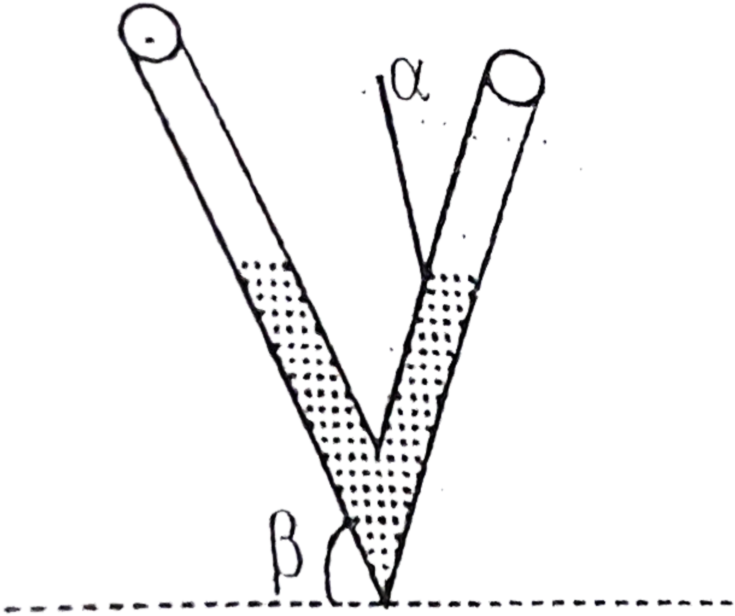
52. An ideal liquid having length of liquid column l is column in V-shape take as shown. If liquid is displaced, then its time period is



A. a. $T = 2\pi\sqrt{\dfrac{l}{g(\cos\beta + \cos\alpha)}}$

B. b. $T = 2\pi\sqrt{\dfrac{l}{g(\sin\beta + \cos\alpha)}}$

C. c. $T = 2\pi\sqrt{\dfrac{l}{g(\sin\alpha + \sin\beta)}}$

D. d. $T = 2\pi\sqrt{\dfrac{l}{g(\sin\alpha + \cos\beta)}}$

Answer: 2

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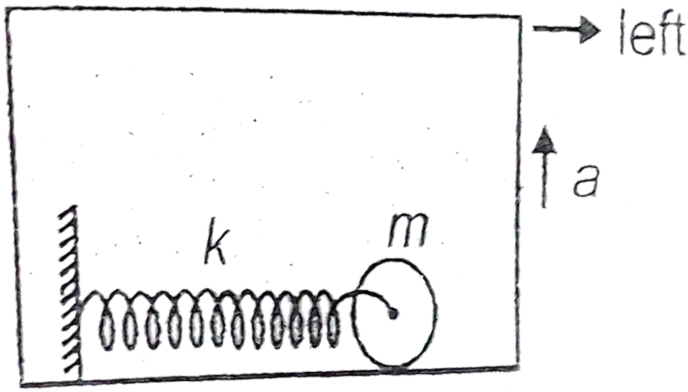
53. In the arrangement shown in figure a solid sphere is attached to spring and displaced, then it starts S.H.M. without slipping, the time period of sphere is



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

B. $T = 2\pi\sqrt{\frac{5m}{7k}}$

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

D. $T = 2\pi\sqrt{\frac{7m}{5k}}$

Answer: 4

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54. A person is standing on an open car moving with a constant velocity of 30 m/s on a straight horizontal road.The men throws a ball in the vertically upward direction and it return to the person after the car has moved 240 m. The speed and angel of projection

In the previous problem if the car moving with a constant acceleration of 2 m/s^2 , the ball will fall behind the person at a distance

A. 32m

B. 64m

C. 96m

D. 16m

A. 32m

B. 64m

C. 96m

D. 16m

Answer: 3

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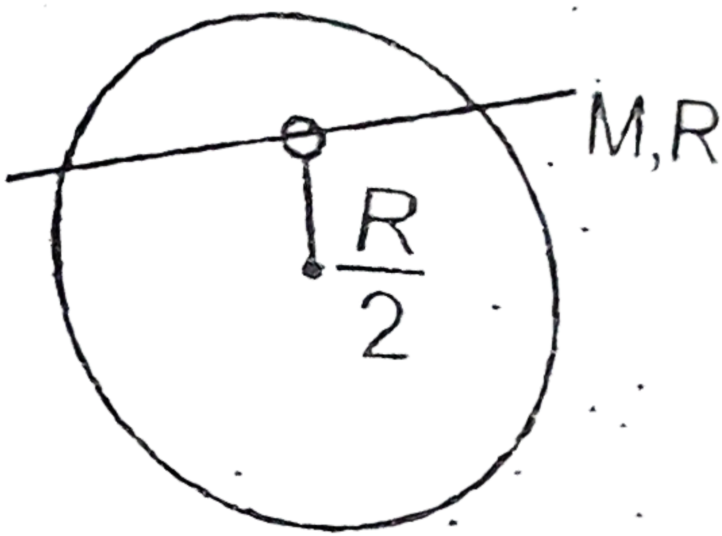
55. A disc is hanging from pin hole as shown in figure and displaced slightly, then its time period.



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

B. $T = 2\pi\sqrt{\frac{3R}{2g}}$

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

D. $T = 2\pi\sqrt{\frac{R}{g}}$

Answer: 2

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56. 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

A. $\frac{1}{2\pi}\sqrt{\frac{YA}{mL}}$

B. $2\pi\sqrt{\frac{mL}{YA}}$

C. $\frac{1}{\pi}\sqrt{\frac{YA}{mL}}$

D. $\pi\sqrt{\frac{mL}{YA}}$

Answer: 1

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57. A heavy brass sphere is hung from a weightless inelastic string and used as a simple pendulum. Its time period of osciallation is T. When the sphere is immersed in a non-viscous liquid of density $\frac{1}{10}$ that of brass. It acts as a simple pendulum of period.

A. T

B. $\frac{10}{9}T$

C. $\sqrt{\frac{9}{10}}T$

D. $\sqrt{\frac{10}{9}}T$

Answer: 4

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58. Two pendulums of lengths 1.44 m and 1 m start oscillating together. After how many oscillations will Activate they again start swinging together?

A. 5 oscillations of smaller amplitude pendulum

B. 6 oscillations of smaller pendulum

C. 4 oscillations of bigger pendulum

D. 6 oscillations of bigger pendulum

Answer: 2

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ASSIGNMENT (SECTION-B)

1. Two particles executing SHM of same frequency, meet at $x = +A/2$, while moving in opposite direction . Phase difference between the particles is

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

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

C. $\frac{5\pi}{6}$

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

Answer: 4

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2. Two S.H.Ms are given by $y_1 = a\sin\left(\frac{\pi}{2}t + \frac{\pi}{2}\right)$ and $y_2 = b\sin\left(\frac{2\pi}{3}t + \frac{\pi}{2}\right)$. The phase difference between these after 1 second is

A. π

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

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

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

Answer: 4

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3. If a graph is plotted between velocity (v) and displacement (y) of a particle executing SHM from mean position, then the nature of the graph is

A. Straight line

B. Parabola

C. Ellipse

D. Hyperbola

Answer: 3

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4. A particle moves according to the equation $x = a \cos \pi t$. The distance covered by it in 2.5 s is

A. 3a

B. 5a

C. 2a

D. 9a

Answer: 2

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5. Two simple harmonic motions are given by $y_1 = 5\sin(\omega t - \pi/3)$. $y_2 = 5(\sin\omega t + \sqrt{3}\cos\omega t)$. Ratio of their amplitudes is

A. $1:2$

B. $1:4$

C. $1:5$

D. $1:8$

Answer: 1

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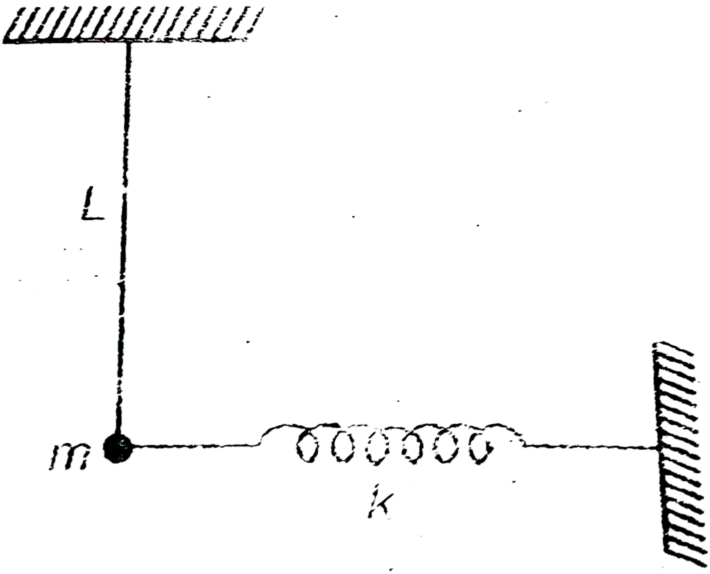
6. If a bob of mass 'm' is attached as shown in figure. When displaced , the pendulum will undero S.H.M. with a period T is equal to



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

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

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

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

Answer: 3

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7. A particle of mass 4 kg moves along x axis, potential energy (U) varies with respect to x as $U = 20 + (x - 4)^2$, maximum speed of paritcle is at

A. $x = 4$

B. $x = 2$

C. $x = 0$

D. $x = 2.5$

Answer: 1

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8. A block of mass m kg hanging from a verticla spring executes simple harmonic motion of amplitude 4 cm . If maximum speed of particle is $8m/s$. Maximum acceleration of block is

A. $800m/s^2$

B. $100m/s^2$

C. $1600m/s^2$

D. $400m/s^2$

Answer: 3

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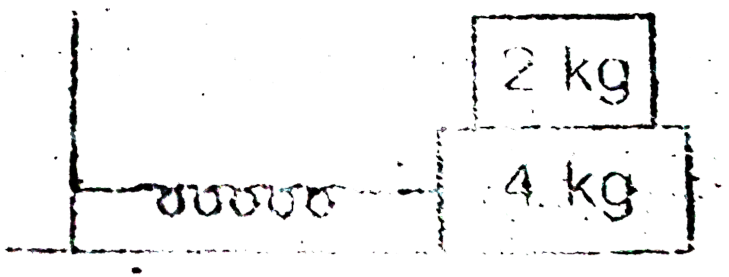
9. A small block of mass 2 kg is placed on a bigger block of mass 4 kg which is attached to horizontal spring of spring constant $K = 500N/m$ as shown in figure, coefficient of friction between block is 0.2 .Maximum amplitude of system so that there is no relative slipping between blocks.



A. 4.8 cm

B. 9.6 cm

C. 2.4 cm

D. 1.2 cm

Answer: 3

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10. A simple harmonic motino has amplitude A and time period T. The maxmum velocity will be

A. $4AT$

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

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

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

Answer: 4

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11. If a ball is dropped from height 2 metre on a smooth eleastic floor, then the time period of oscillation is

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

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

C. $\frac{4}{g}$

D. $\frac{4}{\sqrt{g}}$

Answer: 4

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12. A particle moves in a circular path with a uniform speed. Its motion is

A. Periodic

B. Oscillatory

C. Simple harmonic

D. Angular simple harmonic

Answer: 1

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13. The average acceleration in one time period in a simple harmonic motion is

A. Zero

B. $2A\omega^2$

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

D. $A\omega^2$

Answer: 1

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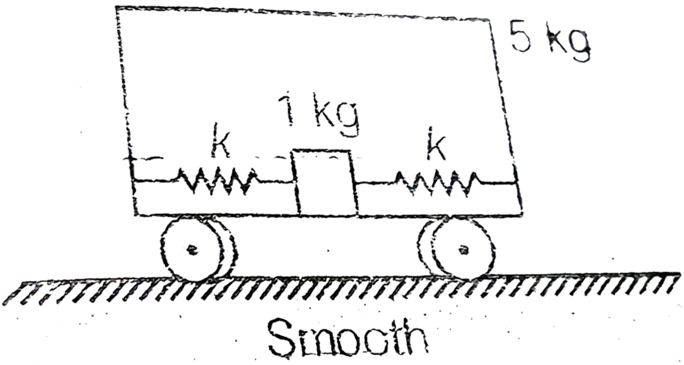
14. A block of mass 1 kg is placed inside a car of mass 5 kg , as shown . The block can slide smoothly along horizontal direction. If block is displaced slightly and released , then time period of osciallation is



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

B. $2\pi\sqrt{\frac{5}{12k}}$

C. $2\pi\sqrt{\frac{12}{5k}}$

D. $2\pi\sqrt{\frac{2}{5k}}$

Answer: 2

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15. A car is moving on a horizontal road with constant acceleration 'a' . A bob of mass 'm' is suspended from the ceiling of car. The mean position about which the bob will oscillate is given by ($'\theta'$ is angle with vertical)

A. $\tan\theta = \dfrac{g}{a}$

B. $\tan\theta = \dfrac{a}{g}$

C. $\tan\theta = \dfrac{2a}{9}g$

D. $\tan\theta = \dfrac{a}{2g}$

Answer: 2

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16. If a particle is executing S.H.M. then the graph between its acceleration and velocity is , in general

A. An ellipse

B. A circle

C. A parabola

D. A hyperbola

Answer: 1

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17. A particle moves along x-axis according to relation $x = 1 + 2\sin\omega t$.

The amplitude of S.H.M. is

A. 2

B. 1

C. $\sqrt{5}$

D. 3

Answer: 1

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18. In a S.H.M. with amplitude 'A', what is the ratio of K.E. and P.E. at $\frac{A}{2}$ distance from the mean position ?

A. $1:4$

B. $3:4$

C. $3:1$

D. $1:3$

Answer: 3

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19. Whatis the displacement equation of S.H.M. with an amplitude 2m , if 120 oscillations are performed during one minute and initial phase is 60° [Consider displacement time equation of the form $y = A\sin(\omega t + \phi)$] ?

A. $2\sin\left(4\pi t + \frac{\pi}{3}\right)$

B. $2\sin(4\pi t)$

C. $2\sin\left(2\pi t\frac{\pi}{3}\right)$

D. $2\sin\left(\pi t + \frac{\pi}{3}\right)$

Answer: 1

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20. A simple pendulum of mass 'm' , swings with maximum angular displacement of 60° . When its angular displacement is 30° ,the tension in the string is

A. Less than mg $\cos 30^\circ$

B. Equal to $mg\cos 30^\circ$

C. Greater than $mg\cos(30^\circ$

D. Zero.

Answer: 3

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21. If P.E. of a system is given by relation $U = \frac{A}{x^2} - \frac{B}{x}$, where 'A'and'B' are positive constant, then the mean positive of S.H.M.is

A. $x = \frac{A}{B}$

B. $x = \frac{B}{A}$

C. $x = \frac{B}{2A}$

D. $x = \frac{2A}{B}$

Answer: 4

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22. If displacement time equation of an S.H.M. is$x = \sin. \frac{\pi t}{6}$, then the moment of times at which peak value of acceleration is attained are

A. 2,4,6,.......s

B. 1,3,5 ....s

C. 3,9,15 ....s

D. 1,2,3.........s

Answer: 3

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23. If a particle executres S.H.M. with time period 4 s when magnitude of resotring force constant is5 N/m and with timper period2 s when magnitude restoring force constant is $20N/m$, then time period under the combined action of two forces willl be

A. $4\sqrt{5}s$

B. $2\sqrt{5}s$

C. $\frac{2}{\sqrt{5}}s$

D. $\frac{4}{\sqrt{5}}s$

Answer: 4

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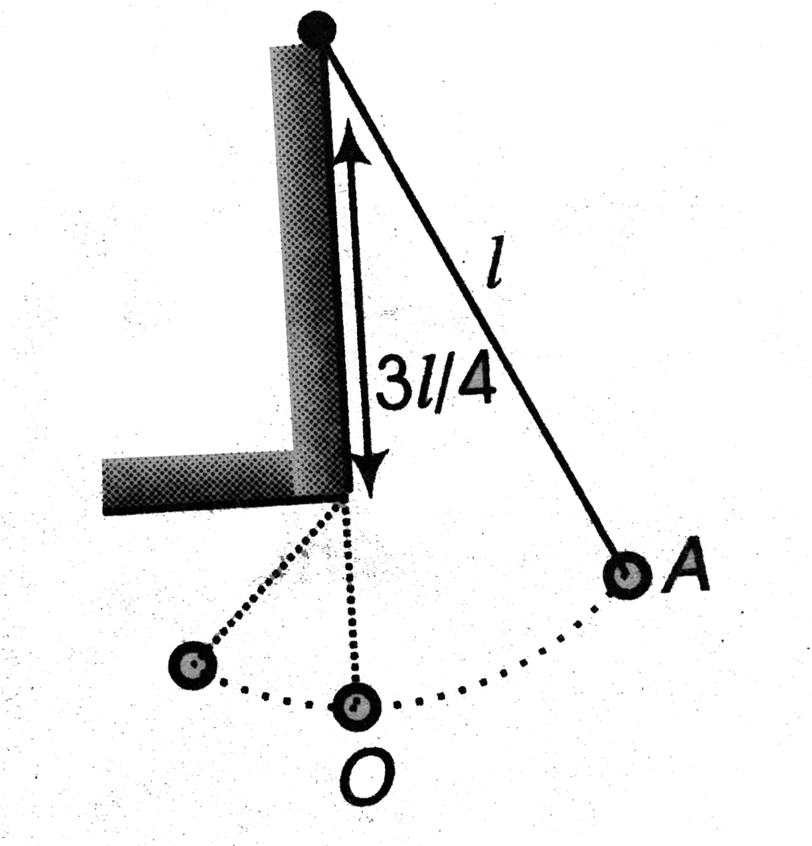
24. A pendulum has a period T for small oscillations. An obstacle is placed directly beneath the pivot, so that only the lowest one - quarter of the string can follow the pendulum bob when it swings to the left of its resting position. The pendulum is released from rest at a certain point. How long will 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.



A. T

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

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

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

Answer: 3

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

A. $T = 2\pi\sqrt{\frac{ml_0}{YA}}$

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

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

D. $T = 2\pi\sqrt{\frac{m(AY + kl_0)}{YAK}}$

Answer: 4

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ASSIGNMENT (SECTION-C)

1. Which of the following will change the time period as they are taken to moon?

A. Spring-block system

B. Torsional pendulum

C. Simple pendulum

D. Physical pendulum

Answer: 3,4

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2. If abody starts executing S.H.M. from mean position with amplitude 'A', maximum velocity v_0 and time period 'T', then the correct statemens are (x is displacement from mean position)

A. If$v=\frac{v_0}{2}$, then $|x|>\frac{A}{2}$

B. if $x = \frac{A}{2}$, then $V > \frac{v_0}{2}$

C. For $t = \frac{T}{8}, x > \frac{A}{2}$

D. For$x = \frac{A}{2}, t < \frac{T}{8}$

Answer: 1,2,3

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3. If a particle is moving as $\vec{r} = \left(\vec{i} + 2\vec{j}\right)\cos\omega_0 t$ then,motion of the particleis

A. Elliptical

B. Along a straight line

C. Periodic

D. Simple harmonic

Answer: 2,3,4

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4. A particle is executing S.H.M. If u_1 and u_2 are the velocitiesof the particle at distances x_1 and x_2 from the mean position respectively, then

A. $T = 2\pi\sqrt{\frac{x_1 + x_2}{u_1 + u_2}}$

B. $T = 2\pi\sqrt{\frac{x_2^2 + x_1^2}{u_1^2 + u_2^2}}$

C. $\omega = \sqrt{\frac{u_2^2 - u_1^2}{x_1^2 - x_2^2}}$

D. $2\pi\sqrt{\frac{u_1 x_2}{u_2 x_1}}$

Answer: 2,3

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5. If the inertial mass m_1 of the bob of a simple pendulum of length 'l' is not equal to the gravitationalmass m_g, then its period is

A. a. $T = 2\pi\sqrt{\frac{m_i l}{m_g.\, g}}$

B. b. $T = 2\pi\sqrt{\frac{m_g. l}{m_i. g}}$

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

D. d. $T = 2\pi\sqrt{\frac{(m_i + m_g)}{(m_i - m_g)}.\frac{l}{g}}$

Answer: 1

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6. If the P.E. of a system of two atoms (diatomic molecule) is given by $U(x) = -2 + 3(x - x_0)^2$, where x_0 is equilibium separation than

A. The restoring force is $-6(x - x_0)$

B. Acceleration of the one action with respect to other is other is $-\frac{6(x - x_0)}{\mu}[\mu \rightarrow$ reduced of system]

C. The restoring force is $\frac{3}{2}(x - x_0)$

D. The acceleratoin of atom is $-\frac{3}{2\mu}(x - x_0)$

Answer: 1,2

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7. Which of the following equations represent S.H.M. ?

A. $y = 2\sin(\omega t + 30^\circ)$

B. $y = 2\cos(\omega t - 30^\circ)$

C. $y = 2\sin\omega t + 3\cos\omega t$

D. $y = 2\sin\omega t.\,\cos\omega t$

Answer: 1,2,3,4

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8. If $a = -\omega^2 x$ represents the acceleration of a particle executing S.H.M.which of the following statement(s) is / are correct ?

A. a' is maximum at the extreme position

B. Timeperiod is $T = 2\pi\sqrt{\omega}$

C. At $x = 0$, the potential energy is maximum

D. At x=0 , the K.E. is maximum

Answer: 1,4

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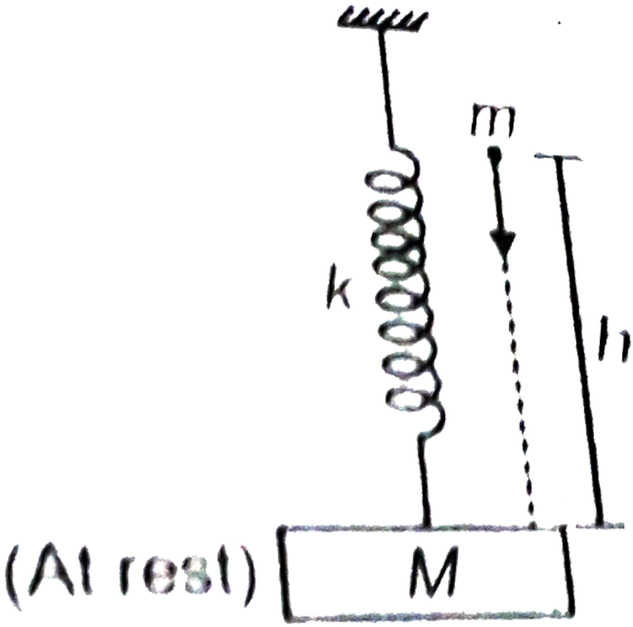
9. A ball is dropped from height 'h' as shown.The collision is perfectly inelastic. Select the correct alternative (s)



A. The speed of the combined blocks just after collision is $\sqrt{2gh}$

B. The speed of the combined blocks just after collision is

$$\left(\frac{m}{M+m}\right)\sqrt{2gh}$$

C. The amplitude of oscillations of the system is $\frac{mg}{k}$

D. The amplitude of osciallations of the system is

$$\frac{mg}{k}\left(1+\frac{2hk}{(M+m)g}\right)^{1/2}$$

Answer: 2

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

A. Maximum potential energy is100J

B. Maximum kinetic energy is 100J

C. Maximum potential energy is160 J

D. Maximum potential energy is zero.

Answer: 2,3

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11. 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 is90°

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: 1,3

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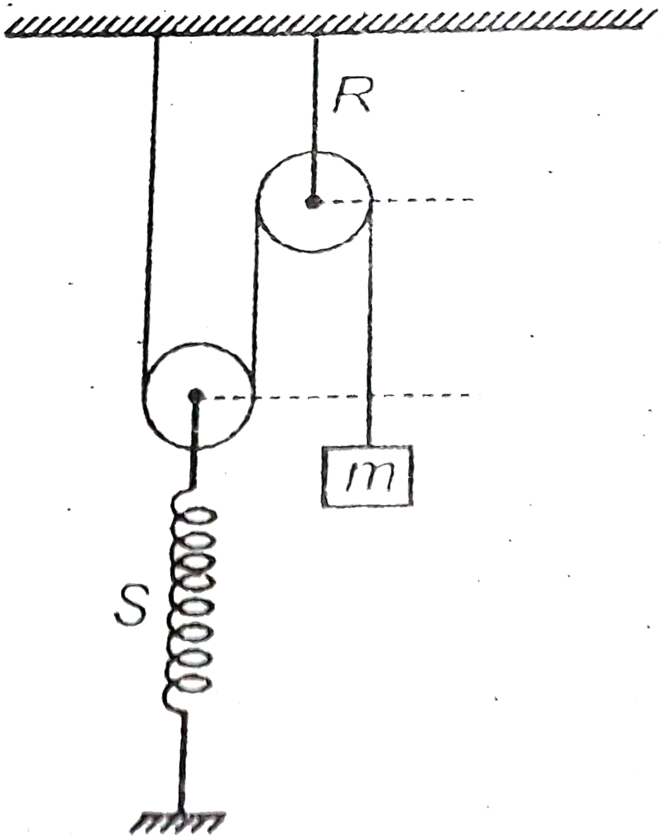
ASSIGNMENT (SECTION -D(Comprehension))

1. A block of mass$m=20g$ is attached to one end of an inextensible thread passing over two frictionless and massless pulleys as shown in figure. The spring constant of the spring is $2\frac{N}{m}$. Suppose the blockis pulled downward and released .



The natural frequency of oscialltion of system is Hz

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

B. $\frac{5}{2\pi}$

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

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

Answer: 2

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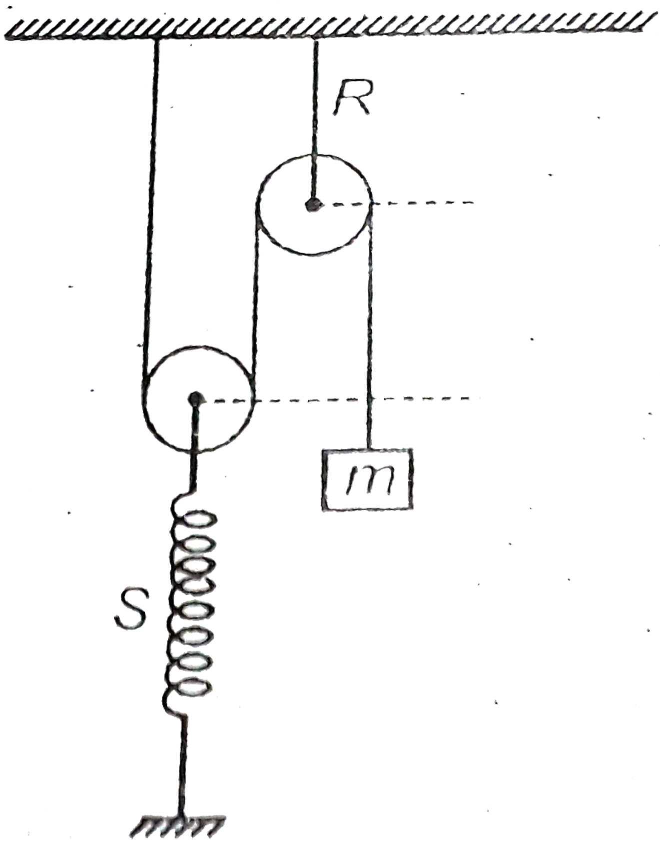
2. A block of mass $m = 20g$ is attached to one end of an inextensible thread passing over two frictionless and massless pulleys as shown in figure. The spring constant of the spring is $2\frac{N}{m}$. Suppose the blockis pulled downward and released .



The natural frequency of oscialltion of system is Hz

A. 10 cm

B. 20 cm

C. 40 cm

D. 5 cm

Answer: 2

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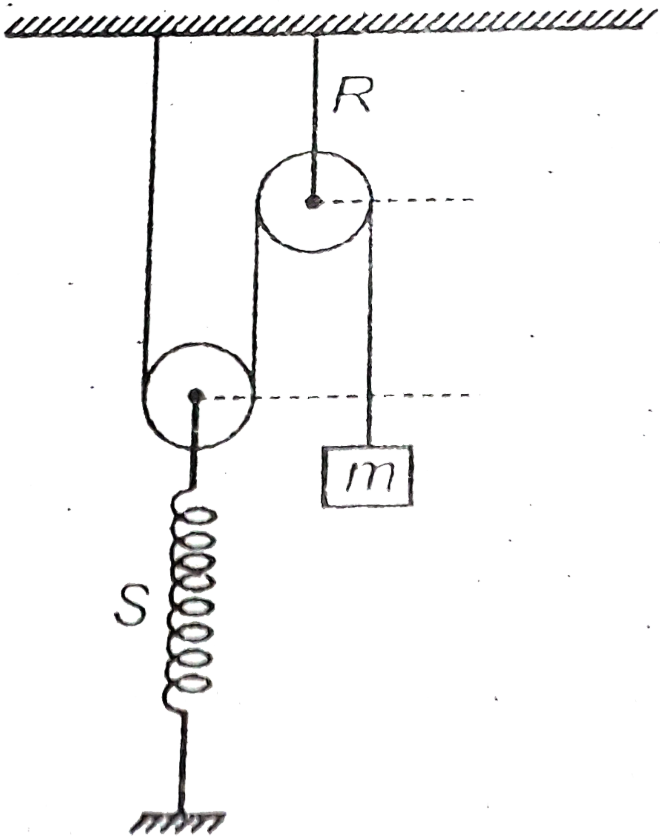
3. A block of mass$m = 20g$ is attached to one end of an inextensible thread passing over two frictionless and massless pulleys as shown in figure. The spring constant of the spring is $2\frac{N}{m}$. Suppose the blockis pulled downward and released .



The natural frequency of oscialltion of system is Hz

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

B. $\frac{5\sqrt{2}}{4\pi}$

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

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

Answer: 2

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ASSIGNMENT (SECTION-E(ASSERTION-REASON TYPE QUESTION))

1. STATEMENT-1 : If a body is floacting submerged,then on pressing, it will execute damped oscillatory motion.

and

STATEMENT-2 : When a body is floating fully submerged and displaced from its position , then no net force acts at its position.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1

B. Statement-1 is True, Statement-2 is True,Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement -1 is False,Statement-2 is True.

Answer: 4

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2. STATEMENT-1: Time period of the liquid executing S.H.M.in a U-tube depends on the area of cross section of U-tube.

and

STATEMENT-2 : The restoring force acting on liquid displaced from equilibrium position of U -tube depends on the difference in levels of liquid in the two limbs of U -tube.

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3. STATEMENT-1: Time period of a simple pendulum changes when the solid bob is replaced by a hollow sphere of same radius but difference mass

and

STATEMENT-2 : The time period of a simple pendulum depends on force acting on bob per unit mass dueto the earth.

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4. STATEMENT-1, The total energy of a particle executing S.H.M(of given amplitude) of depends on the mass of particle but does not depend on its displacement from mean position

and

STATEMENT -2 : The total energy of a particle executing S.H.M. ismaximum at the mean position.

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5. STATEMENT-1: Time periodof oscillation of a simple pendulum mounted in a cabin that is freely falling is zero

and

STATEMENT -2 , In the cabin falling freely under gravity the pendulum is in state of weightlessness.

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6. A uniform plank is resting over a smooth horizontal floor and is pulled by applying a horizontal force at its one end. Which of the following statements are not correct?

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7. Two identical balls are dropped from the surface of earth, on isdropped in atunnel along the diameter of the earth and other isdroppped in tunnel along a chord.

STATEMENT-1 : Both balls will execute S.H.M. with same time period.

and

STATEMENT -2 : Both balls cross their mean position (i.e., centre of earth) with same speed

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8. A simple pendulum is made of a hollow sphere having a small hole in the bottom. The pendulum is made to vibrate after filling it with water.

STATEMENT -1 : Time period of pendulum will first increase upto certain maximum value and then decrease are return to its initial minimum value.

and

STATEMENT-2 : The effective length of osciallation of a simple pendulum first increases andthen decreases toreturn to its initial minimum value

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9. STATEMENT -1 : The time period of oscillation of a simple pendulum of constant length is more at a place inside a mine than on the surface of the earth.

and

STATEMENT -2 : The frequency of oscillations of a simple pendulum is more at a place inside a mine than on the surface of the earth .

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10. STATEMENT -1 : If a simple pendulum is in a carriage which is accelerating downward and acceleration is greater than acceleration due to gravity , then pendulum turns up side down and oscillates about highest point.

and

STATEMENT -2 : The time period of pendulum will be independent of g in above case of pendulum oscillating about highest point.

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11. STATEMENT -1 : The force acting on a particle moving alongx -axis is $F = -\alpha(x + vt)$, where α is a constant.

and

STATEMENT-2 : To an observer moving along x-axis with constant velocity v, it represents SHM.

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12. STATEMENT-1 : The energy is increased because the amplitude is increased .

and

STATEMENT-2 : The amplitude is increased because energy is increased.

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13. STATEMENT-1 : An oscillatory motion is necessarily periodic.

and

STATEMENT -2 : A simple harmonic motion is necessarily osciallatory.

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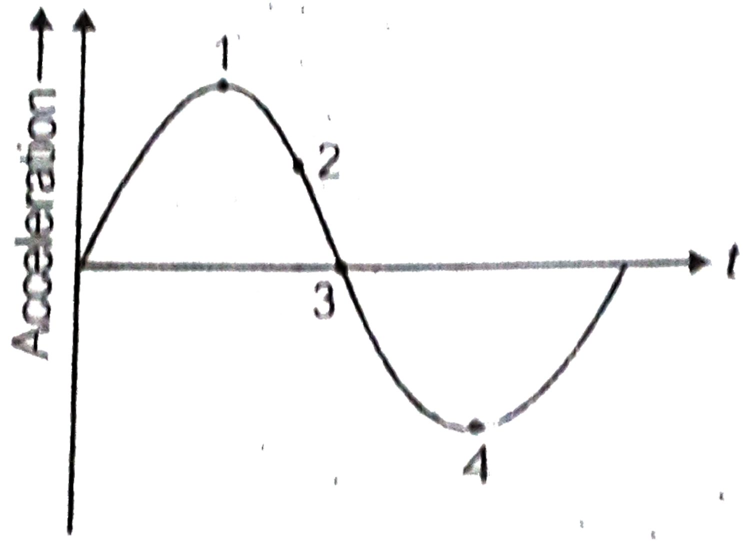
ASSIGNMENT (SECTION-F(MATRIX MATCH TYPE QUESTIONS))

1. The acceleration- time graph of a particle executing SHM along x-axis is shown in figure. Match Column-I with column-II



	Column-I		Column-II
	Position of particle		Physical,quantites related with particle's
(A)	At position 1	(p)	Kinetic energy is maximum
(B)	At position 2	q	Potential energy is maximum
(C)	At position 3	(r)	Displacement of particle is negative
(D)	At position 4	(s)	Velocity is maximum

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2. A simple pendulum of length l is oscillating with a time period T $= 1$ minute . Match the columns.

	Column-I
(A)	Time period if the pendulum is osciallated inside liquid
(B)	Time period if a constant force less than or equal to weight of bob is a
(C)	Time period if the pendulum is oscillated in a moving lift
(D)	Time period if its length becomes equal to radius of earth (R)

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3. A particle is executing simple harmonic motion with frequency f. Match the columns.

	Column-I		Column-II
(A)	Zero	(p)	Frequency with which kinetic energy of particle osci
(B)	t	(q)	Frequency with which potential energy of particle os
(C)	$2f$	(r)	Frequency with which difference between kinetic and
(D)	$4f$	(s)	Frequency with which velocity of paritcle osciallates
		(t)	Frequency with which total mechanical energy oscill

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ASSIGNMENT (Section-G(Integers Answer Type Question))

1. The equation of motion of a body executing S.H.M. is $x = a\cos.\frac{\pi}{3}(t+1)$. Find the time at which the body comes to rest for first time.

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2. Two simple pendulum have lengths land $\frac{25l}{16}$. At $t=0$ they are in same phase after how may oscillations of smaller pendulum will they be again in phase for first time ?

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3. A spring mass system osciallates with a time period 7s. The entiresystem is immersed in a liquid whose density at halt that of the material of the block. Find the new time period (in s) of osciallations.

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4. Starting from the origin a body oscillates simple harmonically with a period of 2s . After time $\frac{1}{x}$ second willthe kinetic energy be 75% of its total energy , then value of x is

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ASSIGNMENT (SECTION-H (MULTIPLE TRUE-FALSE TYPE QUESTIONS))

1. STATEMENT-1 : In SHM the scalar product of velocity and acceleration is always negative .

STATEMENT-2 : Time period of a simple pendulum of very large lenth compared to earth's radius is 1.4 hr.

STATEMENT-3 : For a given amplitude of S.H.M. total energy of spring mass system is independent of mass of body.

A. T.T.F.

B. T.F.T.

C. T.T.T.

D. F.F.F.

Answer: 3

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2. STATEMENT-1: Time period of a physical pendulum is independent of mass of the body.

STATEMENT-2 : Time period of a torsional pendulum is $2\pi\sqrt{\frac{l}{k}}$ where, $l =$ moment of inertia and $k =$ Torsional constant.

STATEMENT-3 : S.H.M. is an example of non-uniform motion.

A. T.T.T

B. F.T.F.

C. T.F.F.

D. F.F.F

Answer: 1

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3. STATEMENT-1 : A particle executing simple harmonic motion comes to rest at the extreme positions.

STATEMENT-2 : Displacement and velocity of SHM differ in phase by $\frac{\pi}{2}$ rad.

STATEMENT- 3 : Soldiers are asked to break steps while crossing the bridges.

A. T.T.T.

B. F.T.F.

C. T.F.F.

D. F.F.F.

Answer: 1

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ASSIGNMENT (SECTION-I(SUBJECTIVE TYPE QUESTIONS))

1. A body undergoing simple harmonic motion has a maximum acceleration of 8 m $/ s^2$, and a maximum speed of$1.6 m / s$. Find the period and the amplitude of the motion.

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2. An object undergoes simple harmonic motion with a frequency of $1.6 Hz$ and an amplitude of 4 mm. What is the acceleration at the maximum displacement from equilibrium ? What is the acceleration 0.4 seconds later?

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3. A mass of 0.5 kg is hung from a spring. A gradually increasing 0.5 N force is required to pull the mass downward a distance of 0.25 m from its equilibrium position,if the mass is then released from this position, find

(a) The total energy of the system .

(b) The frequency of the oscillation

(c) The speed and acceleration of the mass as it passes the equilibrium position.

(d) The speed and acceleration of the mass when the diplacement from equilibrium is 0.25 m

(e) For the initial condition stated, write down the diplacement equation of motion for this mass.

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4. A particle moving with S.H.M. has velocitiesof $4cm/s$ and $3cm/s$ at distances of 3 cm and 4 cm respectively from the equilibrium position. Find

(a)The amplitude of the osciallation

(b) Time period

(c) The velocity of the particle as is pases through the equilibrium position.

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5. A light spring is loaded with a mass under gravity . If the spring extends by 10cm ,calculate the period of small vertical osciallation.

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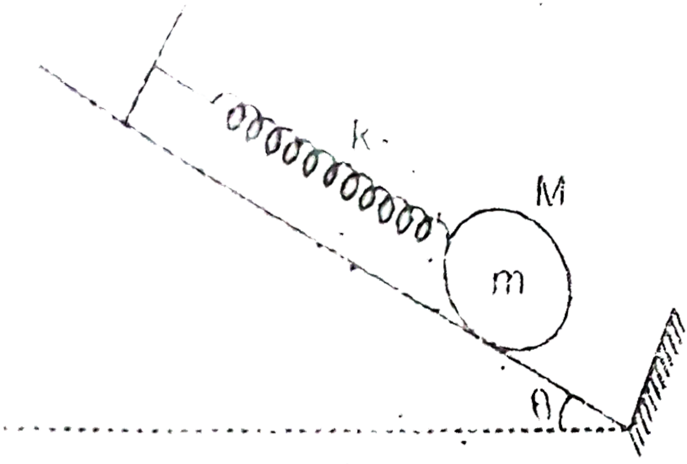
6. Find the angular frequency of the small osciallations of the thin sphere of mass M constaining ideal fluid of mass m . The spring has a constant k and sphere executes pure roling.



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7. A bullet of mass m embeds itself in a block of mass M resting on a smooth horizontal surface, attached to a spring of force constant k. If the initial speed of the bullet is v_0 along horizontal, find (a) the maximum compression of the spring and (b) the time for the bullet - block system to come to rest.

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ASSIGNMENT (SECTION-J)

1. As a result of adding two mutually perpendicular oscillations of equal frequency the motion of an object occurs alongan ellipse, in one case the motion is clockwise, while in the other it is counter clockwise . Write the equations of motion along each coordinate axis, assuming that the initial phase along the x-axis is zero.

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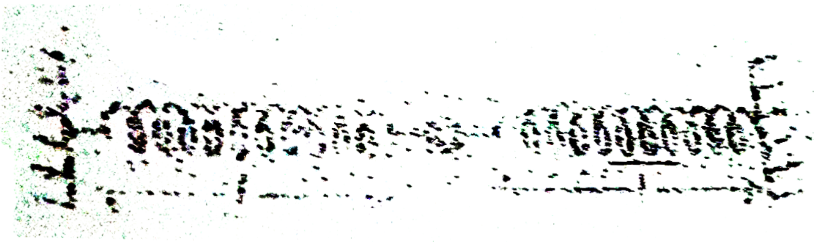
2. A ball of mass, m is attractive to two springwhich are already stretched so that each pulls on to ball with a force F. length of each spring . In this Determine the period of small oscillations of the ball in a difference perpendicular of length of psirng. Difference of the mass of spring and gravity .



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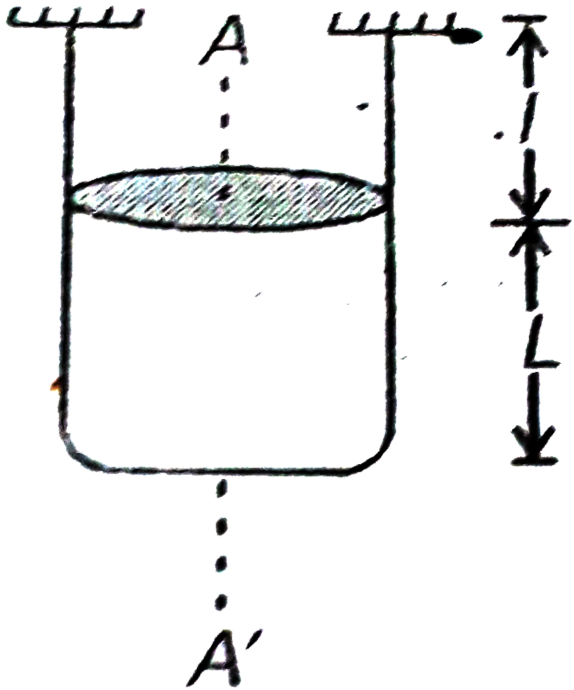
3. A solid cylinder of mass m length L and radius R is suspended by means of two ropes of length l each as shown. Find the time period of small angular oscillations of the cylinder about its axis AA'



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4. A particle of mass 3 kg moves in aone dimensional field along x-axis. The force due to the field depends on its position as $F = 729x^6 - 64$. Find the state equilibrium position. Determine the time period of osciallations for small amplitude osciallations about the stable equlibrium position.

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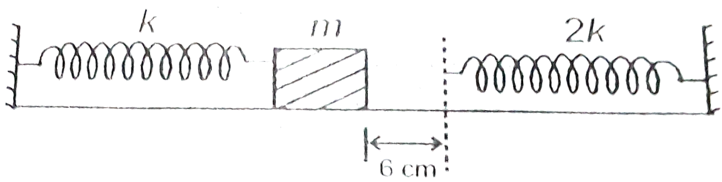
5. The block of M in the figure is connected to a left spring $(k_1 = k)$. The right spring $(k_2 = 2k)$ is fixed to the other wall such that its free end is 6 cm away from blocm. In this situation, entire system isin equilibrium. Now, block is displaced to left by $6\sqrt{2}$ cm and released. Determine the time period of oscillatory motion of the block.



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6. For a diatomic gas having 3 translational and 2 rotational degree of freedom ,the energy is given by ?

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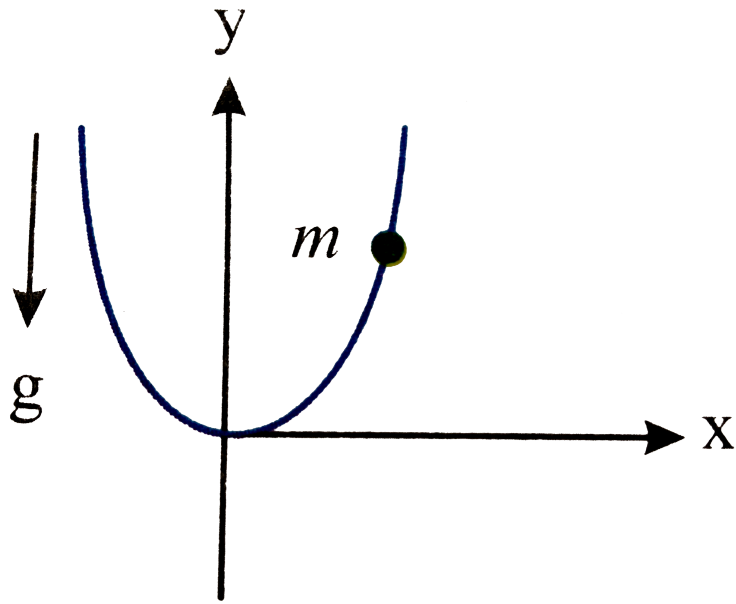
7. A particle of mass m is allowed to oscillate near the minimum of a vertical parabolic path having the equaiton $x^2 = 4ay$. The angular frequency of small oscillation is given by



A. a. $\sqrt{ga}$

B. b. $\sqrt{\frac{g}{a}}$

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

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

Answer: 2

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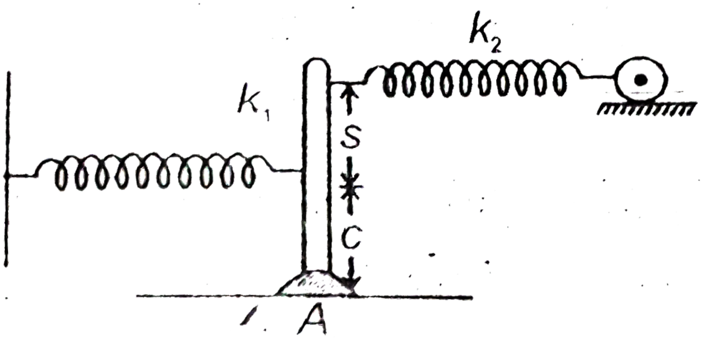
8. Find the angular frequency of motion of disc of mass m and radius r for small motion (Assuming that disc rolls without slipping) of disc.When we neglect the inertial effect of rod BD, spring constant are k_1 and k_2 as shown in figure.



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EXAMPLE

1. Categorize the motion as periodic or oscillatory motion

(I) Motion of planets around the sun.

(ii) A weighted test tube floating in a liquid pressed down and released

(ii) Motion of hands of a clock.

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2. A nurse in a hospital , noted for a patient that heart was beating 75 times a minutes. Find its frequency and time period.

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3. Which of the following functions of time represented (a) periodic and (b) non-periodic motion ? Given the period for each case of periodic motion (ω is any positive constant(i)$\sin\omega t - \cos\omega t(ii)\log(2\omega)$

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4. Categorise the following function of time $: \sin\omega t + \sin 3\omega t + \sin 5\omega t$ as

(a) S.H.M.

(b) Periodic but no S.H.M. .Also give the period.

Hint : Find the smallest interval of time after which the sum of 3 terms repeats

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5. Categories the following function of time $3\sin\left(2\omega t - \frac{\pi}{4}\right)$ as

(a) SHM , (b) Periodic but not SHM. Also give the period.

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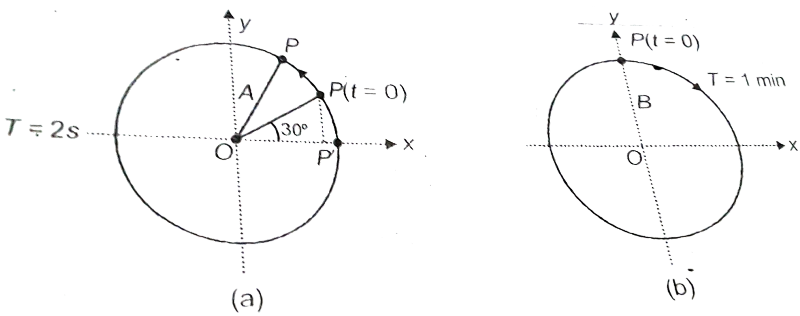
6. 

Figure depicts two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated on the figure. Obtain the SHMs of the x-projection of the radius vector of the rotating particle P in each case.

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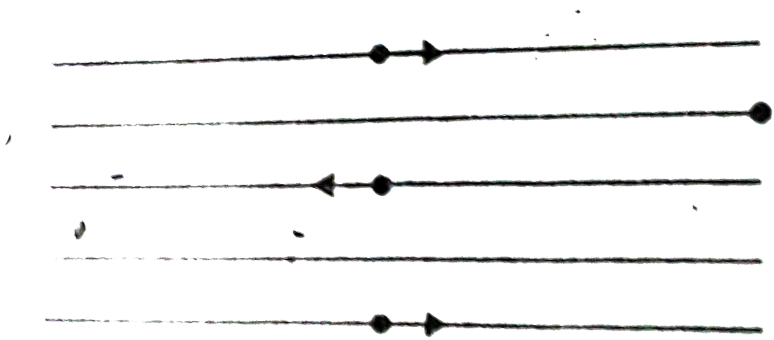
7. In the figure, dots and arrows show the position and the velocity of a paritcle executing SHM. What are the phases at the five indicated instants when the position at time t is given by

$x = A\sin(\omega t + \phi)$



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8. Plot the corresponding reference circle for given SHM, indicate the initial $(t=0)$ position of the paritcle, the radius of the circle , and the angular speed of the rotating paritcle. Consider anticlockwise direction for rotation. $x = -3\sin\left(2t + \frac{\pi}{4}\right)$ (Express in the form , $x =$ Acos (omega t + phi))`.

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9. A particle executes a simple harmonic motion of time period T. Find the time taken by the particle to go directly from its mean position to half the amplitude.

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10. A particle executes SHM with a time period of 2s and amplitude 10 cm . Find its (i) Displacement (ii) Velocity (iii) Acceleration after 1/6 s, Starting from mean position.

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11. A particle of mass 2 kg executing SHM has amplitude 10 cm and time period is 1 s.Find (i) the angular frequency (ii) the maximum speed (ii) the maximum acceleration (iv) the maximum restoring force (v) the speed when the displacement from the mean position is 8 cm (vi) the speed after $\frac{1}{12}$ s the particle was at the extreme position (vii) the time taken by the particle to go directly from its mean position to half the amplitude (viii) the time taken by the particle to go directly from its exterme position to half the amplitude.

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12. The speed of a particle executing SHM with amplitude of displacement 5 cm is $3cm/s$ at a distance 2.5 cm from mean position. What will be its speed at a distance $2.5\sqrt{3}$ from mean position?

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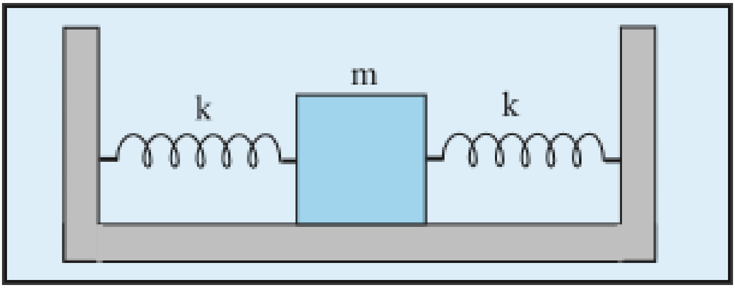
13. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as shown in Fig. 14.14. Show that when the mass is displaced from its equilibrium position on either side, it executes a simple harmonic motion. Find the period of oscillations.



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14. Howdoes the huge ball $(5.4 \times 10^5 kg)$ hanging on the 22^{nd} floor of one of the world's tallest building (chapter opening question mentioned in the introduction) counter the sway of the building?

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15. A block whose mass is 2 kg is fastened on a spring whose spring constant is 100 Nm^{-1} . It is pulled to a distance of 0.1 m from over a frictionless surface and is released at t=0. Calculate the kinetic eneryg of the block when it is 0.05 m away from its mean position.

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16. A particle executes SHM with amplitude A and time period T. When the displacement from the equilibrium position is half the amplitude , what fractions of the total energy are kinetic and potential energy?

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17. A particle of mass 0.2 kg is excuting SHM of amplitude 0.2 m. When it passes through the mean position its kinetic energy is $64 \times 10^{-3} J$. Obtain the equation of motion of this particle if the initial phase of oscillation is $\pi / 4$.

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18. A 2.5 kg collar is attached to a spring of spring constant $250Nm^{-1}$. It slides without friction over a horizontal surface . It is displaced from its equilibrium position by 20 cm and releasd. Calculate the period of osciallation and the maximum speed.

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19. The length of the simple pendulum which ticks seconds is

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20. If the length of a simple pendulum of a clock incrreases by 2% how much loss or gain of second per day will take place ?

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21. For the damped oscillator shown in Figure, the mass m of the block is 400 g, $k = 45Nm^{-1}$ and the damping constant b is $80gs^{-1}$. Calculate .

(a) The period of osciallation ,

(b) Time taken for its amplitude of vibrations to drop to half of its initial value and

(c) The time taken for its mechanical energy to drop to half its initial value.

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Exercise

1. Which of the following is/are not SHM?

A. $y = A \cos \omega t$

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

C. $y = A \sin 3\omega t$

D. $y = Ae^{kT}$

Answer: D

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2. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is:-

A. zero

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

C. π

D. 2π

Answer: B

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3. A particle executing SHM along y-axis, which is described by $y = 10\sin\frac{\pi t}{4}$, phase of particle at t =2s is

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

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

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

D. π

Answer: B

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4. A particle is executing SHM about y =0 along y-axis. Its position at an instant is given by $y = (7m)\sin(\pi t)$. Its average velocity for a time interval 0 to 0.5 s is

A. 14m/s

B. 7m/s

C. $\frac{1}{7}$m/s

D. 28m/s

Answer: A

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5. A body is executing SHM with amplitude A and time period T. The ratio of kinetic and potential energy when displacement from the equilibrium position is half the amplitude

A. $1:1$

B. $2:1$

C. $1:3$

D. $3:1$

Answer: D

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6. 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. $0.2\pi s$

B. $0.1\pi s$

C. πs

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

Answer: A

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7. A simple harmonic motion is represented by :

$y = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)cm$ The amplitude and time period of the motion by :

A. 10m

B. 5m

C. $5(1+\sqrt{3})m$

D. $5\sqrt{3}m$

Answer: A

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8. A particle of mass 2kg executing SHM has amplitude 20cm and time period 1s. Its maximum speed is

A. 0.314 m/s

B. 0.628 m/s

C. 1.256 m/s

D. 2.512 m/s

Answer: C

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9. If length of a simple pendulum is increased by 69%, then the percentage increase in its time period is

A. 0.69

B. 0.3

C. 0.5

D. 0.1

Answer: B

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10. A uniform solid sphere of mass m and radius R is suspended in vertical plane from a point on its periphery. The time period of its oscillation is

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

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

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

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

Answer: A

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11. A second pendulum is moved to moon where acceleration dur to gravity is 1/6 times that of the earth, the length of the second pendulum on moon would be

A. 6 times

B. 12 times

C. $\frac{1}{6}$ times

D. $\frac{1}{12}$ times

Answer: C

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12. Imagine a narrow tunnel between the two diametrically opposite points of the earth. A particle of mass m is released in this tunnel . The time period of oscillation is

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

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

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

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

Answer: C

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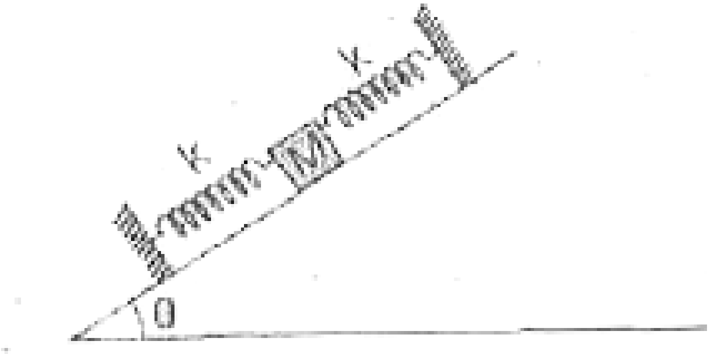
13. In the adjacent figure, if the incline plane is smooth and the springs are identical then the period of oscillation of this body is



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

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

C. $2\pi\sqrt{\frac{M}{k\sin\theta}}$

D. $2\pi\sqrt{\frac{M\sin\theta}{k}}$

Answer: A

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14. In case of damped oscillation frequency of oscillation is

A. Greater than natural frequency

B. Less than natural frequency

C. Equal to natural frequency

D. Both (1) & (3)

Answer: B

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15. In forced oscillations , a particle oscillates simple harmonically with a frequency equal to

A. Frequency of driving force

B. Natural frequency of body

C. Difference of frequency of driving and natural frequency

D. Mean of driving force and natural frequency

Answer: A

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16. Which of the following equation represents damped oscillation?

A. $\dfrac{dx^2}{dt^2} = -kx$

B. $\dfrac{dx^2}{dt^2} = -kx + f_0 \sin \omega_0 t$

C. $\dfrac{d^2x}{dt^2} - kx + \dfrac{dx}{dt} = 0$

D. $\dfrac{d^2x}{dt^2} + \dfrac{dx}{dt} + \dfrac{k}{m}x = 0$

Answer: D

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17. In case of damped oscillation frequency of oscillation is

A. $Ae^{\frac{bt}{2m}}$

B. $Ae^{\frac{bt}{2m}}$

C. $Ae^{\frac{\mathrm{at}^2}{m}}$

D. $Ae^{\frac{m}{bt^2}}$

Answer: A

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18. Resonsance is a special case of

A. Damped oscillation

B. Forced oscillation

C. Natural oscillatin

D. Both (1) & (3)

Answer: B

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Assignment (Section - A) (OBJECTIVE TYPE QUESTIONS)

1. For a particle executing simple harmonic motion, the acceleration is -

A. is uniform

B. varies linearly with time

C. is non uniform

D. Both (2) & (3)

Answer: C

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2. The phase difference between displacement and acceleration of particle in a simple harmonic motion is

A. zero

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

C. π

D. 2π

Answer: B

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3. The shape of graph plotted between velocity and position of a particle executing simple harmonic motion is

A. A straight line

B. An ellipse

C. A parabola

D. A hyperbola

Answer: B

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4. If particle is excuting simple harmonic motion with time period T, then the time period of its total mechanical energy is :-

A. zero

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

C. 2T

D. Infinite

Answer: D

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5. Identify the corret definition

A. If after every certain interval of time, particle repeats its motion then motion is called periodic motion

B. To and fro motion of a particle over the same path is called oscillatory motion

C. Oscillatory motion described in terms of single sine and cosine functions is called simple harmonic motion

D. All of these

Answer: D

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6. The equation of motion of a simple harmonic motion is not

A. $x = A\sin(\omega t + \phi)$

B. $x = A\cos(\omega t - \phi)$

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

D. $x = A\sin(\omega t + \phi)$+ B sin (2 omega t + phi)`

Answer: D

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7. Select wrong statement about simple harmonic motion

A. The body is uniformly accelerated

B. The velocity of the body changes smoothly at all instants

C. The amplitude of oscillation is symmetric about the equilibrium position

D. The frequency of oscillation is independent of amplitude

Answer: A

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8. The motion of a particle executing simple harmonic motion is given by $X = 0.01 \sin 100\pi(t + 0.05)$, where X is in metres andt in second. The time period is second is

A. 0.01s

B. 0.02s

C. 0.1 s

D. 0.2 s

Answer: B

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9. A particle moves under force $F = 5(x-2)^3$ .Motion of the particle is

A. Translatory

B. Oscillatory

C. SHM

D. All of these

Answer: B

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10. For a particle showing motion under forces $F = -5(x-2)^2$, the motion is

A. Translatory

B. Oscillatory

C. SHM

D. All of these

Answer: A

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11. For a particle showing motion under forces $F = -5(x-2)$, the motion is

A. Translatory

B. Oscillatory

C. SHM

D. Both (2) & (3)

Answer: D

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12. A boy is swinging in a swing. intially he is sitting then he stands , the time period will

A. First decrease then increase

B. Decrease

C. increase

D. Remain same

Answer: B

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13. Time period of a simple pendulum in a freely falling lift will be

A. Finite

B. Infinite

C. zero

D. All of these

Answer: B

Watch Video Solution

14. If the length of a simple pendulum is equal to the radius of the earth, its time period will be

A. $T = \pi\sqrt{\frac{R}{g}}$

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

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

D. $T = 2\pi\sqrt{\frac{R}{2g}}$

Answer: D

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15. A particle is executing SHM with time period T. If time period of its total mechanical energy isT' then $\frac{T'}{T}$ is

A. 2

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

C. zero

D. Infinite

Answer: D

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16. A body executing S.H.M.along a straight line has a velocity of $3ms^{-1}$ when it is at a distance of 4m from its mean position and$4ms^{-1}$ when it is at a distance of 3m from its mean position.Its angular frequency and amplitude are

A. $2rads^{-1}$ & 5m

B. $1 rads^{-1}$ & 10 m

C. $2 rads^{-1}$ & 10m

D. $1 rads^{-1}$ & 5m

Answer: D

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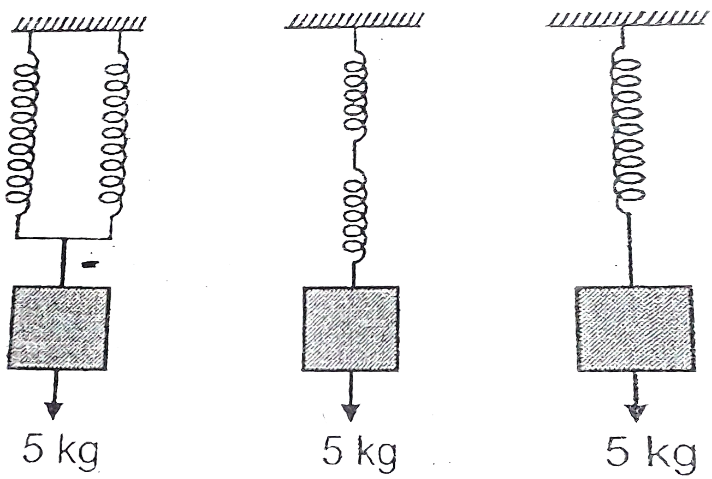
17. Two identical springs have the same force constant $73.5 Nm^{-1}$. The elongation produced in each spring in three cases shown in Figure-1, Figure-2 and Figure-3 are $(g = 9.8 ms^{-2})$



A. $\frac{1}{6}m, \frac{2}{3}m, \frac{1}{3}m$

B. $\frac{1}{3}m, \frac{1}{3}m, \frac{1}{3}m$

C. $\frac{2}{m}, \frac{1}{3}m, \frac{1}{6}m$

D. $\frac{1}{3}m, \frac{4}{3}, \frac{2}{3}m$

Answer: D

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18. The frequency of oscillation of amass m suspended by a spring is v_1. If length of spring is cut to one third then the same mass oscillations with frequency v_2. Then

A. $v_2 = 3v_1$

B. $3v_2 = v_1$

C. $v_2 = sqr3v_1$

D. $\sqrt{3}v_2 = v_1$

Answer: C

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19. Two particles executing SHM of same frequency, meet at $x = +A/2$, while moving in opposite direction . Phase difference between the particles is

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

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

C. $\frac{5\pi}{6}$

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

Answer: D

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20. A particle is executing SHM with time period T Starting from mean position, time taken by it to complete $\frac{5}{8}$ oscillations is,

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

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

C. $\frac{5T}{12}$

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

Answer: D

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

A. $T_1 < T_2$

B. $T_1 > T_2$

C. $T_1 = T_2$

D. $T_1 = 2T_2$

Answer: A

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22. Two S.H.Ms are given by $y_1 = a\sin\left(\frac{\pi}{2}t + \frac{\pi}{2}\right)$ and $y_2 = b\sin\left(\frac{2\pi}{3}t + \frac{\pi}{2}\right)$. The phase difference between these after 1 second is

A. π

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

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

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

Answer: D

Watch Video Solution

23. A simple harmonic motino has amplitude A and time period T. The maxmum velocity will be

A. 4AT

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

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

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

Answer: D

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24. A particle is executing S.H.M. with amplitude A and has maximum velocity v_0. Its speed at displacement $\frac{3A}{4}$ will be

A. $\frac{\sqrt{7}}{4}V_0$

B. $\frac{v_0}{\sqrt{2}}$

C. v_0

D. $\frac{\sqrt{3}}{2}v_0$

Answer: A

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25. A particle executes simple harmonic motion according to equation $4\frac{d^2x}{dt^2}+320x=0$. Its time period of oscillation is :-

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

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

C. $\frac{\pi}{2\sqrt{5}}s$

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

Answer: C

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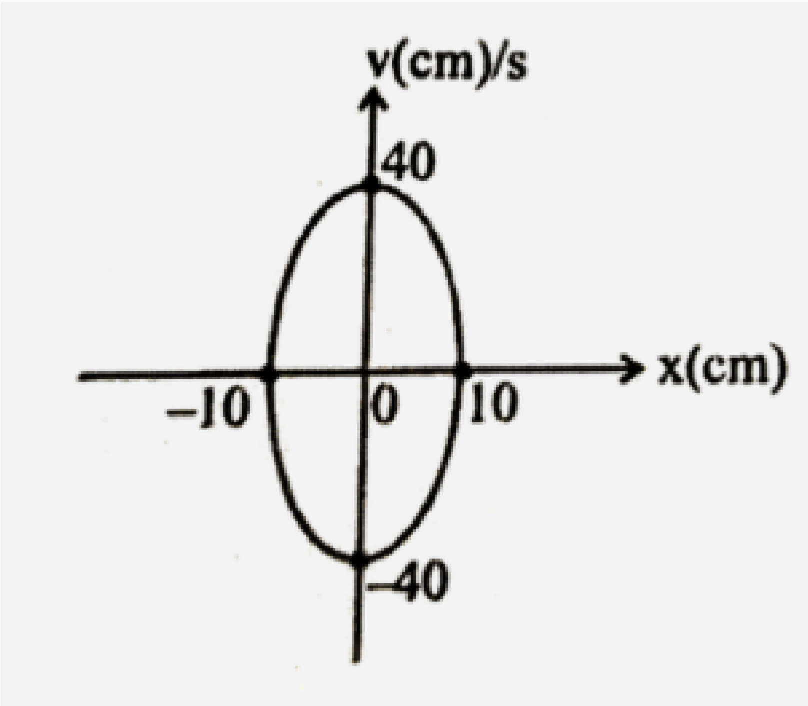
26. The plot of velocity (v) versus displacement (x) of a particle executing simple harmonic motion is shown in figure. The time period of oscillation of particle is :-



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

B. πs

C. $2\pi s$

D. $3\pi s$

Answer: A

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27. A particle of mass 10g is undergoing SHM of amplitude 10cm and period 0.1s. The maximum value of force on particle is about

A. 5.6N

B. 2.75 N

C. 3.5 N

D. 4N

Answer: D

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28. Two identical pendulums oscillate with a constant phase difference $\frac{\pi}{4}$ and same amplitude. If the maximum velocity of one is v, the maximum velocity of the other will be.

A. v

B. $\sqrt{2}v$

C. 2v

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

Answer: A

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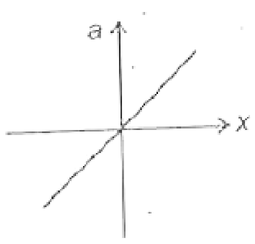
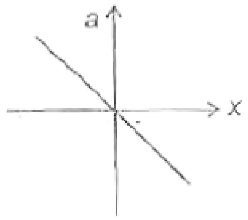
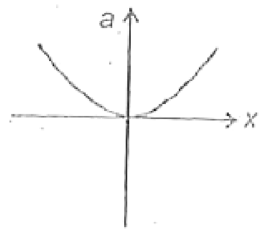
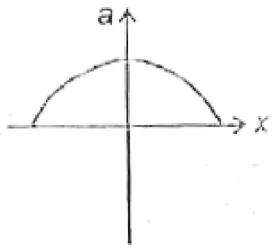
29. Which of the following graphs best represents the variation of acceleration 'a' with displacement x?

A. 

B. 

C. 

D. 

Answer: B

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30. A body executes SHM with an amplitude a. At what displacement from the mean positions, the potentail energy of the body is one-fourth of its total energy?

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

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

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

D. Some other fraction of A

Answer: B

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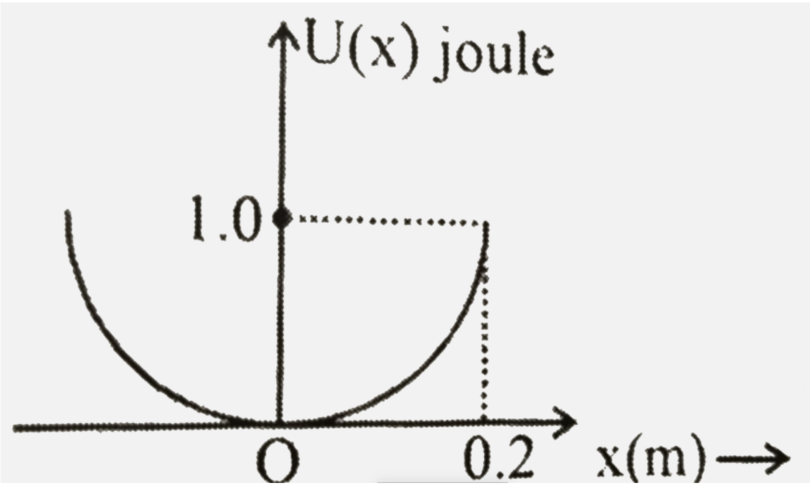
31. A particle of mass 4kg moves simple harmonically such that its PE (U) varies with position x, as shown. The period of oscillations is :-



A. $\frac{2\pi}{25}s$

B. $\frac{\pi\sqrt{2}}{5}s$

C. $\frac{4\pi}{5}s$

D. $\frac{2\pi\sqrt{2}}{5}s$

Answer: D

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

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

D. $A\sqrt{2}$

Answer: B

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33. 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. $1.57ms^{-1}$

B. $3.12ms^{-1}$

C. $2.0ms^{-1}$

D. $6.42ms^{-1}$

Answer: B

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34. A simple pendulum suspended from the celling of a stationary lift has period T_0. When the lift descends at steady speed, the period is T_1, and when it descends with constant downward acceleration, the period is T_2 which one of the following is true?

A. $T_0 = T_1 = T_2$

B. $T_0 = T_1 < T_2$

C. $T_0 = T_1 > T_2$

D. $T_0 < T_1 < T_2$

Answer: B

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35. If a Seconds pendulum is moved to a planet where acceleration due to gravity is 4 times, the length of the second's pendulum on the planet should be made

A. 2 times

B. 4 times

C. 8 times

D. 15 times

Answer: B

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36. A simple pendulum with a metallic bob has a time period T.The bob is now immersed in a non-viscous liquid and oscillated . If the density of the liuid is $\frac{1}{4}$ that of metal , what will be the time period of the same pendulum?

Hint : If the solid bob of the pendulum has relative densty D and has been submerged in a non-viscous liquid of relative density ρ then effective acceleration due to gravity $g' = g - \frac{g}{n}$ where $n = \frac{D}{\rho}$

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

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

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

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

Answer: B

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37. 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. 10

B. 11

C. 20

D. 21

Answer: A

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38. The time period of oscillations of a simple pendulum is 1 minute. If its length is increased b 44% then its new time period of oscillation will be

A. 96s

B. 58s

C. 82s

D. 72s

Answer: D

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39. If the length of a clock pendulum increases by 0.2% due to atmospheric temperature rise, then the loss in time of clock per day is

A. 86.4s

B. 43.2s

C. 72.5s

D. 32.5s

Answer: A

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40. A simple pendulum is oscillating in a trolley moving on a horizontal straight road with constant acceleration a. If direction of motion of trolley is taken as positive x direction and vertical upward direction as positive y direction then the mean position of pendulum makes an angle

A. $\tan^{-1}\left(\frac{g}{a}\right)$ with y axis in +x direction

B. $\tan^{-1}\left(\frac{a}{g}\right)$ with y axis in -x direction

C. $\tan^{-1}\left(\frac{a}{g}\right)$ with y axis in +x direction

D. $\tan^{-1}\left(\frac{g}{a}\right)$ with y axis in -x direction

Answer: B

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41. The time period of oscillation of a simple pendulum is $\sqrt{2}s$. If its length is decreased to half of initial length, then its new period is

A. 4s

B. 1s

C. $\sqrt{2}s$

D. $2\sqrt{2}s$

Answer: D

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42. The graph between time period (T) and length (l) of a simple pendulum is

A. Straight line

B. Parabolic

C. Hyperbolic

D. Elliptical

Answer: B

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43. 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. The period will go on increasing till the sphere is empty

B. The period will go on decreasing till the sphere is empty

C. The period will not be affected at all

D. The period will increase first, then decrease to initial value till the sphere is empty

Answer: D

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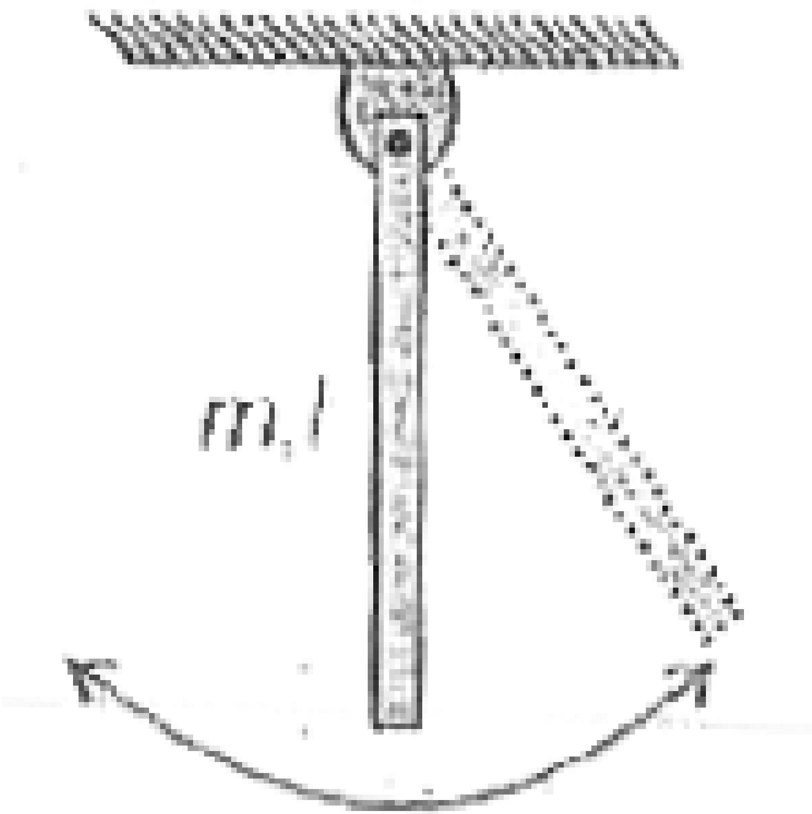
44. A uniform rod of mass m and length l is suspended about its end. Time period of small angular oscillations is



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

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

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

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

Answer: C

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45. A uniform disc of mass m and radius r is suspended through a wire attached to its Centre. If the time period of the torsional oscillations be T, what is the torsional constant of the wire?

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

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

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

D. $2\pi\sqrt{\frac{3R}{2g}}$

Answer: D

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46. A solid cylinder of denisty ρ_0, cross-section area A and length l floats in a liquid $\rho(> \rho_0$ with its axis vertical, . If it is slightly displaced downward and released, the time period will be :

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

B. $2\pi\sqrt{\frac{\rho_0 l}{\rho g}}$

C. $2\pi\sqrt{\frac{\rho l}{\rho_0 g}}$

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

Answer: B

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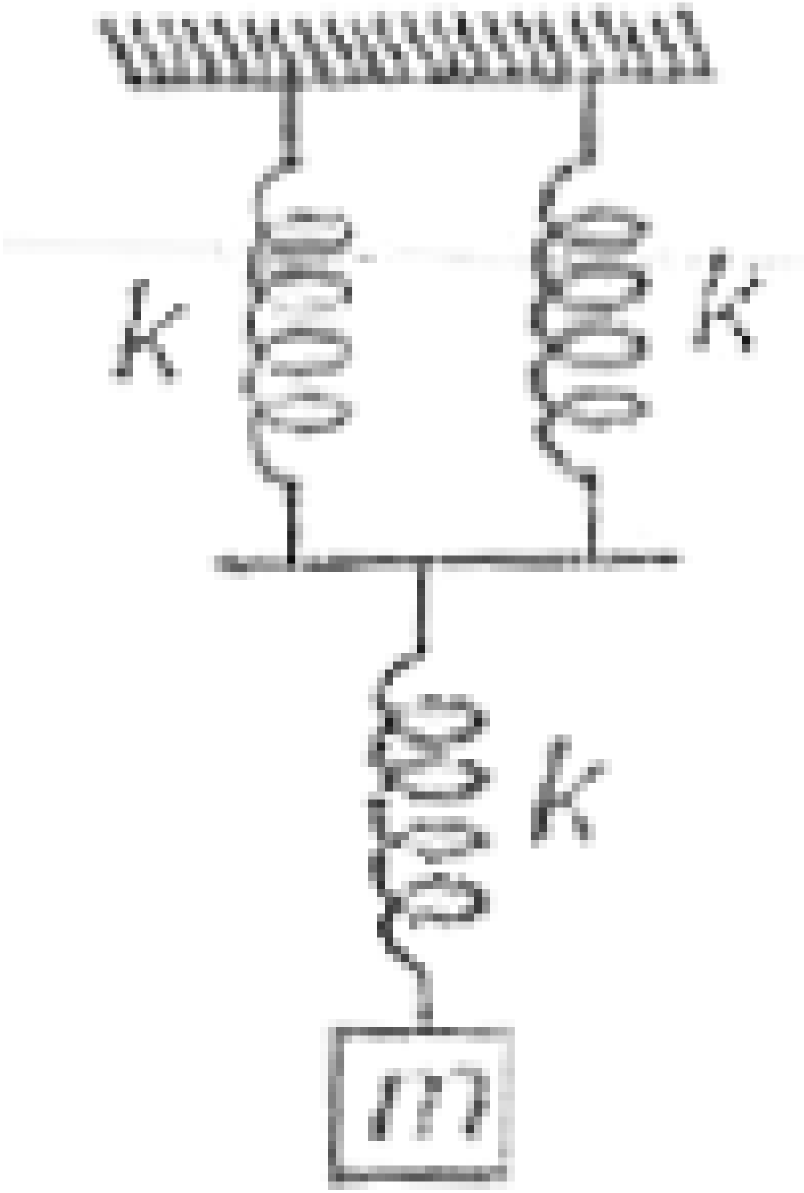
47. A block of mass m hangs from three springs having same spring constant k. If the mass is slightly displaced downwards, the time period of oscillation will be



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

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

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

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

Answer: B

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48. Two masses $m_1 = 1kg$ and $m_2 = 0.5kg$ are suspended together by a massless spring of spring constant $12.5Nm^{-1}$. When masses are in equilibrium m_1 is removed without disturbing the system. New amplitude of oscillation will be

A. 30cm

B. 50cm

C. 80cm

D. 60cm

Answer: C

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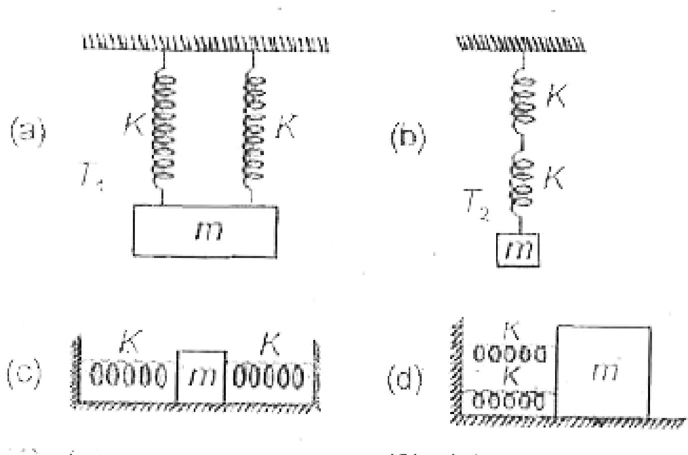
49. A mass m is attached to two springs of same force constant K, as shown in following four arrangements. If T_1, T_2, T_3 and T_4 respectively be the time periods of oscillation in the following arrangements in which case time period is maximum ?



A. a

B. b

C. c

D. d

Answer: B

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50. A clock S is based on oscillations of a spring and clock P is based on pendulum motion, both clocks run at the same rate on Earth. On a planet having the same mass, but twice the radius that of the earth

A. S will run faster than P

B. P will run faster than S

C. Both run at same rate

D. Both run at same rate but different than earth

Answer: B

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51. A 100 g mass stretches a particular spring by 9.8 cm, when suspended vertically from it. How large a mass must be attached to the spring if the period of vibration is to be 6.28 s?

A. 1000g

B. $10^5 g$

C. $10^7 g$

D. $10^4 g$

Answer: D

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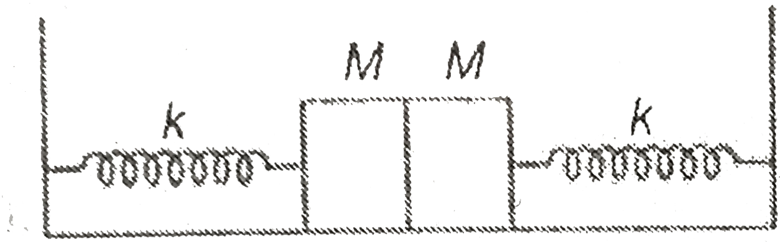
52. An assembly of identicl spring mass system is placed on a smooth horizontal surface as shown. Initially the springs are relaxed. The left mass is displaced to the left while the right mass is displaced to the right and released. The resulting collision is elastic. The time period of the oscillatins of the system is.



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

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

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

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

Answer: C

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53. The time period of a mass suspended from a spring is T. If is the spring is cut into four equal parts and the same mass is suspend from one of the parts, then the new time period will be -

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

B. 2T

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

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

Answer: C

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54. Let T_1 and T_2 be the time periods of two springs A and B when a mass m is suspended from them separately. Now both the springs are connected in parallel and same mass m is suspended with them. Now let T be the time period in this position. Then

A. $\frac{t_1 t_2}{t_1 + t_2}$

B. $\frac{t_1 t_2}{\sqrt{t_1^2 + t_2^2}}$

C. $\sqrt{\frac{t_1 t_2}{t_1 + t_2}}$

D. $t_1 + t_2$

Answer: B

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55. In damped oscillations damping froce is directly proportional to speed of ocillatior .If amplitude becomes half to its maximum value is 1 s, then after 2 s amplitude will be (A_0- initial amplitude)

A. $\frac{1}{4}A_0$

B. $\frac{1}{2}A_0$

C. A_0

D. $\frac{\sqrt{3}A_0}{2}$

Answer: A

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56. In forced oscillations , a particle oscillates simple harmonically with a frequency equal to

A. Frequency of driving force

B. Natural frequency of body

C. Difference of frequency of driving and natural frequency

D. Mean of frequency of driving force and natural frequency

Answer: A

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57. Resonsance is a special case of

A. Forced oscillations

B. Damped oscillations

C. Undamped oscillations

D. Coupled oscillations

Answer: A

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58. The SHM of a particle is given by the equation $x = 2\sin\omega t + 4\cos\omega t$.

Its amplitude of oscillation is

A. 4 units

B. 2 units

C. 6 units

D. $2\sqrt{5}$ units

Answer: D

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59. 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. A straight line

B. A circle

C. An ellipse

D. A hyperbola

Answer: A

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60. Which of the following represents a SHM?

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

B. $\sin \omega t + \cos \omega t$

C. $\sin \omega t + 2 \cos \omega t$

D. All of these

Answer: D

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Assignment (Section - B) (OBJECTIVE TYPE QUESTIONS)

1. The circular motion of a particle with constant speed is

A. Periodic but not simple harmonic

B. Simple harmonic but not periodic

C. Period and simple harmonic

D. Neither periodic nor simple harmonic

Answer: A

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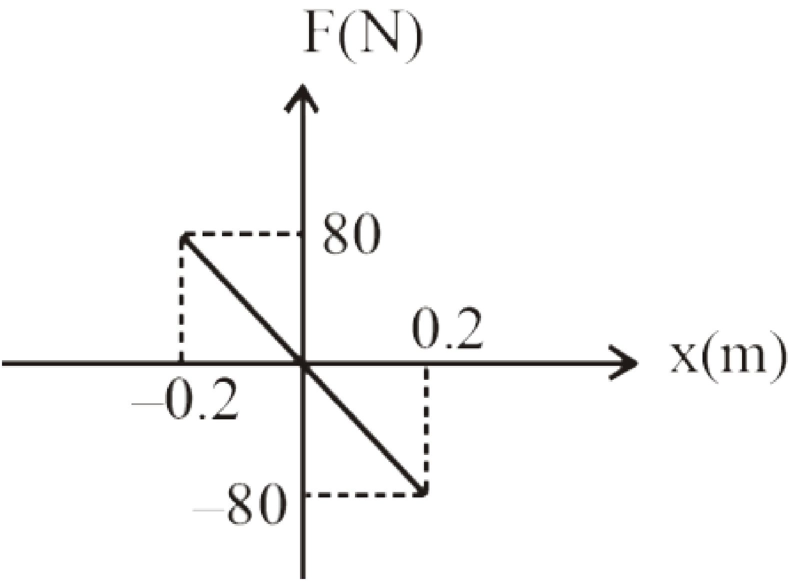
2. A body of mass 0.01 kg executes simple harmonic motion about x = 0 under the influence of a force as shown in figure. The time period of SHM is



A. 1.05s

B. 0.52s

C. 0.25s

D. 0.03s

Answer: D

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3. A 1.00×10^{-20}kg particle is vibrating with simple harmonic motion with a period of1.00×10^{-5} sec and a maximum speed of 1.00×10^{3} m/s . The maximum displacement of the particle is

A. 1.59 mm

B. 1.00 m

C. 10m

D. 3.18 mm

Answer: A

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4. The equation of a S.H.M. of amplitude A and angular frequency ω in which all distances are measured from one extreme position and time is taken to be zero at the other extreme position is

A. $x = A \sin \omega t$

B. $x = A(\cos \omega t + \sin \omega t)$

C. $x = A - A \cos \omega t$

D. $x = A + A \cos \omega t$

Answer: D

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5. A body oscillates with SHM according to the equation , x=(5 cm) $\cos\left[\left(2\pi\text{rad}s^{-1}\right) + \pi/4\right]$. At t=1.5 s, calculate the (i) displacement, (ii) speed and (iii) acceleration of the body.

A. $-139.56m/s^2$

B. $139.56m/s^2$

C. $69.78m/s^2$

D. $-69.78m/s^2$

Answer: B

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6. 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. $\sqrt{2}$

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

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

Answer: C

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7. Two particle execute SHM of same amplitude of $20cm$ with same period along the same line about the same equilibrium position. The maximum distance between the two is $20cm$. Their phase difference in radians is

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

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

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

D. $\frac{4\pi}{5}$

Answer: A

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8. A particle executes SHM with an amplitude of 2 cm. When the particle is at 1 cm from the mean position, the magnitude of its velocity equal to that of its acceleration. Then its time period in seconds is

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

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

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

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

Answer: C

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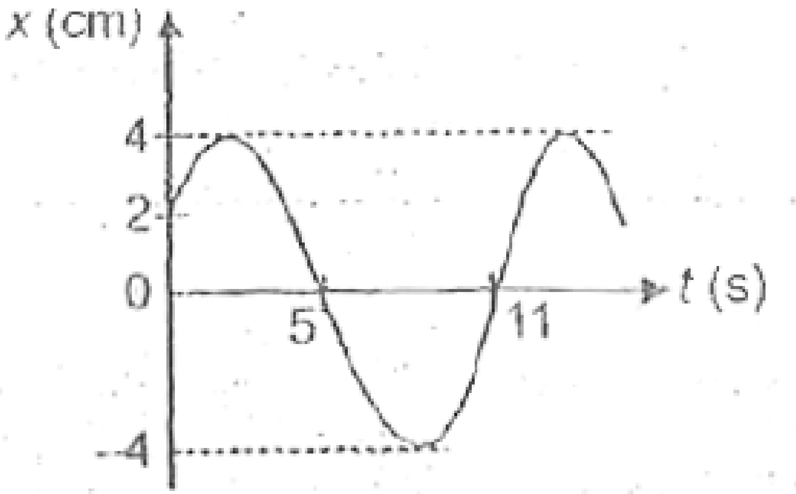
9. Figure shows the position -time graph of an object in SHM. The correct equation representing this motion is



A. $2\sin\left(\frac{2\pi}{5}t+\frac{\pi}{6}\right)$

B. $4\sin\left(\frac{\pi}{5}t+\frac{\pi}{6}\right)$

C. $4\sin\left(\frac{\pi}{6}t+\frac{\pi}{3}\right)$

D. $4\sin\left(\frac{\pi}{6}t+\frac{\pi}{6}\right)$

Answer: D

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10. A particle executes SHM according to equation $x=10(cm)\cos\left[2\pi t+\frac{\pi}{2}\right]$, where t is in seconds. The magnitude of the velocity of the particle at $t=\frac{1}{6}s$ will be :-

A. 24.7 cm/s

B. 20.5 cm/s

C. 28.3 cm/s

D. 31.4 cm/s

Answer: D

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11. A particle execute SHM and its position varies with time as $x = A \sin \omega t$. Its average speed during its motion from mean position to mid-point of mean and extreme position is

A. zero

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

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

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

Answer: B

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12. A particle of mass m in a unidirectional potential field have potential energy $U(x) = \alpha + 2\beta x^2$, where α and β are positive constants. Find its time period of oscillations.

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

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

C. $\pi\sqrt{\frac{m}{\beta}}$

D. $\pi\sqrt{\frac{\beta}{m}}$

Answer: C

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13. A particle is executing SHM and its velocity v is related to its position (x) as $v^2 + ax^2 = b$, where a and b are positive constant. The frequency of oscillation of particle is

A. $\frac{1}{2\pi}\sqrt{\frac{b}{a}}$

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

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

D. $\frac{1}{2\pi}\sqrt{\frac{a}{b}}$

Answer: B

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14. A loaded vertical spring executes simple harmonic oscillations with period of 4 s. The difference between the kinetic energy and potential energy of this system oscillates with a period of

A. 2s

B. 1s

C. 8s

D. 4s

Answer: A

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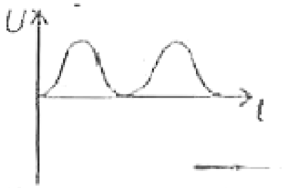
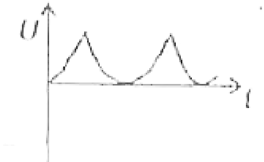
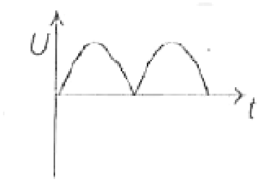
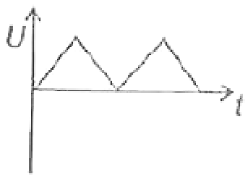
15. A body performs S.H.M. Its kinetic energy K varies with time t as indicated by graph

A. 

B. 

C. 

D. 

Answer: A

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16. A particle is performing SHM energy of vibration 90J and amplitude 6cm. When the particle reaches at distance 4cm from mean position, it is stopped for a moment and then released. The new energy of vibration will be

A. 40J

B. 50J

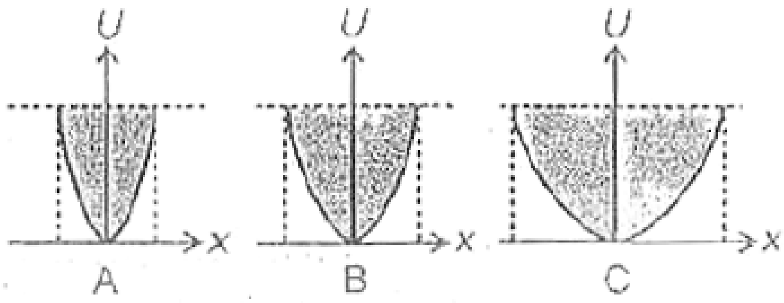
C. 90J

D. 60J

Answer: A

Watch Video Solution

17. The variations of potential energy (U) with position x for three simple harmonic oscillators A, B and C are shown in figure. The oscillators have same mass. The time period of oscillation is greatest for



A. A

B. B

C. C

D. Same for all

Answer: C

Watch Video Solution

18. If the particle repeats its motion after a fixed time interval of 8 s then after how much time its maximum value of PE will be attained after attaining its minimum value ?

A. 2s

B. 4s

C. 8s

D. 1s

Answer: A

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19. A particle is executing SHM with total mechanical energy 90J and amplitude 6cm. If its energy is somehow decreased to 40J then its amplitude will become

A. 2cm

B. 4cm

C. $\frac{8}{3}cm$

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

Answer: B

Watch Video Solution

20. A linear harmonic oscillator of force constant 6×10^5 N/m and amplitude 4cm, has a total energy 600J. Select the correct statement.

A. Maximum potential energy is 600J

B. Maximum kinetic energy is 480 J

C. Minimum potential energy is 120J

D. All of these

Answer: D

Watch Video Solution

21. A seconds pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket

A. Moving down with uniform acceleration

B. Moving around the earth in geostationary orbit

C. Moving up with uniform velocity

D. Moving up with uniform acceleration

Answer: D

Watch Video Solution

22. The curve between square of frequency of oscillation and length of the simple pendulum is

A. Straight line

B. Parabolic

C. Ellipse

D. Hyperbola

Answer: D

Watch Video Solution

23. A simple pendulum of mass m executes SHM with total energy E. if at an instant it is at one of extreme positions, then its linear momentum after a phase shift of $\frac{\pi}{3}$ rad will be

A. $\sqrt{2mE}$

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

C. $2\sqrt{mE}$

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

Answer: B

Watch Video Solution

24. There is a rod of length l and mass m. It is hinged at one end to the ceiling. The period of small oscillation is

A. $2\pi\sqrt{\dfrac{mL}{2g}}$

B. $2\pi\sqrt{\dfrac{mL}{g}}$

C. $2\pi\sqrt{\dfrac{2L}{3g}}$

D. $2\pi\sqrt{\dfrac{m}{gL}}$

Answer: C

Watch Video Solution

25. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium, it undergoes oscillation with a time period T. Then

A. $T \propto \dfrac{1}{\sqrt{m}}$

B. $T \propto \sqrt{\rho}$

C. $T \propto \dfrac{1}{\sqrt{A}}$

D. $T \propto \dfrac{1}{\rho}$

Answer: C

Watch Video Solution

26. When a mass of 5 kg is suspended from a spring of negligible mass and spring constant K, it oscillates with a periodic time 2π. If the mass is removed, the length of the spring will decrease by

A. glk metre

B. klg metre

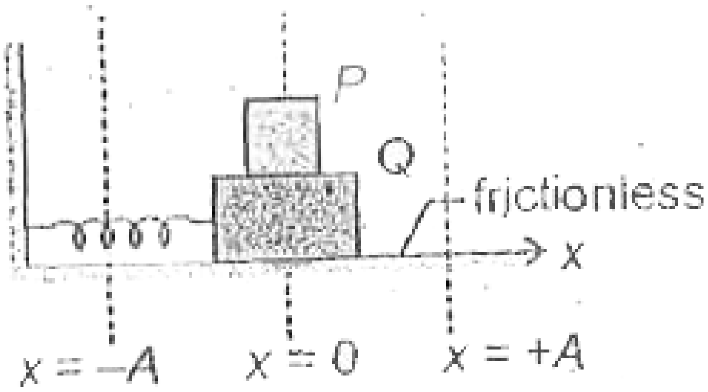
C. 2π metre

D. g metre

Answer: D

Watch Video Solution

27. In the figure shown, there is friction between the blocks P and Q but the constact between the block Q and lower surface is frictionless. Initially the block Q with block P over it lies at x = 0, with spring at its natural length. The block Q is pulled to right and then released. As the spring -blocks system undergoes SHM with amplitude A, the block P tends to slip over Q, P is more likely to slip at



A. x=0

B. $x = +A$

C. $x = +\frac{A}{2}$

D. $x = +\frac{A}{\sqrt{2}}$

Answer: B

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28. A flat horizontal board moves up and down under SHM vertically with amplitude A. The shortest permissible time period of the vibration such that an object placed on the board may not lose contact with the board is

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

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

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

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

Answer: B

Watch Video Solution

29. A simple pendulum with iron bob has a time period T. The bob is now immersed in a non-viscous liquid and oscillated, if the density of liquid is $\frac{1}{12}$th that of iron, then new time period will be

A. $T\sqrt{\frac{8}{7}}$

B. $T\sqrt{\frac{12}{13}}$

C. $T\sqrt{\frac{12}{11}}$

D. $T\sqrt{\frac{6}{5}}$

Answer: C

Watch Video Solution

30. When a mass m attached to a spring it oscillates with period 4s. When an additional mass of 2 kg is attached to a spring, time period increases by 1s. The value of m is :-

A. 3.5 kg

B. 8.2 kg

C. 4.7 kg

D. 2.6 kg

Answer: A

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Assignment (Section C) (PREVIOUS YEARS QUESTIONS)

1. A particle executes linear simple harmonic motion with an amplitude of $3cm$. When the particle is at $2cm$ from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then, its time period in seconds is

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

B. $\frac{\sqrt{5}}{2\pi}$

C. $\frac{4\pi}{\sqrt{5}}$

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

Answer: C

Watch Video Solution

2. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by $1kg$, the time period of oscillations becomes 5s. The value of m in kg is

A. $\frac{3}{4}$

B. $\frac{4}{3}$

C. $\frac{16}{9}$

D. $\frac{9}{16}$

Answer: D

Watch Video Solution

3. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be

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

B. $\frac{\beta^2}{\alpha^2}$

C. $\frac{\alpha}{\beta}$

D. $\frac{\beta^2}{\alpha}$

Answer: A

Watch Video Solution

4. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are v_1 and v_2, respectively. Its time period is

A. $2\pi\sqrt{\dfrac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$

B. $2\pi\sqrt{\dfrac{x_1^2 + x_2^2}{V_1^2 + V_2^2}}$

C. $2\pi\sqrt{\dfrac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$

D. $2\pi\dfrac{\sqrt{V_1^2 + V_2^2}}{x_1^2 + x_2^2}$

Answer: C

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5. When two displacement represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed, the motion is

A. Simple harmonic with amplitude $\dfrac{(a+b)}{2}$

B. Not a simple harmonic

C. Simple harmonic with amplitude $\dfrac{a}{b}$

D. Simple harmonic with amplitude $\sqrt{a^2 + b^2}$

Answer: D

Watch Video Solution

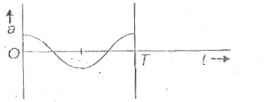
6. The oscillation of a body on smooth horizontal surface is represented by the equation, $x = A\cos\omega t$ where ,x=displacement at time t

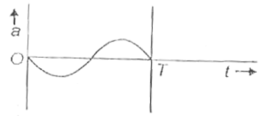
ω=frequency of oscillation

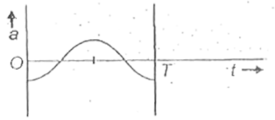
which one of the following graphs shows correctly the variation of a with t?

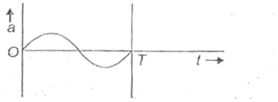
Here , a=acceleration at time t

T =time period

A. 

B. 

C. 

D. 

Answer: C

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7. Out of the following functions representing motion of a particle which represents SHM?

1. $x = \sin^3 \omega t$

2. $x = 1 + \omega t + \omega^2 t^2$

3. $x = \cos \omega t + \cos 3\omega t + \cos 5\omega t$

4. $x = \sin \omega t + \cos \omega t$

A. $y = \sin \omega t - \cos \omega t$

B. $y = \sin^3 \omega t$

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

D. $y = 1 + \omega t + \omega^2 t^2$

Answer: D

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8. 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

A. π

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

C. zero

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

Answer: D

Watch Video Solution

9. The displacement of paritcle along the x-axis is given by x=a $\sin^2 \omega t$.The motion of the particle corresponds to

A. Simple harmonic motion of frequency $\frac{\omega}{\pi}$

B. Simple harmonic motion of frequency $\frac{3\omega}{2\pi}$

C. Non simple harmonic motion

D. Simple harmonic motion of frequency $\frac{\omega}{2\pi}$

Answer: A

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10. The period of oscillation of mass M suspended from a spring of negligible mass is T. If along with it another mass M is also suspended, the period of oscillation will now be

A. T

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

C. 2T

D. $\sqrt{2}T$

Answer: D

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11. A simple pendulum performs simple harmonic motion about $x=0$ with an amplitude a ans time period T. The speed of the pendulum at $x=\frac{a}{2}$ will be

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

B. $\frac{3\pi^2 a}{T}$

C. $\frac{\pi a\sqrt{3}}{T}$

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

Answer: C

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12. Which one of the following equations of motion represents simple harmonic motion ?

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

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

C. Acceleration =kx

D. Acceleration $= -k_0x + k_1x^2$

Answer: A

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13. Two simple harmonic motions of angular frequency $100 rad s^{-1}$ and $1000 rad s^{-1}$ have the same displacement amplitude. The ratio of their maximum accelerations is

A. $1:10^4$

B. $1:10$

C. $1:10^2$

D. $1:10^3$

Answer: C

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14. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = a\sin\left(\omega t + \frac{\pi}{6}\right)$. After the elapse of what fraction of the time period, the velocity of the point will be equal to half of its maximum velocity ?

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

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

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

D. $\frac{T}{5}$

Answer: A

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15. A mass of $2.0kg$ is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released the mas executes a simple harmonic motion. The spring constant is $200N/m$. What should be the minimum amplitude of the motion, so that the mass gets detached from the pan ? (Take $g=10m/s^2$)

A. 10.0 cm

B. Any value less than 12.0 cm

C. 4.0 cm

D. 8.0 cm

Answer: A

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16. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is:-

A. zero

B. 0.5π

C. π

D. 0.707π

Answer: B

Watch Video Solution

17. The particle executing simple harmonic motion has a kinetic energy $K_0 \cos^2 \omega t$. The maximum values of the potential energy and the energy are respectively

A. K_0 and K_0

B. 0 and $2K_0$

C. $\frac{K_0}{2}$ and K_0

D. K_0 and $2K_0$

Answer: A

Watch Video Solution

18. A particle executes simple harmonic oscillation with an amplitudes a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is

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

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

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

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

Answer: D

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19. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium, it undergoes oscillation with a time period T. Then

A. $T \propto \sqrt{\rho}$

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

C. $T \propto \frac{1}{\rho}$

D. $T \propto \frac{1}{\sqrt{m}}$

Answer: B

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20. The circular motion of a particle with constant speed is

A. Simple harmonic but not periodic

B. Periodic and simple harmonic

C. Neither periodic nor simple harmonic

D. Periodic but not simple harmonic

Answer: D

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21. A particle executing simple harmonic motion of amplitude $5cm$ has maximum speed of $31.4cm/s$. The frequency of its oscillation is

A. 3Hz

B. 2Hz

C. 4Hz

D. 1Hz

Answer: D

Watch Video Solution

22. which one of following is a simple harmonic motion?

A. Particle moving in a circle with uniform speed

B. Wave moving through a string fixed at both ends

C. Earth spinning about its axis

D. Ball bouncing between two rigid vertical walls

Answer: B

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23. A particle is moving along the x-axis and force acting on it is given by $F = F_0 \sin \omega x N$, where ω is a constant. The work done by the force from $x = 0$ to $x = 2$ will be

A. $\dfrac{F_0}{\omega(1 - \cos \omega)}$

B. $\dfrac{F_0}{2\omega(1 - \cos 2\omega)}$

C. $\dfrac{F_0}{\omega(1-\cos 2\omega)}$

D. $\dfrac{2F_0 \sin^2 \omega}{\omega}$

Answer: D

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24. Which one of the following statements is true for the speed v and the acceleration α of a particle executing simple harmonic motion?

A. When v is maximum, a is maximum

B. Value of a is zero, whatever may be the value of v

C. When v is zero, a is zero

D. When v is maximum, a is zero

Answer: D

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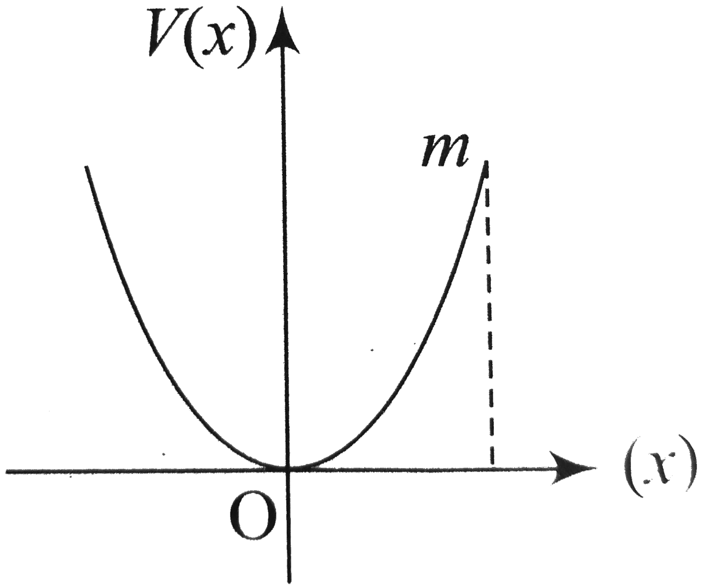
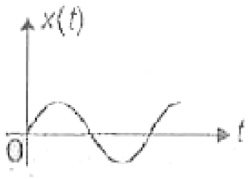
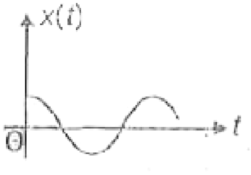
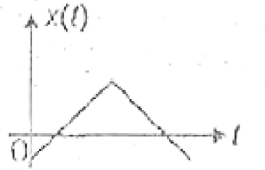
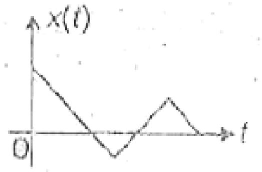
25. A particle of mass m is released from rest and follow a particle part as shown Assuming that the displacement of the mass from the origin is small which graph correctly depicts the position of the particle as a function of time?



A. 

B. 

C. 

D. 

Answer: B

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26. In a simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is kinetic ?

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

B. $\frac{3}{4}$

C. zero

D. $\frac{1}{4}$

Answer: B

Watch Video Solution

27. 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 160J

B. Maximum P.E is zero

C. Maximum P.E. is 100J

D. Maximum P.E. is 120J

Answer: A

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28. Displacement between maximum potential energy position and maximum kinetic energy position for a particle executing $S.\ H.\ M$ is

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

B. $+a$

C. $\pm a$

D. -1

Answer: C

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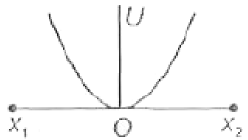
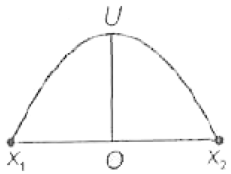
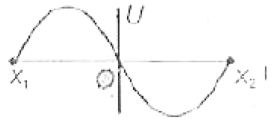
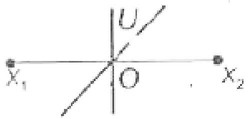
29. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2, the equilibrium position being at O. Its potential energy is plotted . It will be given below in the graph

A. 

B. 

C. 

D. 

Answer: A

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30. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is

(where, E is the total energy)

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

B. $\frac{1}{8}E$

C. $\frac{1}{4}E$

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

Answer: C

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31. If the length of a simple pendulum is increased by 2%, then the time period

A. increases by 1%

B. Decreases by 1%

C. Increases by 2%

D. Decreases by 2%

Answer: A

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32. 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. 2

B. 1

C. 5

D. 3

Answer: A

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33. Two sttings A and B length l_A and l_B and carry masses M_A and M_B at their lower ends . The upper ends being supported by rigid supports. If n_A and n_B are the frequencies of their vibrations and $n_A = 2n_B$, then

A. $l_A = \frac{l_B}{4}$, does not depend on mass

B. $l_A = 4l_B$, does not depend on mass

C. $l_A = 2l_B$ and $M_A = 2M_B$

D. $l_A = \frac{l_B}{2}$ and $M_A = \frac{M_B}{2}$

Answer: A

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34. A mass m is vertically suspended from a spring of negligible mass, the system oscillates with a frequency n. what will be the frequency of the system, if a mass $4m$ is suspended from the same spring?

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

B. 4n

C. $\frac{n}{4}$

D. 2n

Answer: A

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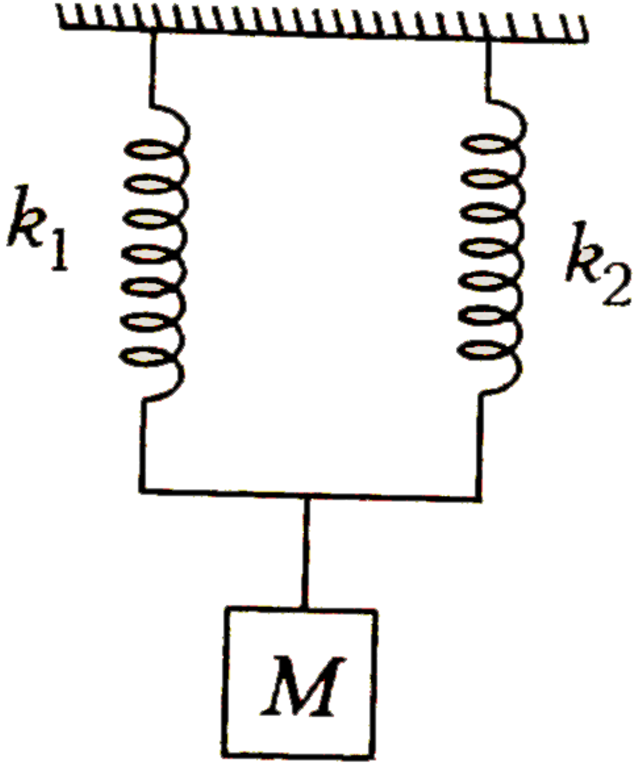
35. A mass is suspended separately by two springs of spring constant k_1 and k_2 in successive order. The time period of oscillations in the two cases are T_1 and T_2 respectively .If the same mass be suspended by connecting the two springs in parallel, (as shown in figure) then the timer period of oscillations is T. The correct relation is



A. $t_0^2 = t_1^2 + t_2^2$

B. $t_0^{-2} = t_1^{-2} + t_2^{-2}$

C. $t_0^{-2} = t_1^{-1} + t_2^{-1}$

D. $t_0 = t_1 + t_2$

Answer: B

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36. The time period of a mass suspended from a spring is T. If is the spring is cut into four equal parts and the same mass is suspend from one of the parts, then the new time period will be -

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

B. T

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

D. 2T

Answer: C

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37. A particle, with restoring force proportional to displacement and resulting force proportional to velocity is subjected to a 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

A. $\omega_1 \neq \omega_0 \text{ and } \omega_2 = \omega_0$

B. $\omega_1 = \omega_0 \text{ and } \omega_2 = \omega_0$

C. $\omega_1 = \omega_0 \text{ and } \omega_2 \neq \omega_0$

D. $\omega_1 \neq \omega_0 \text{ and } \omega_2 \neq \omega_0$

Answer: B

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38. When an oscillator completes 100 oscillation its amplitude reduced to $\frac{1}{3}$ of initial value. What will be its amplitude, when it completes 200 oscillation : -

A. $\frac{1}{8}$

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

C. $\frac{1}{6}$

D. $\frac{1}{9}$

Answer: D

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39. Inc ase of a forced oscillation, the resonance peak becomes very sharp when the

A. Daming force is small

B. Restoring force is small

C. Applied periodic force is small

D. Quality factor is small

Answer: A

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40. Two SHM's with same amplitude and time period, when acting together in perpendicular directions with a phase difference of $\frac{\pi}{2}$ give rise to

A. Straight motion

B. Elliptical motion

C. Circular motion

D. None of these

Answer: C

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41. The equations of two waves given as $x = a\cos(\omega t = \delta)$ and $y = a\cos(\omega t + \alpha)$, where $\delta = \alpha + \frac{\pi}{2}$, then resultant wave represent:

A. A hyperbola

B. A circle

C. An ellipse

D. None of these

Answer: B

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42. The damping force on an oscillator is directly proportional to the velocity. The units of the constant to proportionality are

A. $kgms^{-1}$

B. $kgms^{-2}$

C. kgs^{-1}

D. kgs

Answer: C

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43. A wave has SHM (simple harmonic motion) whose period is 4s while another periods 3 s. If both are combined, then the resultant wave will have the period equal to

A. 4s

B. 5s

C. 12s

D. 3s

Answer: C

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Assignment (Section D) (ASSERTION-REASON TYPE QUESTIONS)

1. A: Simple harmonic motion is not a uniform motion.

R: Simple harmonic motion can be regarded as the projection of uniform circular motion.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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2. Assertion: In simple harmonic motion the velocity is maximum when the acceleration is minimum

Reason : Displacement and velocity of SHM differ in phase by $\frac{\pi}{2}$

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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3. Assertion : The amplitude of an oscillation pendulum decreases gradually with time

Reason : The frequency of the pendulum decrease with time

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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4. Draw the velocity-displacement graph of a body executing shm.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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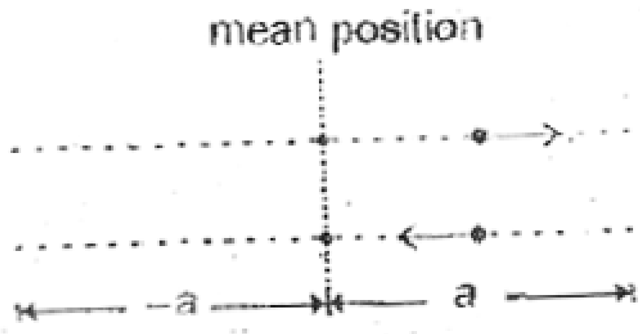
5. A: The phase difference between the two particles shown below is π. (Assuming both particles have same time periods and same amplitudes).



R: If the particles cross each other while they move in the opposite direction, they have a phase difference of π radian.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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6. Any periodic function can be expressed as a superposition of sine and cosine functions of different times periods with suitable coefficients. Which of the following mathematicians proved this result?

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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7. The potential energy of a particle executing SHM varies sinusoidally with frequency f. The frequency of oscillation of the particle will be

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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8. A: If a clock based on simple pendulum is taken to hill it will become slower.

R: With increase of height above surface of earth g decreases so T will increase.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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9. A: If a spring block system, oscillating in a vertical plane is made to oscillate on a horizontal surface, the time period will remain same.

R: The time period of spring block system does not depend on g.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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10. At resonance, the amplitude of forced oscillations is

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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11. A: If length of a spring is halved, then its force constant becomes double.

R: The spring constant is inversely proportional to length of spring.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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12. A: When soldier cross a bridge, they are asked to break steps.

R: If they do not break steps, then they will apply large force on bridge simutaneously.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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13. A: In SHM the change in velocity is not uniform.

R: In SHM the acceleration of body varies linearly with its displacement.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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