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India's Number 1 Education App

## PHYSICS

## BOOKS - DHANPAT RAI \& CO PHYSICS (HINGLISH)

## OSCILLATIONS

## Type A Worked Out Examples

1. A simple harmonic motion is represented by
$x=10 \sin (20 t+0.5)$.
Write down its amplitude, angular frequency, frequency, time period and initial phase if displacement is measured in metres and time seconds.
2. A particle executes SHM with a time period of 2 s and amplitude 5 cm . Find (i) displacement (ii) velocity (iii) acceleration, after $1 / 3$ second, starting from mean position.

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3. The motion of a particle in S.H.M. is described by the displacement function, $x=A \cos (\omega t+\phi)$, If the initial $(t=0)$ position of the particle is 1 cm and its initial velocity is $\omega c m s^{-1}$, what are its amplitude and initial phase angle ? The angular frequency of the particle is $\pi s^{-1}$. If instead of the cosine function, we choose the sine function to describe the $\mathrm{SHM}: x=B \sin (\omega t+\alpha)$, what are the amplitude and initial phase of the particle with the above initial conditions?

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4. The motion of a particle in S.H.M. is described by the displacement function, $x=A \cos (\omega t+\phi)$, If the initial $(t=0)$ position of the particle is 1 cm and its initial velocity is $\omega c m s^{-1}$, what are its amplitude and initial phase angle ? The angular frequency of the particle is $\pi s^{-1}$. If instead of the cosine function, we choose the sine function to describe the $\mathrm{SHM}: x=B \sin (\omega t+\alpha)$, what are the amplitude and initial phase of the particle with the above initial conditions?

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

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6. The equation of a simple harmonic motion is given by $y=6 \sin 10 \pi t+8 \cos 10 \pi \mathrm{~cm}$ and t in sec. Determine the amplitude,
period and initial phase.

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7. A particle executes S.H.M. of amplitude 25 cm and time period 3 s .

What is the minimum time required for the particle to move between two points 12.5 cm on either side of the mean position ?

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8. The shortest distance travelled by a particle executing SHM from mean position in 2 s is equal to $(\sqrt{3} / 2)$ times its amplitude. Determine its time period.

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9. Time period of a simple pendulum is $2 s$ and it can go to and fro from equilibrium position at a maximum distance of 6 cm . If at the start of
the motion the pendulum is in the position of maximum displacement towards the right of the equilibrium position, then write the displacement equation of the pendulum.

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10. In what time after its motion begins, will a particle oscillating according to the equation, $y=7 \sin 0.5 \pi \mathrm{t}$ move from the mean position to maximum displacement ?

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11. A body of mass 16 kg is made to oscillate on a spring of force constant $100 \mathrm{Nkg}^{-1}$. Deduce the angular frequency.

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12. In a HCl molecule, we may treat Cl to be of infinite mass and H alone oscillating. If the osillation of HCl molecule shows frequency $9 \times 10^{13} s^{-1}$, deduce the force constant. The Avogadro number $=6 \times 10^{26}$ per kg-mole.

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13. A particle is moving in SHM in a straight line. When the distance of the particle from equilibrium position has values $x_{1}$ and $x_{2}$, the corresponding values of velocities are $u_{1}$ and $u_{2}$. Show that time period of vibration is $T=2 \pi\left[\frac{x_{2}^{2}-x_{1}^{2}}{u_{1}^{2}-u_{2}^{2}}\right]^{1 / 2}$

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14. The velocity of a particle describing SHM is $16 \mathrm{cms}^{-1}$ at a distance of 8 cm from mean position and $8 \mathrm{cms}^{-1}$ at a distance of 12 cm from mean postion. Calculate the amplitude of the motion.
15. If a simple pendulum oscillates with an amplitude of 50 mm and time period of 2 sec , then its maximum velocity is

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16. A particle executing linear SHM has a maximum velocity of $40 \mathrm{~cm}^{-1}$ and a maximum acceleration of $50 \mathrm{cms}^{-2}$. Find its amplitude and the period of oscillation.

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17. The acceleration of a particle performing S.H.M. is $12 \mathrm{~cm} / \mathrm{sec}^{2} \mathrm{~cm}$ at a distance of 3 cm form the mean position. Its period is
18. The amplitude of a particle executing S.H.M. with frequency of 60 Hz is 0.01 m . The maximum value of the acceleration of the particle is

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19. A small body of mass 0.10 kg is executing S.H.M. of amplitude 1.0 m and period 0.20 sec . The maximum force acting on it i

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20. If the distance $y$ of a point moving on a straight line measured from a fixed origin on it and velocity v are connected by the relation $4 v^{2}=25-y^{2}$, then show that the motion is simple harmonic and find its time period.

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21. A particle executing SHM along a st. line has a velocity of $4 \mathrm{~ms}^{-1}$, when at a distance of 3 m from its mean position and $3 \mathrm{~ms}^{-1}$, when at a distance of 4 m from it. Find the time it take to travel 2.5 m from the positive extremity of its oscillation.

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22. The vertical motion of a huge piston in a machine is approximately simple harmonic with a frequency of $0.50 \mathrm{~s}^{-1}$. A block of 10 kg is placed on the pistion. What is the maximum amplitude of the pistion's SHM for the block and the piston to remain together ?

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23. A partical executes SHM on a straigh line path. The amplitude of oscillation is 2 cm . When the displacement of the particle from the mean position is 1 cm , the magnitude of its acceleration is equal to that
of its velocity. Find the time period of SHM, also the ms. velocity and ms. acceleration of SHM.

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

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25. A body of mass 0.1 kg is executing SHM according to the equation $y=0.5 \cos \left(100 t+\frac{3 \pi}{4}\right)$ metre

Find (i) the frequency of oscillation (ii) initial phase (iii) maximum velocity (iv) maximum acceleration and (v) total energy.
26. A body of mass 1 kg executes $S H M$ which is given by
$y=6.0 \cos \left(100 t+\frac{\pi}{4}\right) c m$
What is the (i) amplitude of displacement (ii) frequency (iii) initial phase (iv) velocity (v) acceleration and (vi) maximum kinetic energy ?

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## Type B Based On Oscillations

1. A mass of 2 kg is suspended from a vertical spring. An additional force of 2.5 N stretches it by 1 cm . (i) Calculate the force constant. (ii) Calculate the frequecny of oscillations, if the spring is stretched by the given force and then released.

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2. A small body of mass 0.1 kg is undergoing SHM of amplitude 1.0 m and period 0.2 s. (i) What is the maximum force acting on it ? (ii) If the oscillations are produced by a spring, what is the force constant of the spring ?

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3. The pan attached to a spring balance has a mass of 1 kg . A weight of kg when placed on the pan stretches the spring by 10 cm . What is the frequency with which the empty pan will oscillate?

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4. A spring compressed by 0.2 m develops a restoring force of 25 N . A body of mass 5 kg is placed over it. Deduce (i) force constant of the spring (ii) the depression of the spring under the weight of the body
and (iii) the period of oscillation, if the body is disturbed. Take $g=10 \mathrm{Nkg}^{-1}$.

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5. A spring balance has a scale that reads from 0 to 50 kg . The length of the scale is 20 cm . A body suspended from this spring, when displaced and released, oscillates with period of 0.60 s . What is the weight of the body?

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6. A body of mass 12 kg is suspended by a coil spring of natural length 50 cm and force constant $2.0 \times 10 \mathrm{Nm}^{-1}$. What is the stretched length of the spring ? If the body is pulled down further stretching the spring to a length of 59 cm and then released, what is the frequency of oscillation of the suspended mass? (Neglect the mass of the spring).
7. For the motion of the mass suspended by a coil spring in example 32 .
(i) What is the net force on the suspended mass at its lowermost position ?
(ii) What is the elastic restoring force on the mass due to the spring at its uppermost position ?

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8. A spring of force constant $1200 \mathrm{Nm}^{-1}$ is mounted on a horizontal table as shown in figure. A mass of 3.0 kg is attached to the free end of the spring, pulled side ways to a distance of 2.0 cm and released. Determing.
(a) the frequency of oscillation of the mass.
(b) the maximum acceleration of the mass.
(c) the maximum speed of the mass.


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9. In example 34, let us take the position of the mass, when the spring is unstretched, as $x=0$, and the direction from left to right as the positive direction of X -axis. Give x as a function of time t for the oscillating mass, if at the moment we start the stop watch ( $\mathrm{t}=0$ ), the mass is (i) at the mean position (ii) at the maximum stretched position
(iii) at the maximum compressed position.

In what do these different functions of SHM differ ? Frequency, amplitude or initial phase ?
10. An impulsive force gives an initial velocity of $1.0 \mathrm{~ms}^{-1}$ to the mass in the unstretched spring position [sec Fig. 16.2]. What is the amplitude of motion ? Give x as a function of time t for the oscillating mass. Given $\mathrm{m}=3 \mathrm{~kg}$ and $k=1200 \mathrm{Nm}^{-1}$.

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11. A 2.5 kg collar attached to a spring of foce constant $1000 \mathrm{Nm}^{-1}$ slides without friction on a horizontal rod. The collar is displaced from its equilibrium position by 5.0 cm and released. Calculate (i) the period of oscillation (ii) the maximum speed of the collar and (iii) the maximum acceleration of the collar.

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12. A small trolley of mass 2.0 kg resting on a horizontal turn table is connected by a light spring to the centre of the table. When the turn
table is set into rotation at a speed of 300 rpm , the length of the stretched spring is 40 cm . If the original length of the spring is 35 cm , determine the force constant of the spring.

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13. Two masses $m_{1}=1.0 \mathrm{~kg}$ and $m_{2}=0.5 \mathrm{~kg}$ are suspended together by a massless spring of force constant, $k=12.5 \mathrm{Nm}^{-1}$. When they are in equillibrium position, $m_{1}$ is gently removed. Calculate the angular frequency and the amplitude of oscillation of $m_{2}$. Given $g=10 \mathrm{~ms}^{-2}$.

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14. four different springs arrangements. If the mass $m$ in each arrangement is displaced from its equilibrium position and released, what is the resulting frequency of vibration in each case? Neglect the mass of the spring. Figure (a) and (b) represent an arrangement of
springs in parallel and (c) and (d) represent springs in series?


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15. Two identical springs, each of spring factor $k$, may be connected in the following ways. Deduce the spring factor of the oscillation of the body in each case.
16. Figure a) shows a spring of force constant $k$ clamped rigidly at once end and a mass $m$ attached to its free end. A force $F$ applied at the free end stretches the spring. Figure b) shows the same spring with both ends free and attached to a mass $m$ at either end. Each end of the spring in figure is stretched by the same force $F$.
(a) What is the maximum extension of the spring in the two cases ?
(b) If the mass in figure and the two masses in figure are released free, what is the period of oscillation in each case?


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17. A tray of mass 12 kg is supported by two identical springs as shown in figure. When the tray is pressed down slightly and released, it
executes SHM with a time period of 1.5 s. What is the force constant of each spring? When a block of mass $m$ is placed on the tray, the period of SHM changes to 3.0 s . What is the mass of the block ?


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18. A tolley of mass 3.0 kg is connected to two identical spring each of force constant $600 \mathrm{Nm}^{-1}$ as shown in figure. If the trolley is displaced from its equilibrium position by 5.0 cm and released, what is
(a) the period of ensuing oscillation?
(b) the maximum speed of trolley?
(c) How much is the total energy dissipated as heat by the time the trolley comes to rest due to damping forces?


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## Type C Based On Oscillations Of A Simple Pendulum

1. The acceleration due to gravity on the surface of the moon is
$1.7 \mathrm{~ms}^{-2}$. What is the time perioid of a simple pendulum on the surface of the moon, if its time period on the surface of earth is $3.5 s$ ?

Take $g=9.8 m s^{-2}$ on the surface of the earth.
2. (i) Calculate the length of a second's pendulum. (ii) If this pendulum is mounted in a lift which accelerates upwards at $2.8 \mathrm{~ms}^{-2}$, by what factor does its period of oscillation change from the original value ? Given g on earth $=9.8 \mathrm{~ms}^{-2}$.

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3. Calculate the percentage change in the time period of a simple pendulum, if (i) the length of the pendulum be increased by $4 \%$ (ii) the mass of the bob be increased by $30 \%$ (iii) the oscillation amplitude be decreased by $40 \%$ and (iv) the pendulum be taken to a place where the value where the value of $g$ be $0.8 \%$ more.
4. If the length of a correct pendulum clock is raised by $0.1 \%$, what will be the effect on the time of the clock in a day ?

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5. The pendulums of lengths 100 cm and 110.25 cm start oscillating in phase. After how many oscillation will they again be in same phase?

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6. A second's pendulum is taken in a carriage. Find the period of oscillation when the carriage move $s$ with an acceleration of $4 \mathrm{~ms}^{-2}$ (i) vertically upwards (ii) vertically downwards, and (iii) in a horizontal direction.

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7. The bottom of a dip on a road has a radius of curvature R. A richshaw of mass $M$ left a little away from the bottom oscillates about the dip. Deduce an expression for the period of oscillation.

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## Type D Based On Other Examples Of Shm

1. One end of a U-tube containing mercury is connected to a suction pump and the other end is connected to the atmosphere. A small pressure difference is maintained between the two columns. Show that when the suction pump is removed, the liquid in the U-tube executes SHM.
2. If the earth were a homogeneous sphere of radius $R$ and a straight hole bored in it through its centre, show that a body dropped into the hole will execute SHM and find its time period.

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## Example

1. A cylidrical wooden piece of cork floats in a liquid of density $\sigma$. The cork is depressed slightly and released. Show that the cork will oscillate up and down simple harmonicaly with a period.
$T=2 \pi \sqrt{\frac{\rho h}{\sigma g}}$, where $\rho$ is the density of the cork.

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2. An air chamber of volume $V$ has a neck area of cross section $A$ into which a ball of mass $m$ just fits and can move up and down without any
friction, figure. Show that when the ball is pressed down a little and released, it executes SHM. Obtain an expression for the time period of oscillations assuming pressure volume variations of air to be isothermal.

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3. A vertical U-tube of uniform cross-section contains water upto a height of 2.45 cm . show that if the water on one side is decpressed and then released, its up and down motion in the tube is SHM and calculate its time period. Given $g=980 \mathrm{cms}^{-2}$.

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4. A test tube weighing 10 g and external dismeter 2.5 cm is floated vertically in water by placing 20 g of mercury at its bottom. The tube is depressed in water a little and then released. Find the time of oscillation. Take $g=10 \mathrm{~ms}^{-2}$.

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5. A cylinderical wooden block of cross-section $15.0 \mathrm{~cm}^{2}$ and mass 230 g is floated over water with an extra weight of 50 g attached to its bottom. The cylider floats vertically. From the state of equilibrium, it is slightly depressed and released. If the specific gravity of wood is 0.30 and $g=9.8 m s^{-2}$ deduce the frequency of the block, $A=15.0 \mathrm{~cm}^{2}=15 \times 10^{-4} \mathrm{~m}^{2}$

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6. The balance wheel of a watch has a moment of inertia of $2 \times 10^{-8} \mathrm{kgm}^{2}$ and the torsional constant of its hair spring is $9.8 \times 10^{-8} \mathrm{Nm} \mathrm{rad}^{-1}$ calculate its frequency.

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7. A sphere is hung with a wire $30^{\circ}$ rotation of the sphere about the wire generates a restoring torque of 4.6 Nm . If the moment of inertia of the sphere is $0.082 \mathrm{~kg} m^{2}$, deduce the frequency of angular oscillations.

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8. A circular disc of mass 10 kg is suspended by a wire attahced to its centre. The wire is twisted by rotating the disc and released. The period of torsional oscillations is found to be 1.5 s . The radius of the disc is 15 cm . Determing the torsional spring constant of the wire. (Torsional spring constant $\alpha$ is definied by the relation $J=-\alpha \theta$, where J is the restoring coubple and $\theta$ the angle of twist.

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9. A body executes SHM of time period 8 s . if its mass be 0.1 kg , its velocity 1 sec after it passes through its mean position be $4 m s^{-1}$, find
its (i) kinetic energy (ii) potential energy and (iii) total energy.

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10. A body of mass 5 kg executes SHM of amplitude 0.5 m . If the force constant be $100 \mathrm{Nm}^{-1}$, calculate its kinetic energy, potential energy and total energy when it is half way between the equilibrium and extreme positions.

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11. In the above example, what is (i) the speed of te mass when the spring is compressed by 1.0 cm , (ii) potential energy of the mass when it momentarily comes to rest, (iii) total energy of the oscillating mass.
12. A particle of mass 10 g is describing SHM along a straight line with a period of 2 s and amplitude of 10 cm . what is the kinetic energy when it is (i) 2 cm (ii) 5 cm , from its equilibrium positio? How do you account for the difference between its two values.?

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13. At a time when the displacement is half the amplitude, what fraction of the total energy is kinetic and what fraction is potential in SHM?

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14. A particle is executing SHM of amplitude A. at what displacement from the mean postion is the energy half kinetic and half potential?

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15. A particle executes simple harmonic motion of amplitude A. (i) At what distance from the mean positio is its kinetic energy equal to its potential energy? (ii) At what points is its speed half the maximum speed?

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16. Show that for a particle in linear S.H.M., the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

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17. What is periodic motion ? Give some of its examples

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18. What is oscillatory motion ? Give some of its examples.

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19. Every oscillatory motion is necessarily periodic but every periodic motion need not be oscillatory. Justify.

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20. Distinguish between periodic, harmonic and non-harmonic functions. Give examples of each

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21. On an average a human heart is found to beat 75 times in a minute.

Calculate its beat frequency and period.
22. What is meant by simple harmonic motion ? Give some examples.

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23. State some important features of simple harmonic motion.

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24. Show that a linear combination of sine and cosine function like $x(t)=a \sin \omega t+b \cos \omega t$ represents a simple harmonice. Also, determine its amplitude and phase constant.

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25. Deduce an expression for the velocity of a particle executing S.H.M. When is the particle velocity maximum?

## (D) Watch Video Solution

26. Deduce an expression for the velocity of a particle executing S.H.M. When is the particle velocity minimum?

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27. A simple harmonic motion is represented by
$x=10 \sin (20 t+0.5)$.
Write down its amplitude, angular frequency, frequency, time period and initial phase if displacement is measured in metres and time seconds.
28. A particle executes SHM with a time period of 2 s and amplitude 5 cm . Find (i) displacement (ii) velocity (iii) acceleration, after $1 / 3$ second, starting from mean position.

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30. A particle executes SHM with a time period of 2 s and amplitude 5 cm . Find (i) displacement (ii) velocity (iii) acceleration, after $1 / 3$ second, starting from mean position.

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31. A body oscillates with SHM according to the equation
$x(t)=5 \cos (2 \pi t+\pi / 4)$
where t is in second and x in metres. Calculate (a) displacement at $\mathrm{t}=0$
(b) time period (c) initial velocity

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32. A body oscillates with SHM, accroding to the equation, $x=(5.0 m) \cos \left[\left(2 \pi r a d s^{-1}\right) t+\pi / 4\right]$

At $t=1.5 s$, calculate the $(a)$ diplacement $(b)$ speed and (c) acceleration of the body.

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33. A body oscillates with SHM, accroding to the equation, $x=(5.0 \mathrm{~m}) \cos \left[\left(2 \pi r a d s^{-1}\right) t+\pi / 4\right]$

At $t=1.5 s$, calculate the $(a)$ diplacement $(b)$ speed and (c) acceleration of the body.

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34. A body oscillates with $S H M$, accroding to the equation, $x=(5.0 m) \cos \left[\left(2 \pi r a d s^{-1}\right) t+\pi / 4\right]$

At $t=1.5 s$, calculate the (a) diplacement (b) speed and (c) acceleration of the body.

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35. The equations of simple harmonic motin is given by
$y=3 \sin 5 \pi t+4 \cos 5 \pi t$, where y is in cm and t in second. Determing the amplitude, period and initial phase.

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## (b) Watch Video Solution

39. A particle executes SHM of time period 10 seconds. The displacement of particle at any instant is given by : $x=10 \sin \omega t$ (in cm ). Find (i) the velocity of the body 2 s after it passes through mean position (ii) the acceleration 2 s after it passes the mean position.

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46. The vertical motion of a huge piston in a machine is approximately simple harmonic with a frequency of $0.50 \mathrm{~s}^{-1}$. A block of 10 kg is placed on the pistion. What is the maximum amplitude of the pistion's SHM for the block and the piston to remain together ?

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47. A block of mass on kg is fastened to a spring with a apring constant $50 \mathrm{Nm}^{-1}$. The block is pulleed to a distance $\mathrm{x}=10 \mathrm{~cm}$ from its equilibrium position at $\mathrm{x}=\mathrm{O}$ on a frictionless surface from rest at $\mathrm{t}=\mathrm{O}$. Write the expression fr its $\mathrm{x}(\mathrm{t})$ and $\mathrm{v}(\mathrm{t})$.

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

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49. A body of mass 0.1 kg is executing SHM according to the equation $y=0.5 \cos \left(100 t+\left(3 \frac{\pi}{4}\right)\right.$ meter. Find the frequency of oscillation.

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50. A body of mass 0.1 kg is executing SHM according to the equation
$y=0.5 \cos \left(100 t+\frac{3 \pi}{4}\right)$ metre
Find (i) the frequency of oscillation (ii) initial phase (iii) maximum velocity (iv) maximum acceleration and (v) total energy.

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51. A body of mass 0.1 kg is executing SHM according to the equation $y=0.5 \cos \left(100 t+\frac{3 \pi}{4}\right)$ metre

Find (i) the frequency of oscillation (ii) initial phase (iii) maximum velocity (iv) maximum acceleration and (v) total energy.

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52. A body of mass 0.1 kg is executing SHM according to the equation $y=0.5 \cos \left(100 t+\frac{3 \pi}{4}\right)$ metre

Find (i) the frequency of oscillation (ii) initial phase (iii) maximum velocity (iv) maximum acceleration and (v) total energy.

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53. A body of mass 0.1 kg is executing SHM according to the equation $y=0.5 \cos \left(100 t+\frac{3 \pi}{4}\right)$ metre

Find (i) the frequency of oscillation (ii) initial phase (iii) maximum velocity (iv) maximum acceleration and (v) total energy.

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54. A block whose mass is 1 kg is fastened to a spring. The spring has a spring constant $50 \mathrm{Nm}^{-1}$. The block is pulled to a distance $x=10 \mathrm{~cm}$ from its equilibrium position at $x=0$ on a frictionless surface at $t=0$
. Calculate the kinetic, potential and total energies of the block when it is 5 cm away from the mean position.

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55. A body executes SHM of time period 8 s . if its mass be 0.1 kg , its velocity 1 sec after it passes through its mean position be $4 m s^{-1}$, find its (i) kinetic energy (ii) potential energy and (iii) total energy.
56. A body executes SHM of time period 8 s . if its mass be 0.1 kg , its velocity 1 sec after it passes through its mean position be $4 m s^{-1}$, find its (i) kinetic energy (ii) potential energy and (iii) total energy.

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57. A body executes SHM of time period 8 s . if its mass be 0.1 kg , its velocity 1 sec after it passes through its mean position be $4 m s^{-1}$, find its (i) kinetic energy (ii) potential energy and (iii) total energy.

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58. A spring of force constant $800 \mathrm{~N} / \mathrm{m}$ has an extension of 5 cm . The work done in extending it from 5 cm to 15 cm is

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59. A particle of mass 10 g is describing SHM along a straight line with a period of 2 s and amplitude of 10 cm . what is the kinetic energy when it is (i) 2 cm (ii) 5 cm , from its equilibrium positio? How do you account for the difference between its two values.?

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60. A particle of mass 10 g is describing SHM along a straight line with a period of 2 s and amplitude of 10 cm . what is the kinetic energy when it is (i) 2 cm (ii) 5 cm , from its equilibrium positio ? How do you account for the difference between its two values.?

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61. At a time when the displacement is half the amplitude, what fraction of the total energy is kinetic and what fraction is potential in SHM?
62. A particle is executing SHM of amplitude A. at what displacement from the mean postion is the energy half kinetic and half potential?

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63. A particle executes simple harmonic motion of ampliltude A. At what distance from the mean position is its kinetic energy equal to its potential energy?

## - Watch Video Solution

64. A particle executes simple harmonic motion of amplitude A. At what points is its speed half the maximum speed?

## - Watch Video Solution

65. Derive ann expression for the time period of a SHM in terms of inertia factor and spring factor.

## - Watch Video Solution

66. The pan attached to a spring balance has a mass of 1 kg . A weight of kg when placed on the pan stretches the spring by 10 cm . What is the frequency with which the empty pan will oscillate?

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67. A spring compressed by 0.2 m develops a restoring force of 25 N . A body of mass 5 kg is placed over it. Deduce (i) force constant of the spring (ii) the depression of the spring under the weight of the body and (iii) the period of oscillation, if the body is disturbed. Take $g=10 \mathrm{Nkg}^{-1}$.
68. A spring compressed by 0.2 m develops a restoring force of 25 N . A body of mass 5 kg is placed over it. Deduce (i) force constant of the spring (ii) the depression of the spring under the weight of the body and (iii) the period of oscillation, if the body is disturbed. Take $g=10 \mathrm{Nkg}^{-1}$.

## - Watch Video Solution

69. A spring compressed by 0.2 m develops a restoring force of 25 N . A body of mass 5 kg is placed over it. Deduce (i) force constant of the spring (ii) the depression of the spring under the weight of the body and (iii) the period of oscillation, if the body is disturbed. Take $g=10 \mathrm{Nkg}^{-1}$.

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70. A 0.2 kg of mass hangs at the end of a spring. When 0.02 kg more mass is added to the end of the spring, it stretches 7 cm more. If the 0.02 kg mass is removed what will be the period of vibration of the system?

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71. A body of mass 12 kg is suspended by a coil spring of natural length 50 cm and force constant $2.0 \times 10^{3} \mathrm{Nm}^{-1}$. What is the stretched length of the spring ? If the body is pulled down further stretching the spring to a length of 59 cm and then released, what is the frequency of oscillation of the suspended mass? (Neglect the mass of the spring).

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72. A small trolley of mass 2.0 kg resting on a horizontal turn table is connected by a light spring to the centre of the table. When the turn
table is set into rotation at a speed of 300 rpm , the length of the stretched spring is 40 cm . If the original length of the spring is 35 cm , determine the force constant of the spring.

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73. Two masses $m_{1}=1.0 \mathrm{~kg}$ and $m_{2}=0.5 \mathrm{~kg}$ are suspended together by a massless spring of force constant, $k=12.5 \mathrm{Nm}^{-1}$. When they are in equillibrium position, $m_{1}$ is gently removed. Calculate the angular frequency and the amplitude of oscillation of $m_{2}$. Given $g=10 \mathrm{~ms}^{-2}$.

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74. Two identical springs, each of spring factor $k$, may be connected in the following ways. Deduce the spring factor of the oscillation of the body in each case.
75. Two identical springs, each of force constant k are connected I ( $a$ ) series (b) parallel and they support a mass $M$. Calculate the ratio of the frequency of oscillation of the mass in two systems.

## - Watch Video Solution

76. What is the length of a simple pendulum which ticks second?

## - Watch Video Solution

77. The pendulums of lengths 100 cm and 110.25 cm start oscillating in phase. After how many oscillation will they again be in same phase ?

## - Watch Video Solution

78. A second's pendulum is taken in a carriage. Find the period of oscillation when the carriage move $s$ with an acceleration of $4 \mathrm{~ms}^{-2}$
vertically upwards (ii) vertically downwards, and (iii) in a horizontal direction.

## - Watch Video Solution

79. A second's pendulum is taken in a carriage. Find the period of oscillation when the carriage move s with an acceleration of $4 \mathrm{~ms}^{-2}$
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## - Watch Video Solution

80. A second's pendulum is taken in a carriage. Find the period of oscillation when the carriage move $s$ with an acceleration of $4 \mathrm{~ms}^{-2}$
vertically upwards (ii) vertically downwards, and (iii) in a horizontal direction.
81. The bottom of a dip on a road has a radius of curvature R. A richshaw of mass $M$ left a little away from the bottom oscillates about the dip. Deduce an expression for the period of oscillation.

## - Watch Video Solution

82. One end of a U-tube containing mercury is connected to a suction pump and the other end is connected to the atmosphere. A small pressure difference is maintained between the two columns. Show that when the suction pump is removed, the liquid in the U-tube executes SHM.

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83. If the earth were a homogeneous sphere of radius $R$ and a straight hole bored in it through its centre, show that a body dropped into the hole will execute SHM and find its time period.
84. A cylidrical wooden piece of cork floats in a liquid of density $\sigma$. The cork is depressed slightly and released. Show that the cork will oscillate up and down simple harmonicaly with a period.
$T=2 \pi \sqrt{\frac{\rho h}{\sigma g}}$, where $\rho$ is the density of the cork.

## - Watch Video Solution

85. An air chamber of volume V has a neck area of cross section A into which a ball of mass $m$ just fits and can move up and down without any friction, figure. Show that when the ball is pressed down a little and released, it executes SHM. Obtain an expression for the time period of oscillations assuming pressure volume variations of air to be isothermal.

## - Watch Video Solution

86. Can a motion be periodic and not oscillatory ?

## - Watch Video Solution

87. Can a motion be oscillatory but not simple harmonic? If your answer is yes give an example and if not explain why?

## (D) Watch Video Solution

88. Every simple harmonic motion is periodic motion, but every periodic motion need not be simple harmonic motion. Do you agree ? Give one example to justify your statement.

## - Watch Video Solution

89. The rotation of the earth about its axis is periodic but not simple harmonic. Justify.
90. What is the basic condition for the motion of a particle to be S.H.M
91. Which of the following conditions is not sufficient for SHM and why?
(i) acceleration $\propto$ displacement,
(ii) restoring force $\propto$ displacement.

## - Watch Video Solution

92. Which of the following conditions is not sufficient for simple harmonic motion and why ? restoring force $\propto$ displacement.
93. What provides the restoring force for simple harmonic oscillations in the following cases? (i)simple pendulum (ii) spring (iii) column of mercury in U tube.

## - Watch Video Solution

94. When are the diplacement and velocity in the same direction in SHM?

## - Watch Video Solution

95. When are the velocity and acceleration in the same direction SHM?

## - Watch Video Solution

96. Can displacement and acceleration be in the same direction in
S.H.M. ?
97. The relation between the acceleration a and displacement $x$ of $a$ particle executing S.H.M. is $a=-(p / q) y$, where p and q are constants. What will be the time period T of the particle ?

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98. The maximum acceleration of a simple harmonic oscillator is $a_{0}$ and the maximum velocity is $V_{0}$. What is the displacement amplitude?

## - Watch Video Solution

99. The time period of an oscillating body is given by $T=2 \pi \sqrt{\frac{m}{a d g}}$. What is the force equation for this body?
100. Two simple pendulum of unequal lengths while oscillating meet each other at mean position. What is their phase difference ?

## (D) Watch Video Solution

101. Velocity and displacement of a body executing S.H.M. are out of phase by $\pi / 2$. How?

## - Watch Video Solution

102. A particle executes S.H.M. of amplitude A . At what positions of its displacement ( x ), will its velocity be zero and maximum?

## - Watch Video Solution

103. A particle executes S.H.M. of amplitude A . At what positions of its displacement ( x ), will its acceleration be zero and maximum ?
104. At what points along the path of a simple pendulum is the tension in the string maximum?

## Watch Video Solution

105. At what point in the motion of a simple pendulum is the string tension greatest ? At what point is it least? What in case of a conical pendulum?

## - Watch Video Solution

106. Can a pendulum vibrate in an artificial satellite.

## (D) Watch Video Solution

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

## - Watch Video Solution

108. Will a pendulum clock lose or gain time when taken to the top of a mountain ?

## - Watch Video Solution

109. The length of a second's pendulum on the surface of earth is 1 m .

What will be the length of a second's pendulum on the moon?

## - Watch Video Solution

110. The bob of a simple pendulum is made of wood. What will be the effect on the time period if the wooden bob is replaced by an identical
bob of aluminium?

## - Watch Video Solution

111. If a hollow pipe passes across the diameter of earth, then what changes takes place in the velocity and acceleration of a ball dropped in the pipe?

## - Watch Video Solution

112. A bob of a simple pendulum of length $I$ is negatively charged. A positively-charged metal plate is placed just below the bob and the pendulum is made to oscillate. What will be the effect on the time period of the pendulum?
113. A simple pendulum of length I and with a bob of mass moving along a circular arc of angle $\theta$ in a vertical plane. A sphere of mass $m$ is placed at the end of the circular arc. What momentum will be given to the sphere by the moving bob?

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114. A body moving in a straight line $O A B$ with simple harmonic motion has zero velocity when at the points $A$ and $B$ whose distances from $O$ and ' $a$ ' and ' $b$ ' respectively and has velocity v when half way between them. Find the period of the simple harmonic motion.

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115. When a body of mass 2.0 kg is suspended by a spring, the spring is stretched. If the body is pulled down slightly and released, it oscillated
up and down. What force is applied on the body by the spring when it passes through the mean position ? $\left(g=9.8 \mathrm{Nkg}^{-1}\right)$

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116. A spring of force constant $k$ is cut into there equal part what is force constant of each part ?

## - Watch Video Solution

117. How would the time period of a spring mass system change, when it is made to oscillate horizontally and then vertically?

## - Watch Video Solution

118. Alcohol in a U tube executes S.H.M. of time period T. Now, alcohol is replaced by water upto the same height in the U-tube What will be the effect on the time period?

## (D) Watch Video Solution

119. There are two springs, one delicate and another stiffer one. Which spring will have a greater frequency of oscillation for a given load ?

## - Watch Video Solution

120. Whet is the ratio between the potential energy the total energy of a particle executing S.H.M, when it's displacement is half of its amplitude?

## - Watch Video Solution

121. A particle is executing linear simple harmonic motion of amplitude 'A'. The fraction of the total energy is the kinetic when the displacement is half of the amplitude is
122. A restoring force is a must for a body to execute $S . H$. $M$ Explain, why

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123. What would happen to the motion of an oscillating system if the sign of the force term in equation $F=-k x$ is changed?

## - Watch Video Solution

124. What determines the natural frequency of a body?

## - Watch Video Solution

125. STATEMENT-1 : The amplitude of an oscillating pendulum in air decrease gradually with time.

STATEMENT-2 : The frequency of the pendulum decreases with time.

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126. A platoon of soldiers marches on a road in steps accoridng to the sound of a marching band The band ils stoped and the soldiers are ordered to break the steps while crossign as bridge. Why?

## - Watch Video Solution

127. A passing airplane sometimes causes the rattling of the windows of a house. Why ?

## - Watch Video Solution

128. How can earthquakes cause disaster sometimes?
129. Sometimes a wire glass is broken by the powerful voice of a celebrated singer why?

## D Watch Video Solution

130. Glass window may be broken by a far away explosion. Explain why?

## - Watch Video Solution

131. The body of a bus begins to rattle something, when the bus picks up a certain speed, why?

## - Watch Video Solution

132. What will be the change in time period of a loaded spring, when taken to moon ?
133. A spring of force constant $k$ is cut into two pieces such that one piece is double the length of the other. Then the long piece will have a force constant of

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134. In forcd oscillation of a particle, the amplitude is maximum for a frequency $\omega_{1}$ of the force, while the energy is maximum for a frequency $\omega_{2}$ of the force. What is the relation between $\omega_{1}$ and $\omega_{2}$ ?

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135. The maximum velocity of a particle, executing simple harmonic motion with an amplitude 7 mm is $4.4 m s^{-1}$. The period of oscillation is
136. Why the motion of a satellite around a planet cannot be taken as S. H. M ?

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137. Time period of a simple pendulum will be double, if we

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138. What is meant by simple harmonic motion (S.H.M.) ?

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139. At what points is the energy entirely kinetic and potential in S.H.M.

## (D) Watch Video Solution

140. What is the total distance travelled by a body executing SHM in a time equal to its time period, if its amplitude is A ?

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141. What is meant by restoring force ? Give one example.

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142. Two particles execute SHMs of the same amplitude and frequency along the same straight line. They cross one another when going in opposite direction. What is the phase difference between them when their displacements are half of their amplitudes?
143. A simple pendulum is hung in a stationary lift and its periodic time is $T$. What will be the effect on its periodic time $T$ if the lift goes up with uniform velocity v ?

## - Watch Video Solution

144. A simple pendulum is hung in a stationary lift and its periodic time is $T$. What will be the effect on its periodic time $T$ if the lift goes up with uniform acceleration a?

## - Watch Video Solution

145. A simple pendulum is hung in a stationary lift and its periodic time
is $T$. What will be the effect on its periodic time $T$ if the lift comes down with uniform acceleration a?
146. The bob of a vibrating simple pendulum is made of ice. How will the period of swing will change when the ice starts melting?

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147. The amplitude of a simple harmonic oscillation is doubled. How does this affect
(i) periodic time (ii) maximum velocity (iii) maximum acceleration and (iv) maximum energy

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148. The amplitude of a simple harmonic oscillation is doubled. How does this affect
(i) periodic time (ii) maximum velocity (iii) maximum acceleration and (iv) maximum energy
149. The amplitude of a simple harmonic oscillator is doubled. How does this affect maximum acceleration?

## (D) Watch Video Solution

150. The amplitude of a simple harmonic oscillation is doubled. How does this affect
(i) periodic time (ii) maximum velocity (iii) maximum acceleration and (iv) maximum energy

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151. You have a light spring, a metre scale and a known mass. How will you find the time period of oscillation of mass without the use of a clock?
152. A man is standing on a platform moving up and down as a S.H.M. will there be any change in his weight as recorded by a weighing machine on the platform ?

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153. The frequency of oscillations of a mass $m$ suspended by a spring is $v_{1}$. If the length of the spring is cut to one-half the same mass oscillates with frequency $v_{2}$. Determine the value of $v_{2} / v_{1}$

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154. All trignometric functions are periodic but only sine or cosine functions are used to define SHM. Why?
155. If a simple harmonic motion is represented by $\frac{d^{2} x}{d t^{2}}+\alpha x=0$, its time period is :

## (D) Watch Video Solution

156. Does the function $y=\sin ^{2} \omega t$ represent a periodic or a simple harmonic motion ? What is the period of the motion?

## (D) Watch Video Solution

157. The length of a simple pendulum executing simple harmonic motion is increased by $21 \%$. The percentage increase in the time period of the pendulum of increased length is

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158. Two simple harmonic motions are represented by the equations : $x_{1}=5 \sin (2 \pi t+\pi / 4), x_{2}=5^{2}(\sin 2 \pi t+\cos 2 \pi t)$ What is the ratio of their amplitudes ?

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159. The bob of a simple pendulum is a hollow sphere filled with water.

How will the period of oscillation change. If the water begins to drain out of the hollow sphere?

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160. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillating bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would
161. The time period of a mass suspended from a spring is $T$ if the spring is cut in to equal part and the same mass is suspended from one of the part then the time period will be

## - Watch Video Solution

162. Two simple harmonic are represented by the equation $y_{1}=0.1 \sin \left(100 \pi+\frac{\pi}{3}\right)$ and $y_{2}=0.1 \cos \pi t$.

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

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163. A particle of mass ( m ) is attached to a spring (of spring constant k ) and has a narural angular frequency omega_(0). An external force $R(t)$
proportional to cos omegat(omega!=omega)(0) is applied to the oscillator. The time displacement of the oscillator will be proprtional to.

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164. A simple pendulum has time period $T_{1}$. The point of suspension is now moved upward according to the relation $y=k t^{2}\left(k=1 \mathrm{~ms}^{-2}\right)$ where y is the vertical diplacement. The time period now becomes $T_{2}$.
What is the ration $\frac{T_{1}^{2}}{T_{2}^{2}}$ ? Given $g=10 \mathrm{~ms}^{-2}$

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165. The bob of simple pendulum executes SHM in water with a period

T , while the period of oscillation of the bob is $T_{0}$ in air. Neglecting frictional force of water and given that the density of the bob is $\frac{4000}{3} \mathrm{kgm}^{-3}$, find the ration between $T$ and $T_{0}$.
166. A mass $(M)$ is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes SHM of time period T. If the mass is increased by m, the time period becomes $\frac{5 T}{3}$. Then the ratio of $\frac{m}{M}$ is .

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

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168. A particle at the end of a spring executes simple harmonic motion with a period $t_{1}$ while the corresponding period for another spring is $t_{2}$
if the oscillation with the two springs in series is T then

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169. A particle executes simple harmonic motion between $x=-A$ and $x=+A$. The time taken for it to go from $0 \rightarrow A / 2 i s T_{1}$ and $\rightarrow g o o m A / 2 \rightarrow(A) i s\left(T_{2}\right)$. Then.

## - Watch Video Solution

170. Two simple harmonic motions are represented by the following

## equations

$$
\begin{aligned}
& y_{1}=10 \sin \left(3 \pi t+\frac{\pi}{4}\right) \\
& y_{2}=5(\sin 3 \pi t+\sqrt{3} \cos 3 \pi t)
\end{aligned}
$$

Find out the ratio of their amplitudes. What are the time periods of two motions?
171. A point particle of mass 0.1 kg is executing SHM of amplitude 0.1 m . When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} \mathrm{~J}$. Obtain the equation of motion of the particle if the initial phase of oscillation is $45^{\circ}$

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172. A simple harmonic motion has an amplitude $A$ and time period $T$.

What is the time taken to travel from $x=A$ to $x=A / 2$ ?

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173. A block is resting on a piston which is moving vertically with simple harmonic motion of period 1.0 second. At what amplitude of motion will the block and piston separate? What is the maximum velocity of the piston at this amplitude?
174. A block is kept on a horizontal table. The stable is undergoing simple harmonic motion of frequency 3 Hz in a horizontal plane. The coefficient of static friciton between block and the table surface is 0.72 . find the maximum amplitude of the table at which the block does not slip on the surface.

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175. Springs of spring constants $k, 2 k, 4 k, 8 k$, ...... are connected in series.

A mass m kg is attached to the lower end of the last spring and the systemm is allowed to vibrate. What is the time period of oscillations? Given $m=40 \mathrm{gm}, k=2.0 \mathrm{Ncm}^{-1}$.
176. A uniform spring whose unstretched length is I has a force constant k . the spring is cut into two pieces of unstretched lengths $l_{1}$ and $l_{2}$, where $l_{1}=n l_{2}$ and n is an integer. What are the corresponding force constant $k_{1}$ and $k_{2}$ in terms of n and k ? what is the ratio $k_{1} / k_{2}$

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177. A horizontal spring block system of mass $M$ executes simple harmonic motion. When the block is passing through its equilibrium position, an object of mass $m$ is put on it and the two move together.

Find the new amplitude and frequency of vibration. Given, $k$ is the spring constant of the system.

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178. The bob of pendulum of length $\mid$ is pulled aside from its equilibrium position through an angle $\theta$ and then released. Find the
speed $v$ with which the bob passes through the equilibrium position.

## - Watch Video Solution

179. A spring balance has a scale that reads from 0 to 50 kg . The length of the scale is 20 cm . A body suspended from this spring, when displaced and released, oscillates with period of 0.60 s . What is the weight of the body?

## (D) Watch Video Solution

180. A spring of force constant $1200 \mathrm{Nm}^{-1}$ is mounted on a horizontal table as shown in figure. A mass of 3.0 kg is attached to the free end of the spring, pulled side ways to a distance of 2.0 cm and released. Determing.
(a) the frequency of oscillation of the mass.
(b) the maximum acceleration of the mass.
(c) the maximum speed of the mass.


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181. A spring of force constant $1200 \mathrm{Nm}^{-1}$ is mounted on a horizontal table as shown in figure. A mass of 3.0 kg is attached to the free end of the spring, pulled side ways to a distance of 2.0 cm and released. Determing.
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(b) the maximum acceleration of the mass.
(c) the maximum speed of the mass.


## - Watch Video Solution

182. A spring of force constant $1200 \mathrm{Nm}^{-1}$ is mounted on a horizontal table as shown in figure. A mass of 3.0 kg is attached to the free end of the spring, pulled side ways to a distance of 2.0 cm and released.

Determing.
(a) the frequency of oscillation of the mass.
(b) the maximum acceleration of the mass.
(c) the maximum speed of the mass.


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183. Plot the corresponding reference circle for each of the following simple hoarmonic motions. Indicate the intial $(t=0)$ position of the particle, the radius of the circle, and the angular speed of the rotating particle. For simplicity, the sense of rotation may be fixed to be anticlockwise in every case : $(x$ is in cm and t is in s$)$.
(a) $x=-2 \sin (3 t+\pi / 3)$
(b) $x=\cos (\pi / 6-t)$
$x=3 \sin (2 \pi t+\pi / 4)(\mathrm{d}) x=2 \cos \pi t$
184. Plot the corresponding reference circle for each of the following simple hoarmonic motions. Indicate the intial $(t=0)$ position of the particle, the radius of the circle, and the angular speed of the rotating particle. For simplicity, the sense of rotation may be fixed to be anticlockwise in every case : $(x$ is in cm and t is in s ).
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$x=3 \sin (2 \pi t+\pi / 4)$ (d) $x=2 \cos \pi t$

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185. Plot the corresponding reference circle for each of the following simple hoarmonic motions. Indicate the $\operatorname{intial}(t=0)$ position of the particle, the radius of the circle, and the angular speed of the rotating particle. For simplicity, the sense of rotation may be fixed to be anticlockwise in every case : $(x$ is in cm and t is in s ).
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(b) $x=\cos (\pi / 6-t)$
$x=3 \sin (2 \pi t+\pi / 4)$ (d) $x=2 \cos \pi t$

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187. The piston in the cylinder head of a locomotive has a stroke (twice the amplitude) of 1.0 m . If the piston moves with simple harmonic motion with an angular frequency of $200 \mathrm{rev} / \mathrm{min}$., what is its maximum speed?

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188. The acceleration due to gravity on the surface of the moon is $1.7 \mathrm{~ms}^{-2}$. What is the time perioid of a simple pendulum on the surface of the moon, if its time period on the surface of earth is $3.5 s$ ?

Take $g=9.8 m s^{-2}$ on the surface of the earth.

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189. Time period of a particle in $S H M$ depends on the force constant $k$
and mass $m$ of the particle $T=2 p \sqrt{\frac{m}{k}}$. A simple pendulum exeutes SHM approximately. Why then is the period of a pendulum independent of the mass of the pendulum ?

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190. Answer the following questions:
(a) The motion of a simple pendulum is approximately simple harmonic for small angle oscillation. For larger angles of oscilliation, a more
involved analysis shows that $T$ is greater than $2 \pi \sqrt{\frac{t}{g}}$ Think of a qualitative argument to appreciate this result.
(b) What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity?

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191. A man with a wrist watch on his hands fall from the top of a tower.

Does the watch give correct time?

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192. A simple pendulum of length I and having a bob of mass $M$ is suspended ina car. The car is moving on a circular track of radius R with a uniform speed $v$. If the pendulum makes small oscillations in a radial direction about its equilibrium, what will be its time period ?
193. A cylindrical piece of cork of base area $A$ and height $h$ floats in a liquid of density $\rho_{1}$. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period
$T=2 \pi \sqrt{\frac{h \rho}{\rho_{1} g}}$

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194. One end of a U-tube containing mercury is connected to a suction pump and the other end is connected to the atmosphere. A small pressure difference is maintained between the two columns. Show that when the suction pump is removed, the liquid in the U-tube executes SHM.

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195. An air chamber of volume $V$ has a neck area of cross section $A$ into which a ball of mass $m$ just fits and can move up and down without any friction, figure. Show that when the ball is pressed down a little and released, it executes SHM. Obtain an expression for the time period of oscillations assuming pressure volume variations of air to be isothermal.

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196. An air chamber of volume $V$ has a neck area of cross section $A$ into which a ball of mass $m$ just fits and can move up and down without any friction, figure. Show that when the ball is pressed down a little and released, it executes SHM. Obtain an expression for the time period of oscillations assuming pressure volume variations of air to be isothermal.
197. You are riding an automobile of mass 3000 kg . Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 15 cm when the entire automobile is placed on it. Also, the amplitude of oscillation decreases by $50 \%$ during one complete oscillation. Estimate the values of (a) the spring constant $k$ and (b) damping constant $b$ for the spring and shock absorber system of one wheel, assuming that each wheel supports $750 \mathrm{~kg} . \mathrm{g}=10 \mathrm{~m} / \mathrm{s}^{2}$.

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198. You are riding an automobile of mass 3000 kg . Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 15 cm when the entire automobile is placed on it. Also, the amplitude of oscillation decreases by $50 \%$ during one complete oscillation. Estimate the values of (a) the spring constant $k$ and (b) damping constant $b$ for the spring and shock absorber system of one wheel, assuming that each wheel supports $750 \mathrm{~kg} . g=10 \mathrm{~m} / \mathrm{s}^{2}$.
199. Show that for a particle in linear S.H.M., the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

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200. A circular disc of mass 10 kg is suspended by a wire attahced to its centre. The wire is twisted by rotating the disc and released. The period of torsional oscillations is found to be 1.5 s . The radius of the disc is 15 cm . Determing the torsional spring constant of the wire. (Torsional spring constant $\alpha$ is definied by the relation $J=-\alpha \theta$, where J is the restoring coubple and $\theta$ the angle of twist.

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201. A body describe simple harmonic motion with an amplitude of 5 cm and a period of $0.2 s$. Find the acceleration and velocity of the body when the displacement is (a) 5 cm (b) 3 cm (c) 0 cm .

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202. A mass attached to a spring is free to oscillate, with angular velocity $\omega$, in a horizontal plane without friction or damping. It is pulled to a distance $x_{0}$ and pushed towards the centre with a velocity $v_{0}$ at time $t=0$. Determine the amplitude of the resulting oscillations in terms of the parameters $\omega, x_{0}$ and $v_{0}$.

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## Problem

1. A force of 6.4 N stretches a vertical spring by 0.1 m . Find the mass that must be suspended from the spring so that it oscillates with a period of $\pi / 4$
second.

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2. Two simple harmonic motions are represented by the equations.
$x_{1}=5 \sin \left(2 \pi t+\frac{\pi}{4}\right), x_{2}=5 \sqrt{2}(\sin 2 \pi t+\cos 2 \pi t)$
find the ratio of their amplitudes.

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3. The simple harmonic motions are represented by the equations:
$\left.y_{1}=10 \sin \left(\frac{\pi}{4}\right)(12 t+1), y_{2}=5(\sin 3 \pi t+\sqrt{3})\right)$
4. A point particle of mass 0.1 kg is executing SHM of amplitude 0.1 m . When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} \mathrm{~J}$. Obtain the equation of motion of the particle if the initial phase of oscillation is $45^{\circ}$

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5. A simple harmonic motion has an amplitude A and time period T . What is the time taken to travel from $x=A$ to $x=A / 2$ ?

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6. A particle executes SHM of period 1.2 s and amplitude 8 cm . find the time it takes to travel 3 cm the positive extremity of its oscillation. Given $\cos ^{-1}(0.625)=51^{\circ}$.
7. A block is resting on a piston which is moving vertically with simple harmonic motion of period 1.0 second. At what amplitude of motion will the block and pisto separate? What is the maximum velocity of the piston at this amplitude?

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8. A block is kept on a horizontal table. The table is undergoing simple farmonic motion of frequency 3 Hz in a horizontal plane. The coefficient of static friction between the block and the table surface is 0.72 . find the maximum amplitude of the table at which the block does not slip on the surface $g=10 \mathrm{~ms}^{-1}$

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9. Two linear harmonic motions of equal amplitudes and frequencies $\omega$ and $2 \omega$ imposed on a particle along the axes of $x$ and $y$ respectively. If
the initial phase difference between them is $\pi / 2$, then find the resultant path followed by the particle.

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10. Two particles execute simple harmonic motion of same amplitude and frequency along the same straight line. They pass on another, when going in opposite directions, each time their displacement is half of their amplitude. What is the phase difference between them?

## - Watch Video Solution

11. A silver atom in a solid oscillates in SHM in a certain direction with a frequency of $10^{12} s^{-1}$. What is the force constant of the bonds connecting one atom with the other? Molecular weight of silver 108 and avogadro number $=6.02 \times 10^{23} \mathrm{gmol}^{-1}$
12. Springs of apring constants $k, 2 k, 4 k, 8 k \ldots$ Are connected in series. A mass m kg is attached to the lower end of the last spring and the system is allowed to vibrate. What is the time period of oscillations?

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13. A uniform spring whose unstretched length is I has a force constant k. the spring is cut into two pieces of unstretched lengths $l_{1}$ and $l_{2}$, where $l_{1}=n l_{2}$ and n is an integer. What are the corresponding force constant $k_{1}$ and $k_{2}$ in terms of n and k ? what is the ratio $k_{1} / k_{2}$

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14. A body of mass 1.0 kg is suspended from a weightless spring having force constant $600 \mathrm{Nm}^{-1}$. Another body of mass 0.5 kg moving vertically upwards hits the suspended body with a velocity of $3.0 \mathrm{~ms}^{-1}$
and gets embedded in it. Find the frequency of oscillations and amplitude of motion.

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15. A horizontal spring block system of mass $M$ executes simple har monic motion.w hen the block is passingle through its equilibrium position, an object of mass $m$ is put on it and the two move tother. Find the new amplitude and frequency of vibration.

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16. A certain spring stretches 25 cm when a 500 g mass is hung from its end. It is now used as shown in fig. With 2 kg mass at one end placed on a frictionless surface. Suppose the mass is pulled to the right until the spring is stretched to 10 cm and then released. find the speed with
which the mass moves through the unstretched position.


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17. Two bodies of masses 1 kg and 3 kg respectively are connected rigidly by a vertcal spring. The body of mass 3 kg rests on a smototh horizontal surface. The force constant of the spring is $484 \mathrm{Nm}^{-1}$. From the equilibrium position, the mass of 1 kg is displaced vertically through a distance of 0.02 m and then released. calculate (i) and frequency of oscillation of the mass of 1 kg (ii) the maximum velocity of this mass (iii) its oscillation energy and (iv) the reaction of the table on
the mass of 3 kg , when mass 1 kg is having harmonic oscillations.


## - Watch Video Solution

18. The bob of pendulum of length $I$ is pulled aside from its equilibrium position through an angle $\theta$ and then released. Find the speed $v$ with which the bob passes through the equilibrium position.

## (D) Watch Video Solution

19. A simple pendulm has a length $L$ and a bob of mass $M$. The bob is vibrating with amplitude a What is the maximum tension in the string?

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

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21. One end of a long metallic wire of length ( L ) is tied to the ceiling.

The other end is tied to a massless spring of spring constant . (K.A)
mass ( m ) hangs freely from the free end of the spring. The area of cross- section and the Young's modulus of the wire are (A) and (Y) respectively. If the mass is slightly pulled down and released, it will oscillate with a time period ( T ) equal to :

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22. Two identical balls (A) and (B) each of mass ( 0.1 kg ), are attached to two identical massless springs. The spring - mass system is constrained to move inside a riged smooth pipe bant in the form of a circle as shown in Fig. The pipe is fixed in a horizontal plane.

The centres of the balls can move in a circle of radius ( 0.06 pi ) meter.
Each spring has a natural length $z o f 0.06 \pi$ meter and spring spring constant5 $0.1 \mathrm{~N} / \mathrm{m}$. Initially, both the balls are displaced by an angle $\theta=\pi / 6$ radian with respect to the diameter ( pQ ) of the circle (as shown in Fig.) and released from, rest.
(i) Calculate the frequency of oscillation of ball (B).
(ii) Find the speed of ball (A) when (A) and (B) are at the two ends of the diameter (PQ).
(iii) What is the total energy of the system.

## Watch Video Solution

23. A thin rod of length (L) and area of cross - section (S) is pivoted at its lowest point (P) inside a stationary, homegeneous and non - viscous liquid. The rod is free to ratate in a vertical plane about a horizontal axis passing through ( P ). The density ( $\mathrm{d}_{-} 1$ ) of the material of the rod is smaller than the density (d_2) of the liquid. The rod is displaced by a small angle (theta) from its equilibrium position and then released.

Show that the motion of the rod is simple harmonic and determine its angular frequency in terms of the given parameters.


## Problems For Self Practice

1. A harmonic oscillation is represented by $\mathrm{y}=0.34 \cos (3000 \mathrm{t}+0.74)$, where y and t are in mm and s respectively. Deduce (i) and amplitude (ii) the frequency and angular frequency (iii) the period and (iv) the intial phase.

## (D) Watch Video Solution

2. Write the displacement equation representing the following conditions obtained for a simple harmonic motion: amplitude $=0.01 \mathrm{~m}$, frequency $=600 \mathrm{~Hz}$ initial phase $=\pi / 6$
3. A simple harmonic oscillation is represented by the equation.
$y=0.40 \sin (440 t+0.61)$
Here $y$ and $t$ are in $m$ are $s$ respectively. What are the values of (i) amplitude (ii) angular frequency (iii) frequency of oscillations (iv) time period of oscillations and (v) initial phase?

## (D) Watch Video Solution

4. The periodic time of a body executing SHM is 2 s . After how much time interval from $\mathrm{t}=0$, will its displacement be half of its amplitude?

## - Watch Video Solution

5. A particle executes SHM represented by the equation $10 y=01 \sin 50 \pi t$, where the displacement y is in metre and time t in second. Find the amplitude and frequency of the particle.
6. The motion of a 100 g mass tied to a spring is described by the equation $x=25 \cos \left(3 t+\frac{\pi}{4}\right) \mathrm{cm}$. Find (i) the angular velocity $\omega$ (ii) frquency $v$ (iii) the time period $T$ (iv) the force constant $k$ ( $v$ ) the amplitude A and (v) the phase angle

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7. The displacement of a particle excuting periodic motion is given by $y=4 \cos ^{2}(t / 2) \sin (1000 t)$. Find the independent constituent SHM's.

## - Watch Video Solution

8. The displacement of a particle executing SHM is given by

$$
y=0.2 \sin 50 \pi(t+0.01) \text { metre }
$$

Calculate the amplitude, t he period, maximum velocity and the displacement at the start of the motion.
9. A particle executing SHM completes 1200 oscillations per minute and passes through the mean position with a velocity of $31.4 \mathrm{~ms}^{-1}$. Determine the maximum displacement of the particle from the mean position also obtain the displacement equation of the aprticle if its displacemet be zero at the instant $\mathrm{t}=0$.

## - Watch Video Solution

10. The time period of a body executing SHM is 0.05 s . if the amplitude is 4 cm , then what will be the maximum velocity and maximum acceleration of the body?

## (D) Watch Video Solution

11. The maximum velocity of a particle executing SHM is $100 \mathrm{cms}^{-1}$ and the maximum acceleration is $157 \mathrm{cms}^{-2}$ determine the periodic time

## - Watch Video Solution

12. A body of mass 0.1 kg is executing SHM of amplitude 1.0 m and period 0.2 s . what is 2 cm . find the time period.

## - Watch Video Solution

13. A particle executing SHM has an acceleration of $0.5 \mathrm{cms}^{-1}$ when its displacement is 2 cm . find the time period.

## - Watch Video Solution

14. A body executing SHM makes 100 vibrations/min if the speed at the mean position is $15 \mathrm{~ms}^{-1}$, calculate its path length. What is its velocity
when it is half way be tween its mean position and extreme position?

## (D) Watch Video Solution

15. A particle is executing SHM if $u_{1}$ and $u_{2}$ are the speeds of the particle at distances $x_{1}$ and $x_{2}$ from the equilibrium position, shown that the frequency of oscillation
$f=\frac{1}{2 \pi}\left(\frac{u_{1}^{2}-u_{2}^{2}}{x_{2}^{2}-x_{1}^{2}}\right)$

## - Watch Video Solution

16. If a particle executes SHM of time period 4 s and amplitude 2 cm , find its maximum velocity and that at half its full displacement also find the acceleration at the turning points and when the displacement is 0.75 cm
17. Show that if a particle is moving in SHM, its velocity at a distance $\sqrt{3} / 2$ of its amplitude from the central position is half its velocity in central position.

## - Watch Video Solution

18. A particle executes $S H M$ of period 12 seconds and amplitude 8 cm .

Find time it takes to travel 3 cm from the positive extremity of its oscillation.

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19. A particle executes SHM of period 12s. Two sec after it passes through the centre of oscillation, the velocity is found to be 3.142 cm $s^{-1}$ fin dht amplitude and the length of the path.

## - Watch Video Solution

20. A particle is moving in a st. line with SHM. Its velocity has the values $3 \mathrm{~ms}^{-1}$ and $2 \mathrm{~ms}^{-1}$ when its distance from the mean positions are 1 m and 2 m respectively find the period of its motion and length of its path.

## - Watch Video Solution

21. A block lying on a horizontal table executes SHM of period 1 second, horizontally. What is the maximum amplitude for which the block does not slide if coeff. Of friction between block and surface is $0.4, \pi^{2}=10$.

## - Watch Video Solution

22. A horizontal platform moves up and down simple harmonically, the total vertical movement being 10 cm what is the shortest period permissible, if object resting on the platform are to remain in contact with it throughout the motion.? Take $g=980 \mathrm{cms}^{-2}$
23. In a gasoline engine, the motion of the piston is simple harmonic.

The piston has a mass of 2 kg and stroke (twice the amplitude) of 10 cm . find maximum acceleration and the maximum unbalanced force on the piston, if it is making 50 complete vibrations each minute.

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24. A man stands on a weighing machine placed on a horizontal platform the machine reads 50 kg . By mean of a suitable mechanism, the platform is made to execute harmonic vibrations up and down with a frequency of 2 vibration per second. What will be the effect on the reading of the weighing machine? The amplitude of vibration of platform is 5 cm . Take $g=10 \mathrm{~ms}^{-2}$

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25. From the figure, obtain the equation of simple harmonic motion of the $y$-projection of the radius vector of the revolving particle $P$ in each case.


## - Watch Video Solution

26. If a body of mass 0.98 kg is made to oscillate on a spring of force constant $4.84 \mathrm{~N} / \mathrm{m}$ the angular frequency of the body is
27. A 20 gram weight produces an extension of 2 cm in a vertical spring.

A mass of 100 gram is suspended at its bottom and left pulling down.
Calculate the frequency of its vibration.

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28. A body of mass 2 kg is made to oscillate using a spring of force constant $8 \mathrm{Nm}^{-1}$ find (i) angular frequency (ii) frequency of vibration
(iii) time period of vibration.

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29. A spring 60 cm long is stretched 2 cm , when subjected to a force of 20 gram weight what would be the length, when a force of 500 gram weight is applied.?

## - Watch Video Solution

30. A thin wire is used to support 100 kg weight. The wire stretches by 0.5 mm . Calculate the force constant k (in $\mathrm{Nm}^{-1}$ ) of the wire.

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31. An uncalibrated spring balance is found to have a period of oscillation of 0.314 s , when a 1 kg weight is suspended from it? How dows the spring elongate, when a 1 kg weight is suspended from it? [take $\pi=3.14$ ]

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32. A spring compressed by 0.1 m develops a restoring force 10 N . A body of mass 4 kg is placed on it. Deduce $(i)$ the force constant of the spring
(ii) the depression of the spring under the weight of the body (take $g=10 \mathrm{~N} / \mathrm{kg}$ ) and ( iii ) the period of oscillation, if the body is left free.
33. The period of oscillation of a mass $m$ suspended by an ideal spring is 2 s . If an additional mass of 2 kg be suspended, the time period is increased by 1 s . Find the value of m .

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34. The frequency of oscillations of a mass $m$ suspended by a spring is $v_{1}$. If the length of the spring is cut to one-half the same mass oscillates with frequency $v_{2}$. Determine the value of $v_{2} / v_{1}$

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35. The periodic time of a mass suspended by a spring (force constant k) is T . if the spring is cut in three equal pieces, what will be the force constant of each part? If the same mass be suspended from one piece, what will be the periodic time?
36. The time period of a body suspended by a spring be $T$. what will be the new period, if the spring is cut into two equal parts and when (i) the body is suspended from one part (ii) the body is suspended from both the parts connected in parallel.

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37. Two identical springs have the same force constant of $147 \mathrm{Nm}^{-1}$. What elongation will be produced in each spring in each case shown in
figure. Take $g=9.8 m s^{-2}$


## (D) Watch Video Solution

38. Three springs are connected to a mass $m$ as shown in figure, When mass oscillates, what is the effective spring constant and time period of vibration? Given $k=2 \mathrm{Nm}^{-1}$ and $\mathrm{m}=80$ gram.



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39. A 2.5 kg collar attached to a spring of foce constant $1000 \mathrm{Nm}^{-1}$ slides without friction on a horizontal rod. The collar is displaced from its equilibrium position by 5.0 cm and released. Calculate (i) the period of oscillation (ii) the maximum speed of the collar and (iii) the maximum acceleration of the collar.

## - Watch Video Solution

40. Two springs are jonied and connected to a mass $m$ as shown in figure. If the force constants of the two springs are $k_{1}$ and $k_{2}$, shown that frequency of oscillation of mass $m$ is


## D Watch Video Solution

41. The time taken by a simple pendulum to perform 100 vibration is 8 minutes 9 sec in bombay and 8 minutes 20 sec . in pune. Calcualte the ratio of acceleration due to gravity in bombay and pune.

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42. If the length of second's pendulum is decreased by $2 \%$, how many seconds it will lose per day

## (D) Watch Video Solution

43. If the length of a second's pendulum is increased by $1 \%$, how many seconds will it loss or gain in a day?

## ( Watch Video Solution

44. If the length of a simple pendulum is increased by $45 \%$ what is the percentage increase in its time period?

## (D) Watch Video Solution

45. A second's pendulum is taken to a height where the value of $g$ is $4.36 \mathrm{~ms}^{-2}$. What will be its new time period?

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46. A simple pendulum whose length is 20 cm is suspended from the ceiling of a lift which is rising up with an acceleration of $3.0 \mathrm{~ms}^{-2}$. Calculate the time-period of the pendulum.

## - Watch Video Solution

47. What will be the time period of second's pendulumm if its length is doubled?

## - Watch Video Solution

48. A pendulum 1 m long makes 20 vibrations in 40 s . Find the time taken to make 30 vibrations, if its length is increased to 4 m .

## - Watch Video Solution

49. A second's pendulum is taken from a place where $g=9.8 \mathrm{~ms}^{-2}$ to a place where $g=9.7 \mathrm{~ms}^{-2}$. How would its length be changed in order that its time period remains unaffected ?

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50. If the acceleration due to gravity on the moon is one-sixth of that on the earth. What will be the change in length of a second pendulum there so that it may beat a second there? Take acceleration due to gravity on earth's surface $=9.8$ ?

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51. A vertical U-tube of uniform cross-section contains water upto a height of 30 cm . show that if the water in one limb is depressed and then released, its up and down motion in the two limbs of the tube is simple harmonic and calculate its time-period.

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52. A wooden cylinder of mass 20 g and area of cross-section $1 \mathrm{~cm}^{2}$, having a piece of lead of mass 60 g attached to its bottom,floates in water. The cylinder is depressed and then released.The frequency of
oxdillations is $\frac{N}{\pi} S^{-1}$. Find the value of N . [Neglect the volume of water displaced by the lead piece, take $g=9.8 m / s^{2}$, density of water $\left.\rho_{w}=1 \mathrm{gcm}^{-3}\right]$

## - Watch Video Solution

53. If the earth were a homogeneous sphere of radius $R$ and a straight hole bored in it through its centre, show that a body dropped into the hole will execute SHM and find its time period.

## - Watch Video Solution

54. A weighted glass tube is floating in a liquid with 20 cm of its length immresed. It is pushed down through a certain distance and then released. Show that up and down motion executed by the glass tube is SHM and find the time period of vibration. Given $g=980 \mathrm{cms}^{-2}$.
55. A sphere hung with a wire $60^{\circ}$ rotation of the sphere about the wire produces a restoring torqueof 4.1 Nm . If the moment of inertis of the sphere is 0.082 kg m . Find the frequencyof angular oscillations.

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56. A lactometer whose mass is 0.2 kg is floating vertically in a liquid of relative density 0.9. Area of cross-section of the mariked portion of lactometer in $0.5 \times 10^{-4} \mathrm{~m}^{2}$. If it is dipped down in the liquid slightly and released, what type of motion will it execute? what will be its timeperiod?

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57. A body weighing 10 g has a velocity of $6 \mathrm{cms}^{-1}$ after one second of its starting from mean position. If the time period is 6 seconds. Find the kinetic energy, potential energy and the total energy.
58. Calculate the energy possessed by a body of mass 20 g executing SHM of amplitude 1 cm and time peeriod 4 s .

## - Watch Video Solution

59. A bob of simple pendulum of mass 1 g is oscillating with a frequency

5 vibrations per second and its amplitude is 3 cm . Find the kinetic energy and kinetic energy at that instant.

## - Watch Video Solution

60. A oscillator of mass 10 kg has a velocity of $5 \mathrm{~ms}^{-1}$ after 1 second of its crossing the mean position. If the time period is 5 s . Find the potential energy and kinetic energy at that instant.
61. A particle executes SHM of period 8 seconds. After what time of its passing through the mean position will the energy be half kinetic and half potential ?

## - Watch Video Solution

62. The total energy of a partical executing simple harmonic motion of period $2 \pi$ seconds is $10,240 \mathrm{erg}$. The displacement of the particle at $\pi / 4$ second is $8 \sqrt{2} \mathrm{~cm}$. Calculate the amplitutde of motion and mass of the particle

## - Watch Video Solution

63. The force constant of a weightless spring is $16 \mathrm{Nm}^{-1}$. A body of mass 1.0 kg suspended from it is pulled down through 5 cm and then released. The maximum energy of the system (spring + body) will be
64. A body of mass 0.50 kg is executing SHM Its period is 0.1 s and amplitude 10 cm . When the body is at a distance of 5 cm from the mean postion, find i its accelration ii force acting upon it and ii its potential energy.

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65. A particle which is attached to a spring oscillates horizontally with simple harmonic motion with a frequency of $1 / \pi \mathrm{Hz}$ and total energy of 10 J . If the maximum speed of the particle is $0.4 m s^{-1}$, what is the force constant of the spring? What will be the maximum potential energy of the spring during the motion?

## - Watch Video Solution

66. Two exactly identical simple pendulums are oscillating with amplitude 2 cma dn 6 cm Calculate the ratio of their energies of oscillation.

## - Watch Video Solution

67. The length of a weigtless spring increaes by 2 cm when a weight of 1.0 kg in the period of oscillation of the spring and its kinetic energy of oscillation. Take $g=10 \mathrm{~ms}^{-2}$.

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## Exercise

1. Draw displacement-time, velocity-time and acceleration-time graphs
for a particle executing simple harmonic motion. Discuss their phase relationship.

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2. A simple harmonic oscillation is represented by the equation.
$y=0.40 \sin (440 t+0.61)$
Here $y$ and $t$ are in $m$ are $s$ respectively. What are the values of (i) amplitude (ii) angular frequency (iii) frequency of oscillations (iv) time period of oscillations and (v) initial phase?

## - Watch Video Solution

3. A simple harmonic oscillation is represented by the equation. $y=0.40 \sin (440 t+0.61)$

Here $y$ and $t$ are in $m$ are $s$ respectively. What are the values of (i) amplitude (ii) angular frequency (iii) frequency of oscillations (iv) time period of oscillations and (v) initial phase?
4. A simple harmonic oscillation is represented by the equation, $y=0.40$ $\sin (440 t+0.61)$ Here $y$ and $t$ are in $m$ and $s$ respectively. What are the values of frequency of oscillations?

## - Watch Video Solution

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## - Watch Video Solution

6. A simple harmonic oscillation is represented by the equation, $y=0.40$ $\sin (440 t+0.61)$ Here $y$ and $t$ are in $m$ and $s$ respectively. What are the values of initial phase?

## - Watch Video Solution

7. The periodic time of a body executing SHM is 2 s . After how much time interval from $\mathrm{t}=\mathrm{O}$, will its displacement be half of its amplitude?

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8. A particle executes SHM represented by the equation $10 y=01 \sin 50 \pi t$, where the displacement y is in metre and time t in second. Find the amplitude and frequency of the particle.

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## - Watch Video Solution

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## - Watch Video Solution

11. The acceleration of a particle performing $S H M$ is $12 \mathrm{~cm} / \mathrm{s}^{2}$ at a distance of 3 cm from the mean position. Calculate its time - period .

Hint : $a=\omega^{2} x$
$a=12 \mathrm{~cm} / \mathrm{s}^{2}, x=3 \mathrm{~cm}$
Find $\omega$
$T=\frac{\pi}{\omega}$

## - Watch Video Solution

12. In a pendulum, the amplitude is 0.05 m and a period of 2 s . Compute the maximum Velocity.

## - Watch Video Solution

13. In what time after its motion begins, will a particle oscillating according to the equation, $y=7 \sin 0.5 \pi \mathrm{t}$ move from the mean position to maximum displacement ?

## - Watch Video Solution

14. A partical executes SHM on a straigh line path. The amplitude of oscillation is 2 cm . When the displacement of the particle from the mean position is 1 cm , the magnitude of its acceleration is equal to that of its velocity. Find the time period of SHM, also the ms. velocity and ms . acceleration of SHM.
15. The velocity of a particle describing SHM is $16 \mathrm{cms}^{-1}$ at a distance of 8 cm from mean position and $8 \mathrm{cms}^{-1}$ at a distance of 12 cm from mean postion. Calculate the amplitude of the motion.

## - Watch Video Solution

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$f=\frac{1}{2 \pi}\left(\frac{u_{1}^{2}-u_{2}^{2}}{x_{2}^{2}-x_{1}^{2}}\right)$

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0.75 cm

## - Watch Video Solution

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## (D) Watch Video Solution

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## - Watch Video Solution

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## - Watch Video Solution

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## - Watch Video Solution

24. A bob of simple pendulum of mass 1 g is oscillating with a frequency

5 vibrations per second and its amplitude is 3 cm . Find the kinetic energy of bob at lowest position.

## - Watch Video Solution

25. A body weighing 10 g has a velocity of $6 \mathrm{cms}^{-1}$ after one second of its starting from mean position. If the time period is 6 seconds. Find the kinetic energy, potential energy and the total energy.

## - Watch Video Solution

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## - Watch Video Solution

27. The total energy of a partical executing simple harmonic motion of period $2 \pi$ seconds is $10,240 \mathrm{erg}$. The displacement of the particle at $\pi / 4$ second is $8 \sqrt{2} \mathrm{~cm}$. Calculate the amplitutde of motion and mass of the particle
28. A particle which is attached to a spring oscillates horizontally with simple harmonic motion with a frequency of $1 / \pi \mathrm{Hz}$ and total energy of 10 J . If the maximum speed of the particle is $0.4 \mathrm{~ms}^{-1}$, what is the force constant of the spring? What will be the maximum potential energy of the spring during the motion?

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29. A spring compressed by 0.1 m develops a restoring force 10 N . A body of mass 4 kg is placed on it. Deduce $(i)$ the force constant of the spring (ii) the depression of the spring under the weight of the body (take $g=10 \mathrm{~N} / \mathrm{kg}$ ) and (iii) the period of oscillation, if the body is left free.

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30. A spring compressed by 0.1 m develops a restoring force 10 N . A body of mass 4 kg is placed on it. Deduce $(i)$ the force constant of the spring ( $i i$ ) the depression of the spring under the weight of the body ( take $g=10 \mathrm{~N} / \mathrm{kg}$ ) and (iii) the period of oscillation, if the body is left free.

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31. The period of oscillation of a mass $m$ suspended by an ideal spring is 2 s . If an additional mass of 2 kg be suspended, the time period is increased by 1 s . Find the value of m .

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32. The frequency of oscillations of a mass $m$ suspended by a spring is $v_{1}$. If the length of the spring is cut to one-half the same mass oscillates with frequency $v_{2}$. Determine the value of $v_{2} / v_{1}$
33. The periodic time of a mass suspended by a spring (force constant $k$ ) is $T$. if the spring is cut in three equal pieces, what will be the force constant of each part? If the same mass be suspended from one piece, what will be the periodic time?

## - Watch Video Solution

34. The time period of a body suspended by a spring be $T$. what will be the new period, if the spring is cut into two equal parts and when (i) the body is suspended from one part (ii) the body is suspended from both the parts connected in parallel.

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35. The time period of a body suspended by a spring be $T$. what will be the new period, if the spring is cut into two equal parts and when (i) the body is suspended from one part (ii) the body is suspended from both the parts connected in parallel.

## D Watch Video Solution

36. The time taken by a simple pendulum to perform 100 vibration is 8 minutes 9 sec in bombay and 8 minutes 20 sec . in pune. Calcualte the ratio of acceleration due to gravity in bombay and pune.

## - Watch Video Solution

37. If the length of a second's pendulum is increased by $1 \%$, how many seconds will it loss or gain in a day ?
38. If the length of a simple pendulum is increased by $45 \%$ what is the percentage increase in its time period?

## - Watch Video Solution

39. What will be the time period of second's pendulumm if its length is doubled?

## - Watch Video Solution

40. If the acceleration due to gravity on moon is one-sixth of that on the earth, what will be the length of a second pendulum there ? Take $g=9.8 m s^{-2}$

## - Watch Video Solution

41. If the earth were a homegeneous sphere and a straight hole was bored in it through its centre, so when a body is dropped in the hole, it will excutes SHM. Determine the time period of its oscillation. Radius of the earth is $6.4 \times 10^{5} \mathrm{~m}$ and $g=9.8 \mathrm{~ms}^{-2}$

## - Watch Video Solution

42. A weighted glass tube is floating in a liquid with 20 cm of its length immresed. It is pushed down through a certain distance and then released. Show that up and down motion executed by the glass tube is SHM and find the time period of vibration. Given $g=980 \mathrm{cms}^{-2}$.

## - Watch Video Solution

43. A sphere hung with a wire $60^{\circ}$ rotation of the sphere about the wire produces a restoring torqueof 4.1 Nm . If the moment of inertis of the sphere is 0.082 kg m . Find the frequencyof angular oscillations.
44. A lactometer whose mass is 0.2 kg is floating vertically in a liquid of relative density 0.9. Area of cross-section of the mariked portion of lactometer in $0.5 \times 10^{-4} \mathrm{~m}^{2}$. If it is dipped down in the liquid slightly and released, what type of motion will it execute? what will be its timeperiod?

## - Watch Video Solution

45. A simple harmonic motion is represented by
$F(t)=10 \sin (20 t+0.5)$. The amplitude of the S.H.M. is
A. $A=30$
B. $A=17$
C. $A=20$
D. $A=5$

## Answer:

## - Watch Video Solution

46. A particle has displacement y given by $y=3 \sin (5 \pi t+\pi)$, where y is in meter and $t$ is in second. What are frequency and period of motion
?
A. $0.4 \mathrm{~Hz}, 2.5 \mathrm{~s}$
B. $2.5 \mathrm{~Hz}, 0.4 \mathrm{~s}$
C. $2.5 \mathrm{~Hz}, 2.5 \mathrm{~s}$
D. $0.4 \mathrm{~Hz}, 0.4 \mathrm{~s}$

## Answer:

## - Watch Video Solution

47. The motion of a particle executing SHM in one dimension is described by $x=-0.5 \sin (2 t+\pi / 4)$ where x is in meters and t in seconds. The frequency of oscillation in Hz is
A. 2
B. $\pi$
C. $\frac{\pi}{2}$
D. $\frac{1}{\pi}$

## Answer:

## - Watch Video Solution

48. A particle executing simple harmonic motion has a time period of 4 s. If the particle starts moving from the mean position at $t=0$, then after how much interval of time from $t=0$, will its displacement be half of its amplitude?
A. $\frac{1}{3} s$
B. $\frac{1}{2} s$
C. $\frac{2}{3} s$
D. $\frac{1}{6} s$

## Answer:

## - Watch Video Solution

49. A particle executes simple harmonic motion of amplitude $A$ along the x - axis. At $t=0$, the position of the particle is $x=\frac{A}{2}$ and it moves along the positive x - direction. Find the phase contant $\delta$ of the equation if it is written as $x=A \sin (\omega t+\delta)$.
A. $5 \frac{\pi}{6}$
B. $2 \frac{\pi}{3}$
C. $\frac{\pi}{6}$
D. $2 \frac{\pi}{5}$

## Answer:

## - Watch Video Solution

50. The displacement of a particle from its mean position (in metre) is given by
$y=0.2 \sin (10 \pi t+1.5 \pi) \cos (10 \pi t+1.5 \pi)$
The motion of the particle is
A. periodic but not SHM
B. non-periodic
C. simple harmonic motion with period 0.1 s
D. simple harmonic motion with period 0.2 s

## Answer:

51. Two simple harmonic motions are represented by $y_{1}=5[\sin 2 \pi t+\sqrt{3} \cos 2 \pi t]$ and $y_{2}=5 \sin \left(2 \pi t+\frac{\pi}{4}\right)$

The ratio of their amplitudes is
A. $1: 1^{\prime}$
B. 1:2'
C. $2: 1^{\prime}$
D. $1: \sqrt{3}$

## Answer:

## - Watch Video Solution

52. Two pendulums have time period $T$ and $5 T / 4$. They starts $S H M$ at the same time from the mean position. What will be the phase difference between them after the bigger pendulum completed one oscillation ?
A. $45^{\circ}$
B. $90^{\circ}$
C. $60^{\circ}$
D. $30^{\circ}$

## Answer:

## - Watch Video Solution

53. A particle executes SHM of amplitude A. If $T_{1}$ and $T_{2}$ are the times taken by the particle to traverse from 0 to $\frac{A}{2}$ and from $\frac{A}{2}$ to A respectively, then $\frac{T_{1}}{T_{2}}$ will be equal to
A. 1
B. $\frac{1}{2}$
C. $\frac{1}{4}$
D. 2

## Answer:

## - Watch Video Solution

54. Velocity of a body moving in simple harmonic motion is
A. $\omega \sqrt{a^{2}+y^{2}}$
B. $\omega^{2} \sqrt{a^{2}+y^{2}}$
C. $\omega \sqrt{a^{2}-y^{2}}$
D. $\omega^{2} \sqrt{a^{2}-y^{2}}$

## Answer:

## Watch Video Solution

55. A body is executing the S.H.M. with an angular frequency of 2 $\mathrm{rad} / \mathrm{sec}$. Velocity of the body at 20 m displacement, when amplitude of
motion is 60 m , is
A. $90 \mathrm{~m} / \mathrm{s}$
B. $118 \mathrm{~m} / \mathrm{s}$
C. $113 \mathrm{~m} / \mathrm{s}$
D. $131 \mathrm{~m} / \mathrm{s}$

## Answer:

## - Watch Video Solution

56. A particle is executing SHM of amplitude 10 cm . Its time period of oscillation is $\pi$ seconds. The velocity of the particle when it is 2 cm from extreme position is
A. $10 \mathrm{cms}^{-1}$
B. $12 \mathrm{cms}^{-1}$
C. $16 \sqrt{16} \mathrm{cms}^{-1}$
D. none of these

## Answer:

## - Watch Video Solution

57. A particles is SHM is described by the displacement function $x(t)=a \cos (\omega t+\theta)$. If the initinal $(t=0)$ position of the particle is 1 cm and its initinal velcotiy is $\pi \mathrm{cm} / \mathrm{s}$. The angular frequncy of the particle is $\pi r a d / s$. Then is amplitude is
A. 1 cm
B. $\sqrt{2} \mathrm{~cm}$
C. 2 cm
D. 2.5 cm

## Answer:

58. A particle executes SHM, its time period is 16 s . If it passes through the centre of oscillation, then its velocity is $2 \mathrm{~ms}^{-1}$ at times 2 s . The amplitude will be
A. 7.2 m
B. 4 cm
C. 6 cm
D. 0.72 m

## Answer:

## - Watch Video Solution

59. The magnitude of acceleration of particle executing SHM at the position of maximum displacement is
B. minimum
C. maximum
D. none of these

## Answer:

## - Watch Video Solution

60. The maximum velocity and the maximum acceleration of a body moving in a simple harmonic oscillator are $2 \mathrm{~m} / \mathrm{s}$ and $4 \mathrm{~m} / \mathrm{s}^{2}$. Then angular velocity will be
A. $4 \mathrm{rad} / \mathrm{sec}$
B. $3 \mathrm{rad} / \mathrm{sec}$
C. $2 \mathrm{rad} / \mathrm{sec}$
D. $8 \mathrm{rad} / \mathrm{sec}$
61. A particle executing S.H.M. having amplitude 0.01 m and frequency 60 Hz . Determine maximum acceleration of particle.
A. $144 \pi^{2} \frac{m}{s^{2}}$
B. $80 \pi^{2} \frac{m}{s^{2}}$
C. $120 \pi^{2} \frac{m}{s^{2}}$
D. $60 \pi^{2} \frac{m}{s^{2}}$

## Answer:

## - Watch Video Solution

62. A particle executing simple harmonic motion has an amplitude of 6 cm . Its acceleration at a distance of 2 cm from the mean position is $8 c \frac{m}{s^{2}}$ The maximum speed of the particle is
A. 24
B. 16
C. 12
D. 4

## Answer:

## - Watch Video Solution

63. If $x=R \sin \omega t+R \omega t$ and $y=R \cos (\omega t)+R$ (where $\omega$ and R are constants), what are $x$ and $y$ components of acceleration when $y$ is minimum?
A. $0, R \omega^{2}$
B. $R \omega^{2}, 0$
C. $0,-R \omega^{2}$
D. $-R \omega^{2}, 0$

## Answer:

## - Watch Video Solution

64. A simple harmonic oscillator has amplitude A, angular velocity $\omega$, and mass $m$. Then, average energy in one time period will be
A. $\left(\frac{1}{4}\right) m \omega^{2} A^{2}$
B. $\left(\frac{1}{2}\right) m \omega^{2} A^{2}$
C. $m \omega^{2} A^{2}$
D. 0

## Answer:

Watch Video Solution
65. Average value of $K E$ and PE over entire time period is
A. $0,\left(\frac{1}{2}\right) m \omega^{2} A^{2}$
B. $\left(\frac{1}{2}\right) m \omega^{2} A^{2}, 0$
C. $\left(\frac{1}{2}\right) m \omega^{2} A^{2},\left(\frac{1}{2}\right) m \omega^{2} A^{2}$
D. $\left(\frac{1}{4}\right) m \omega^{2} A^{2},\left(\frac{1}{4}\right) m \omega^{2} A^{2}$

## Answer:

## - Watch Video Solution

66. when the maximum k.E of a simple pendulum is $k$, then what is its displacement in terms of amplitude a when its K.E. is $k / 2$
A. $a / \sqrt{2}$
B. $a / 2$
C. $a / \sqrt{3}$
D. $a / 3$

## Answer:

## - Watch Video Solution

67. The displacement of an SHM doing oscillation when KE. = P.E. (amplitude $=4 \mathrm{~cm}$ ) is
A. $2 \sqrt{2} \mathrm{~cm}$
B. 2 cm
C. $\frac{1}{\sqrt{2}} \mathrm{~cm}$
D. $\sqrt{2} \mathrm{~cm}$

## Answer:

68. A particle is executing SHM at mid point of mean position \& extremity. What is the potential energy in terms of total energy (E)
A. $E / 4$
B. $E / 16$
C. $E / 2$
D. $E / 8$

## Answer:

## - Watch Video Solution

69. For any S.H.M., amplitude is 6 cm . If instantaneous potential energy is half the total energy then distance of particle from its mean position is
A. 3 cm
B. 4.2 cm
C. 5.8 cm
D. 6 cm

## Answer:

## - Watch Video Solution

70. A particle is having potential energy $1 / 3$ of the maximum value at a distance of 4 cm from mean position. Amplitude of motion is
A. $4 \sqrt{3}$
B. $\frac{6}{\sqrt{2}}$
C. $\frac{2}{\sqrt{6}}$
D. $2 \sqrt{6}$

## Answer:

71. The potential energy of a particle executing S.H.M. is 2.5 J , when its displacement is half of amplitude. The total energy of the particle will be
A. 5 J
B. 10 J
C. 15 J
D. 20 J.

## Answer:

## - Watch Video Solution

72. If the frequency of oscillations of a particle doing $S H M$ is $n$, the frequency of kinetic energy is
A. 2 n
B. $n$
C. $\frac{n}{2}$
D. none of these

## Answer:

## - Watch Video Solution

73. A point particle of mass 0.1 kg is executing $S H M$ with amplitude of $0.1 m$. When the particle passes through the mean position. Its $K . E$. is $8 \times 10^{-3} \mathrm{~J}$. Obtain the equation of motion of this particle if the initial phase of oscillation is $45^{\circ}$.
A. $y=0.1 \sin \left(\frac{t}{4}+\frac{\pi}{4}\right)$
B. $y=0.1 \sin \left(\frac{t}{2}+\frac{\pi}{4}\right)$
C. $y=0.1 \sin \left(4 t-\frac{\pi}{4}\right)$
D. $\left.y=0.1 \sin \left(4 t+\frac{\pi}{4}\right)\right)$

## Answer:

## (D) Watch Video Solution

74. Natural length of a spring is 60 cm and its spring constant is 4000 $\mathrm{N} / \mathrm{m}$. A mass of 20 kg is hung from it. The extension produced in the spring is (Take, $g=9.8 m / s^{2}$ )
A. 4.9 cm
B. 0.49 cm
C. 9.4 cm
D. 0.94 cm

## Answer:

75. A spring (spring constant=k) is cuttend into 4 equal parts and two parts are connected in parallel. What is the effective spring constant?
A. 4 k
B. 16k
C. 8 k
D. 6 k

## Answer:

## - Watch Video Solution

76. A mass $m$ is suspended from a spring. Its frequency of oscillation is
f. The spring is cut into two halves and the same mass is suspended from one of the pieces of the spring. The frequency of oscillation of the mass will be

$$
\text { A. } \sqrt{2} f
$$

B. $f / 2$
C.f
D. 2 f

## Answer:

## - Watch Video Solution

77. Two bodies ( M ) and ( N ) of equal masses are suspended from two separate massless springs of spring constants (k_1) and (k_2) respectively. If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude of vibration of (M) to the of $(N)$ is.
A. $\left(\frac{k_{2}}{k_{1}}\right)^{1 / 2}$
B. $\left(\frac{k_{1}}{k_{2}}\right)^{1 / 2}$
C. $\left(\frac{k_{2}}{k_{1}}\right)$
D. $k_{1} k_{2}$

## Answer:

## - Watch Video Solution

78. When two springs of spring force constant k and 2 k are connected in series then force constant becomes $k_{s}$, if they are connected in parallel, then force constant becomes $k_{p}$. Ratio $k_{s} / k_{p}$ is
A. $2 / 9$
B. $1 / 2$
C. $2 / 1$
D. $1 / 3$

## Answer:

79. The scale of a spring balance reading from 0 to 10 kg is 0.25 m long.

A body suspended from the balance oscillates vertically with a period of $\pi$ / 10 second. The mass suspended is (neglect the mass of the spring)
A. 10 kg
B. 0.98 kg
C. 5 kg
D. 20 kg

## Answer:

## - Watch Video Solution

80. A massless spring of natural length of 0.5 m and spring constant 50 $\mathrm{N} / \mathrm{m}$ has one end fixed and the other end attached to a mass of 250 g . The spring mass system is on a smooth floor. The mass is pulled until the length of the spring is 0.6 m and then released from rest. The kinetic energy of the mass when the length of the spring is 0.5 m is
A. 0.25 J
B. 2.25 J
C. 6.25 J
D. 9 J

## Answer:

## - Watch Video Solution

81. To show that a simple pendulum executes simple harmonic motion, it is necessary to assume that
A. length of the pendulum is small
B. amplitude of oscillation is small
C. mass of the pendulum is small
D. acceleration due to gravity is small

## Answer:

## - Watch Video Solution

82. Time period of a simple pendulum will be double, if we
A. decrease the length 2 times
B. decrease the length 4 times
C. increase the length 2 times
D. increase the length 4 times

## Answer:

## - Watch Video Solution

83. The time period of a simple pendulum is 2 s . It its length is increased by 4 times, then its period becomes
A. 16 sec
B. 8 sec
C. 12 sec
D. 4 sec

## Answer:

## - Watch Video Solution

84. The graph of time period ( $T$ ) of a simple pendulum versus its length
(I) is
A.
B.
C.
D.

## Answer:

## - Watch Video Solution

85. If the frequency of oscillation of a pendulum in simple harmonic motion is $n$, then frequency of pendulum whose length becomes four times is
A. n
B. $\frac{n}{2}$
C. 2 n
D. 4 n

## Answer:

## - Watch Video Solution

86. The ratio of frequencies of two pendulums are $2: 3$, then their length are in ratio
A. $\sqrt{2 / 3}$
B. $\sqrt{3 / 2}$
C. $4 / 9$
D. $9 / 4$

## Answer:

## - Watch Video Solution

87. What is time period of a pendulum hanged in a satellite ? ( $T$ is time period on earth)
A. zero
B. T
C. infinite
D. $T / \sqrt{6}$

## Answer:

Watch Video Solution
88. A simple pendulum is attached to the roof of a lift. If time period of oscillation, when the lift is stationary is T . Then frequency of oscillation, when the lift falls freely, will be
A. zero
B. $T$
C. $1 / T$
D. none

## Answer:

89. The length of a second's pendulum at the surface of earth is 1 m . The length of second's pendulum at the surface of moon where $g$ is $1 / 6$ th that at earth's surface is
A. $1 / 6$ times
B. 6 times
C. $1 / 36$ times
D. 36 times

## Answer:

## - Watch Video Solution

90. A simple pendulum has a time period of 1 s . In order to increase the time period to 2 s .
A. the mass of the bob should be doubled
B. the length of the pendulum should be doubled
C. the length of the pendulum should be increased by a factor of 4
D. the length of the pendulum should be decreased by a factor of 4

## Answer:

## - Watch Video Solution

91. There is a simple pendulum hanging from the ceiling of a lift. When the lift is stand still, the time period of the pendulum is $T$. If the resultant acceleration becomes $g / 4$,then the new time period of the pendulum is
A. 0.8 T
B. 0.25 T
C. 2 T
D. 4 T

## Answer:

## - Watch Video Solution

92. The mass and diameter of a planet are twice those of earth. What will be the period of oscillation of a pendulum on this plenet. If it is a 2 second's pendulum on earth?
A. $1 / \sqrt{2} s$
B. $2 \sqrt{2} s$
C. 2 s
D. $\frac{1}{2} s$

## Answer:

## - Watch Video Solution

93. On a planet a freely falling body takes 2 sec when it is dropped from a height of 8 m , the time period of simple pendulum of length 1 m on that planet is
A. 1.42 sec
B. 3.14 sec
C. 2.92 sec
D. 5.36 sec

## Answer:

## - Watch Video Solution

94. Simple pendulum is executing simple harmonic motion with time period $T$. If the length of the pendulum is increased by $21 \%$, then the increase in the time period of the pendulum of the increased length is:
A. 0.1
B. 0.3
C. 0.21
D. 0.5

## Answer:

## - Watch Video Solution

95. The time period of a simple pendulum measured inside a stationary
lift is found to be T . If the lift starts accelerating upwards with an acceleration $g / 3$, the time period is
A. $2 \frac{T}{\sqrt{3}}$
B. $\frac{T}{3}$
C. $\frac{\sqrt{3}}{2} T$
D.
96. A simple pendulum oscillates in a vertical plane. When it passes through the mean position, the tension in the string is 3 times the weight of the pendulum bob.what is the maximum displacement of the pendulum with respect to the vertical
A. $30^{\circ}$
B. $45^{\circ}$
C. $60^{\circ}$
D. $90^{\circ}$

## Answer:

## - Watch Video Solution

97. The length of the second's pendulum is decreased by 0.3 cm , when it is shifted to Chennai from London. If the acceleration due to gravity at London is $981 \mathrm{~cm} / \mathrm{s}^{2}$, the acceleration due to gravity at Chennai is (Assume $\pi^{2}=10$ )
A. $981 c \frac{m}{s^{2}}$
B. $978 c \frac{m}{s^{2}}$
C. $984 c \frac{m}{s^{2}}$
D. $975 c \frac{\mathrm{~m}}{\mathrm{~s}^{2}}$

## Answer:

## - Watch Video Solution

98. A pendulum suspended from the roof of an elevator at rest has a time period $T_{1}$, when the elevator moves up with an acceleration $a$ its
time period becomes $T_{2}$, when the elevator moves down with an acceleration $a$, its time period becomes $T_{3}$, then
A. $T_{1}=\sqrt{T}{ }_{2} T_{3}$
B. ${ }^{T} 1=$ =sqrt( $\left.T_{-} 2^{\wedge} 2+T_{-} 3^{\wedge} 2\right)$
C. $T_{1}=\frac{T_{2} T_{3} \sqrt{2}}{\sqrt{T_{2}^{2}+T_{3}^{2}}}$
D. none of these

## Answer:

## (D) Watch Video Solution

99. If a simple pendulum of length 'L' has maximum angular displacement alpha'. Then the maximum kinetic energy of bob mass $m$ is
A. $\frac{1}{2}\left(M \frac{L}{g}\right)$
B. $M \frac{g}{2} L$
C. $M g L(1-\cos \alpha))$
D. $M g L \frac{\sin \alpha}{2}$

## Answer:

Watch Video Solution
100. A hollow spherical pendulum filled with mercury has time period T .

If mercury is thrown out completely, then the new time period
A. increases
B. decreases
C. same
D. none of these

## Answer:

101. A hollow sphere is filled with water through a small hole in it. It is then hung by a long thread and made to oscillate. As the water slowly flows out of the hole at the bottom, the period of oscillation of the sphere.
A. increase
B. remain constant
C. decrease
D. first (a) then (c)

## Answer:

## - Watch Video Solution

102. A rod of length I and mass $m$ is capable of rotating freely about an axis passing through a hole at the end. The period of oscillation of this physical pendulum is
A. $2 \pi \sqrt{\frac{l}{3} g}$
B. $2 \pi \sqrt{2 \frac{l}{3} g}$
C. $2 \pi \sqrt{\frac{m}{2} k}$
D. $2 \pi \sqrt{2 \frac{l}{g}}$

## Answer:

## - Watch Video Solution

103. The resultant of two rectangular simple harmonic motion of the same frequency and unequal amplitude but differing in phase by $\pi / 2$ is
A. simple harmonic
B. circular
C. elliptical
D. parabolic

## Answer:

## - Watch Video Solution

104. A block rests on a horizontal table which is executing SHM in the horizontal plane with an amplitude A. What will be the frequency of oscillation, the block will just start to slip? Coefficient of friction $=\mu$.
A. $\left(\frac{1}{2} \pi\right) \sqrt{\frac{\mu}{a}}$
B. $2 \pi \sqrt{\frac{a}{\mu} g}$
C. $\left(\frac{1}{2} \pi\right) \sqrt{\frac{a}{\mu} g}$
D. $\sqrt{\frac{a}{\mu} g}$

## Answer:

## - Watch Video Solution

105. In case of a forced vibration, the resonance wave becomes very sharp when the
A. applied periodic force is small
B. quality factor is small
C. damping force is small
D. restoring force is small

## Answer:

## - Watch Video Solution

106. A simple pendulum is vibrating in an evacuated chamber. It will
A. constant amplitude
B. increasing amplitude
C. decreasing amplitude
D. none of these

## Answer:

## (D) Watch Video Solution

107. Two simple pandulum whose lengths are 100 cm and 121 cm are suspended side by side. Then bobs are pulled together and then released. After how many minimum oscillations of the longer pendulum will two be in phase again.?
A. 11
B. 10
C. 21
D. 20

## Answer:

108. During the phenomenon of resonance
A. the amplitude of oscillation becomes large
B. the frequency of oscillation becomes large
C. the time period of oscillation becomes large
D. all of these

## Answer:

## - Watch Video Solution

109. What is periodic motion ?

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110. What is Oscillatory motion?
111. What are harmonic functions in SHM?

## - Watch Video Solution

112. Explain that $\sin \theta$ and $\cos \theta$ are periodic functions.

## - Watch Video Solution

113. Write the values of amplitude and frequency from the equation
$y=A \sin \omega t$ of S.H.M.

## - Watch Video Solution

114. Write the relation between acceleration, displacement and frequency of a particle executing S.H.M.

## (D) Watch Video Solution

115. The equation of motion of a particle executing S.H.M. is $a=-b x$, where a is the acceleration of the particle, x is the displacement from the mean position and $b$ is a constant. What is the time period of the particle?

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116. Write the relation between time period $T$, displacement $x$ and acceleration a of a particle in S.H.M.

## - Watch Video Solution

117. Spring constant is a dimensional contant. Justify.
118. What do you understand by the term 'phase' of an oscillating particle?

## (D) Watch Video Solution

119. Two simple pendulums of equal length cross each other at mean position. Then their phase difference is

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120. What is the phase relationship between diplacement, velocity and acceleration in SHM?

## - Watch Video Solution

121. What is phase difference between the displacement and acceleration of a particle executing S.H.M ?

## - Watch Video Solution

122. What is a second's pendulum?

## - Watch Video Solution

123. A simple pendulum moves from one end to the other in $1 / 4$ second.

What is its frequency?

## - Watch Video Solution

124. Write the values of amplitude and angular frequency for the following simple harmonic motion. $y=0.2 \sin (99 t+0.36)$
125. Write the displacement equation representing the following conditions obtained for a simple harmonic motion: amplitude $=0.01 \mathrm{~m}$, frequency $=600 \mathrm{~Hz}$ initial phase $=\pi / 6$

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126. How will the the time period of a simple pendulum change when its length is doubled?

## - Watch Video Solution

127. What would be the effect on the time period, if the amplitude of a simple pendulum increases?

## - Watch Video Solution

128. The time period of a simple pendulum when it is made to oscillate on the surface of moon

## - Watch Video Solution

129. A pendulum clock is thrown out of an airplane. How will it behave during its free fall in air?

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130. If on going up a hill, the value of $g$ decreases by $10 \%$, then what change must be made in the length of a pendulum clock in order to obtain accurate time?

## - Watch Video Solution

131. Which quantity is conserved during the oscillation of a simple pendulum?

## (D) Watch Video Solution

132. A girl is sitting on a swing. Another girl sits by her side. What will be the effect on the periodic-time of the swing?

## - Watch Video Solution

133. What is the frequency of a second's pendulum in an elevator moving up with an acceleration of $g / 2$ ?

## - Watch Video Solution

134. Two identical springs of spring constant $k$ each are connected in series and parallel as shown in figure. A mass $M$ is suspended from
them. The ratio of their frequencies of vertical oscillation will be


## - Watch Video Solution

135. Two identical springs of spring constant $k$ each are connected in series and parallel as shown in figure. A mass $M$ is suspended from
them. The ratio of their frequencies of vertical oscillation will be


## - Watch Video Solution

136. The time period of a body executing S.H.M. is 0.05 s and the amplitude of vibration is 4 cm . What is the maximum velocity of the

## body?

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137. A particle executes S.H.M. of 2 cm . At the extreme position, the force is 4 N . What is the force at a point midway between mean and extreme positions?

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138. The potential energy of a particle executing SHM varies sinusoidally with frequency $f$. The frequency of oscillation of the particle will be

## - Watch Video Solution

139. When will the motion of a simple pendulum be simple harmonic?
140. When is the P.E. and K.E. of a harmonic oscillator maximum and what are these maximum values?

## - Watch Video Solution

141. On what factors does the energy of a harmonic oscillator depend ?

## - Watch Video Solution

142. The time period of a simple pendulum at the centre of the earth is

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143. A simple harmonic motion of acceleration 'a' and displacement ' $x$ ' is represented by $a+4 \pi^{2} x=0$ What is the time period of S.H.M ?
144. What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

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145. The amplitudes of oscillations of two simple pendulums similar in all respects are 2 cm and 5 cm respectively. Find the ratio of their energies of oscillations.

## - Watch Video Solution

146. Define periodic time. Give its SI unit

## - Watch Video Solution

147. What is meant by SHM ?
148. What is meant by the displacement of a particle executing SHM ?

## - Watch Video Solution

149. Define amplitude of $S . H . M$. ?

## (D) Watch Video Solution

150. List any two characteristics of simple harmonic motion.

## - Watch Video Solution

151. What is the time period of second's pendulum ?
152. A pendulum is making one oscillation in every two seconds. What is the frequency of oscillation?

## - Watch Video Solution

153. A simple pendulum is inside a space craft. What should be its time period of vibration?

## - Watch Video Solution

154. A simple pendulum is described by $a=-16 x$, where a is acceleration, x is displacement in meter. What is the time period ?

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

## - Watch Video Solution

156. What is simple harmonic motion ? Write its any four properties

## - Watch Video Solution

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

## - Watch Video Solution

158. Derive an expression for instantaneous velocity and acceleration of a particle executing simple harmonic motion.
159. Derive an expression for the instantaneous velocity of the particle executing S.H.M. Find the position at which the particle velocity is minimum.

## - Watch Video Solution

160. Derive an expression for the instantaneous velocity of the particle executing S.H.M. Find the position at which the particle velocity is minimum.

## - Watch Video Solution

161. Show that in simple harmonic motion (S.H.M.), the acceleration is directly proportional to its displacement at the given instant.
162. The relation between the acceleration a and displacement $x$ of $a$ particle executing SHM is $a=-(p / q) y$, where p and q are constant quantities. What will be the time period of oscillation of the particle? If $p$ is doubled and $q$ is halved, then find the value of new time period of oscillation.

## - Watch Video Solution

163. A body is executing SHM according to the equation : $y=14 \sin \left(100 \pi t+\left(\frac{\pi}{6}\right)\right) \mathrm{cm}$. Find its maximum speed.

## - Watch Video Solution

164. A body is executing SHM according to the equation : $y=14 \sin \left(100 \pi t+\left(\frac{\pi}{6}\right)\right) \mathrm{cm}$. Find its maximum acceleration.
165. Passage V) In SHM displacement, velocity and acceleration all oscillate simple harmonically with same angular frequency $\omega$. Phase difference between any two is $\frac{\pi}{2}$ except that between displacement and acceleration which is $\pi$.
v -t graph of a particle is SHM is as shown in figure Choose the wrong option.


## - Watch Video Solution

166. A particle is executing SHM of amplitude A. at what displacement from the mean postion is the energy half kinetic and half potential?

## - Watch Video Solution

167. What is meant by simple harmonic motion ? Give any two examples.

Write its differential form.

## Watch Video Solution

168. A particle is executing SHM of amplitude A. at what displacement from the mean postion is the energy half kinetic and half potential?

## - Watch Video Solution

169. Draw the graphical representation of simple harmonic motion, showing the displacement-time curve.
170. Draw the graphical representation of simple harmonic motion, showing the acceleration-time curve.

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171. Find an expression for the total energy of a particle executing

## S.H.M.

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172. Show that the total energy of a body executing S.H.M. is constant.
173. Show that for a small oscillations the motion of a simple pendulum is simple harmonic. Derive an expression of its time period.

## - Watch Video Solution

174. Show that for small oscillations the motion of a simple pendulum is simple harmonic. Derive an expression for its time period. Does it depend on the mass of the bob ?

## - Watch Video Solution

175. A cylindrical piece of cork of base area $A$ and height $h$ floats in a liquid of density $\rho_{1}$. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period
$T=2 \pi \sqrt{\frac{h \rho}{\rho_{1} g}}$
176. In SHM of a particle, draw graphs showing variation in acceleration with time. Hence discuss the phase relationship between them using proper equations.

## - Watch Video Solution

177. Out of the following functions representing motion of a particle which represents SHM
I. $y=\sin \omega t-\cos \omega t$
II. $y=\sin ^{3} \omega t$
III. $y=5 \cos \left(\frac{3 \pi}{4}-3 \omega t\right)$
IV. $y=1+\omega t+\omega^{2} t^{2}$
178. The amplitude of a simple harmonic oscillation is doubled. How does this affect
(i) periodic time (ii) maximum velocity (iii) maximum acceleration and (iv) maximum energy

## - Watch Video Solution

179. The amplitude of a simple harmonic oscillation is doubled. How does this affect
(i) periodic time (ii) maximum velocity (iii) maximum acceleration and
(iv) maximum energy

## - Watch Video Solution

180. The amplitude of a simple harmonic oscillator is doubled, how does this affect maximum velocity of the oscillator.
181. Show that for a particle in linear S.H.M., the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

## (D) Watch Video Solution

182. A particle executes simple harmonic motion of ampliltude A. At what distance from the mean position is its kinetic energy equal to its potential energy?

## - Watch Video Solution

183. What is a spring factor? Find its value in case of two springs connected in (i) series and (ii) parallel.
184. What is a spring factor? Find its value in case of two springs connected in (i) series and (ii) parallel.

## - Watch Video Solution

185. A particle executes simple harmonic motion between $x=-A$ and $x=+A$. The time taken for it to go from $0 \rightarrow A / 2 i s T_{1}$ and $\rightarrow$ goom $A / 2 \rightarrow(A) i s\left(T_{2}\right)$. Then.
A. $T_{1}<T_{2}$
B. $T_{1}>T_{2}$
C. $T_{1}=T_{2}$
D. $T_{1}=2 T_{2}$

## Answer:

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


(a) $I, I I I$
(b) $I I, I V$ (c ) $I I, I I I$
(d) $I, I V$
A. I, III
B. II, IV
C. II, III
D. I, IV

## Answer:

187. A particle free to move along the $x$ - axis has potential energy given by $U(x)=k\left[1-e^{-x^{2}}\right]$ for $-\infty \leq x \leq+\infty$, where $k$ is a positive constant of appropriate dimensions. Then select the incorrect option
A.at points away from the origin, the particle is in unstable equilibrium
B. for any finite nonzero value of $x$, there is a force directed away from the origin
C. if its total mechanical energy is $\mathrm{k} / 2$, it has its minimum kinetic
energy at the origin
D.for small displacements from $\mathrm{x}=0$, the motion is simple harmonic.

## Answer:

188. A spring of force constant $k$ is cut into two pieces such that one piece is double the length of the other. Then the long piece will have a force constant of
A. $\frac{2}{3} k$
B. $\frac{3}{2} k$
C. 3 k
D. 6 k

## Answer:

## Watch Video Solution

189. Two bodies ( M ) and ( N ) of equal masses are suspended from two separate massless springs of spring constants (k_1) and (k_2) respectively. If the two bodies oscillate vertically such that their
maximum velocities are equal, the ratio of the amplitude of vibration of (M) to the of $(N)$ is.
A. $\frac{k_{1}}{k_{2}}$
B. $\sqrt{\frac{k_{1}}{k_{2}}}$
C. $\frac{k_{2}}{k_{1}}$
D. $\sqrt{\frac{k_{2}}{k_{1}}}$

## Answer:

## - Watch Video Solution

190. An object of mass 0.2 kg executes simple harmonic oscillation along the $x-a \xi s$ with a frequency of $(25 / \pi) H z$. At the position $x=0.04$, the object has Kinetic energy of 0.5 J and potential energy `. 0.4 J. The amplitude of oscillations is.......m.
A. 6 cm
B. 4 cm
C. 8 cm
D. 2 cm

## Answer:

## - Watch Video Solution

191. A simple pendulum has a time period $T_{1}$ when on the earth's surface and $T_{2}$ when taken to a height R above the earth's surface, where R is the radius of the earth. The value of $\frac{T_{2}}{T_{1}}$ is
A. 1
B. $\sqrt{2}$
C. 4
D. 2
192. The period of oscillation of a simple pendulum of length (L) suspended from the roof of a vehicle which moves without friction down an inclined plane of inclination (prop), is given by.
A. $2 \pi \sqrt{\frac{L}{g} \cos \alpha}$
B. $2 \pi \sqrt{\frac{L}{g} \sin \alpha}$
C. $2 \pi \sqrt{\frac{L}{g}}$
D. $2 \pi \sqrt{\frac{L}{g} \tan \alpha}$

## Answer:

## - Watch Video Solution

193. A simple pendulum has time period ( $T_{-} 1$ ). The point of suspension is now moved upward according to the relation
$y=K t^{2},\left(K=1 \mathrm{~m} / \mathrm{s}^{2}\right)$ where (y) is the vertical displacement. The time period now becomes (T_2). The ratio of $\frac{T_{1}^{2}}{T_{2}^{2}}$ is $\left(g=10 \mathrm{~m} / \mathrm{s}^{2}\right)$.
A. $\frac{5}{6}$
B. $\frac{6}{5}$
C. 1
D. $\frac{4}{5}$

## Answer:

## - Watch Video Solution

194. The function $x=A \sin ^{2}(\omega) t+B \cos ^{2}(\omega) t+C \sin (\omega) t \cos (\omega) t$ represent (SHM) for which of the option(s).
A. for all values of $\mathrm{A}, \mathrm{B}$ and $\mathrm{C}(C \neq 0)$
B. $A=B, C=2 B$
C. $A=-B, C=2 B$
D. $A=B, C=O$.

## Answer:

## - Watch Video Solution

195. 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 $45^{\circ}$, then
A. the resultant amplitude is $(1+\sqrt{2}) a$
B. the phase of the resultant relative to the first is $90^{\circ}$
C. the energy associated with the resulting motion is $(3+2 \sqrt{2})$
times the energy associated with any single motion
D. the resulting motion is not simple harmonic

## Answer:

196. A particle executes simple harmonic motion with a frequency. (f). The frequency with which its kinetic energy oscillates is.
A. $\frac{f}{2}$
B. $f$
C. 2 f
D. 4 f

## Answer:

## - Watch Video Solution

197. A linear harmonic oscillator of force constant $2 \times 10^{6} \mathrm{~N} / \mathrm{m}$ and amplitude ( 0.01 m ) has a total mechanical energy of ( 160 J ). Its.
A. maximum potential energy is 100 J
B. maximum kinetic energy is 100 J
C. maximum potential energy is 160 J
D. maximum potential energy is zero

## Answer:

## - Watch Video Solution

198. A particle of mass $(m)$ is executing oscillations about the origin on the ( x ) axis. Its potential energy is $V(x)=k|x|^{3}$ where $(\mathrm{k})$ is a positive constant. If the amplitude of oscillation is $a$, then its time period $(T)$ is.
A. proportional to $1 / \sqrt{a}$
B. independent of a
C. proportional to $\sqrt{a}$
D. proportional to $a^{3} / 2$
199. The function $\sin ^{2}(\omega t)$ represents:
A. a periodic but not simple harmonic motion with a period $2 \pi / \omega$
B. a periodic, but not simple harmonic motion with a period $\pi / \omega$
C. a simple harmonic motion with a period $2 \pi / \omega$
D. a simple harmonic motion with a period $\pi / \omega$

## Answer:

## - Watch Video Solution

200. $x$ and $y$ displacements of a particle are given as $x(t)=-a \sin \omega t$ and $y(t)=a \sin 2 \omega t$. Its trajectory will look like.
A.
B.
C.
D.

## Answer:

## D Watch Video Solution

201. Two simple harmonic are represented by the equation $y_{1}=0.1 \sin \left(100 \pi+\frac{\pi}{3}\right)$ and $y_{2}=0.1 \cos \pi t$.

The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is.
A. $-\pi / 6$
B. $\pi / 3$
C. $-\pi / 3$
D. $\pi / 6$

## Answer:

## - Watch Video Solution

202. The displacement of an obuect attached to a spring and executing simple harmonic motion is given by $x=2 \times 100^{-2} \cos \pi t$ metre. The time at which the maximum speed first occurs is.
A. 0.5 s
B. 0.75 s
C. 0.125 s
D. 0.25 s

## Answer:

## - Watch Video Solution

203. A point mass oscillates along the $x$-axis according to the law $x=x_{0} \cos ($ moegat $-\pi / 4)$. Iftheae $\leq$ rationofthepartic $\leq i s w r i e n a s$ $a=A \cos (o m e g a t+d e l t a)$, the .
A. $a_{0}=x_{0} \omega^{2}, \sigma=-\pi / 4$
B. $a_{0}=x_{0} \omega^{2}, \sigma=\pi / 4$
C. $a_{0}=x_{0} \omega^{2}, \sigma=-\pi / 4$
D. $a_{0}=x_{0} \omega^{2}, \sigma=3 \pi / 4$

## Answer:

## - Watch Video Solution

204. The maximum velocity of a particle, executing simple harmonic motion with an amplitude 7 mm is $4.4 \mathrm{~ms}^{-1}$. The period of oscillation is
A. 0.01 s
B. 0.1 s
C. 10 s
D. 100 s

## Answer:

## (D) Watch Video Solution

205. If a simple harmonic motion is represented by $\frac{d^{2} x}{d t^{2}}+\alpha x=0$, its time period is :
A. $2 \pi / \alpha$
B. $2 \pi / \sqrt{\alpha}$
C. $2 \pi \alpha$
D. $2 \pi \sqrt{\alpha}$

## Answer:

206. If $x, v$ and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period $T$, then, which of the following does not change with time?
A. $a^{2} T^{2}+4 \pi^{2} v^{2}$
B. $a T / x$
C. $a T+2 \pi v$
D. $a T / v$

## Answer:

## - Watch Video Solution

207. A simple harmonic oscillator of angular frequency $2 \mathrm{rad} s^{-1}$ is acted upon by an external force $F=\sin t N$. If the oscillator is at rest
in its equilibrium position at $t=0$, its position at later times is proportional to :-
A. $\cos t-\left(\frac{1}{2}\right) \sin 2 t$
B. $\sin t+\left(\frac{1}{2}\right) \cot 2 t$
C. $\sin t+\left(\frac{1}{2}\right) \sin 2 t$
D. $\sin t-\left(\frac{1}{2}\right) \sin 2 t$

## Answer:

## - Watch Video Solution

208. A particle moves with simple harmonic motion in a straight line. In first $\tau s$, after starting form rest it travels a destance a, and in next $\tau s$ it travels 2a, in same direction, then:
A. amplitude of motion is 3 a
B. time period of oscillations is $8 \tau$
C. amplitude of motion is $4 a$
D. time period of oscillations is $6 \tau$

## Answer:

## - Watch Video Solution

209. A coin is placed on a horizontal platform which undergoes vertical simple harmonic motion of angular frequency $\omega$. The amplitude of oscillation is gradually increased. The coin will leave contact with the platform for the first time
A. for an amplitude of $g^{2} / \omega^{2}$
B. for an amplitude of $g / \omega^{2}$
C. at the highest position of the platform
D. at the mean position of the platform

## Answer:

210. Two particles are executing simple harmonic of the same amplitude (A) and frequency $\omega$ along the $x$-axis. Their mean position is separated by distance ${ }^{X} X_{-}(0)\left(X_{-}(0) g t A\right)$. If the maximum separation between them is $\left(X \_(0)+A\right)$, the phase difference between their motion is:
A. $\frac{\pi}{2}$
B. $\frac{\pi}{3}$
C. $\frac{\pi}{4}$
D. $\frac{\pi}{6}$

## Answer:

211. The total energy of a particle executing simple harmonic motion is
A. $\propto x$
B. $\propto x^{2}$
C. independent of $x$
D. $\propto x^{1 / 2}$

## Answer:

## - Watch Video Solution

212. In a simple harmonic oscillator, at the mean position
A. kinetic energy is minimum, potential energy is maximum
B. both kinetic and potential energies are maximum
C. kinetic energy is maximum, potential energy is minimum
D. both kinetic and potential energies are minimum.

## Answer:

## - Watch Video Solution

213. A body executes simple harmonic motion. The potential energy
(P.E), the kinetic energy (K.E) and energy (T.E) are measured as a function of displacement $x$. Which of the following staements is true?
A. K.E. is maximum, when $x=0$
B. T.E. is $s$ zero, when $x=0$
C. K.E. is maximum, when x is maximum
D. P.E. is maximum, when $x=0$.

## Answer:

## - Watch Video Solution

214. A particle of mass $m$ executes $S H M$ with amplitude 'a' and frequency ' $v$ '. The average kinetic energy during motion from the position of equilibrium to the end is:
(1) $2 \pi^{2} m a^{2} v^{2}$ (2) $\pi^{2} m a^{2} v^{2}$
(3) $\frac{1}{2} m a^{2} v^{2}$ (4) $4 \pi^{2} m a^{2} v^{2}$
A. $\pi^{2} m a^{2} v^{2}$
B. $\left(\frac{1}{4}\right) \pi^{2} m a^{2} v^{2}$
C. $4 \pi^{2} m a^{2} v^{2}$
D. $2 \pi^{2} m a^{2} v^{2}$

## Answer:

## - Watch Video Solution

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

## energy?

A. $1 / 12 s$
B. $1 / 6 s$
C. $1 / 4 s$
D. $1 / 3 s$

## Answer:

## - Watch Video Solution

216. If a spring has time period $T$, and is cut into ( $n$ ) equal parts, then the time period of each part will be.
A. $T \sqrt{n}$
B. $T / \sqrt{n}$
C. nT
D. $T$

## Answer:

## - Watch Video Solution

217. A mass ( $M$ ) is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes SHM of time period $T$. If the mass is increased by $m$, the time period becomes $\frac{5 T}{3}$. Then the ratio of $\frac{m}{M}$ is.
A. $3 / 5$
B. $25 / 9$
C. $16 / 9$
D. $5 / 3$

## Answer:

218. A particle at the end of a spring executes simple harmonic motion with a period $t_{1}$ while the corresponding period for another spring is $t_{2}$ if the oscillation with the two springs in series is $T$ then
A. $T=t_{1}+t_{2}$
B. $T^{2}=t_{1}^{2}+t_{2}^{2}$
C. $T^{-1}=t_{1}^{-1}+t_{2}^{-1}$
D. $T^{-2}=t_{1}^{-2}+t_{2}^{-2}$

## Answer:

## (D) Watch Video Solution

219. Two bodies ( M ) and ( N ) of equal masses are suspended from two separate massless springs of spring constants (k_1) and (k_2) respectively. If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude of vibration of (M) to the of $(N)$ is.
A. $k_{1} / k_{2}$
B. $\sqrt{k}_{1} / k_{2}$
C. $k_{2} / k_{1}$
D. $\sqrt{k_{2}} / k_{1}$

## Answer:

## - Watch Video Solution

220. A spring of force constant $800 \mathrm{~N} / \mathrm{m}$ has an extension of 5 cm . The work done in extending it from 5 cm to 15 cm is
A. 8 J
B. 16J
C. 24J
D. 32J

## Answer:

## - Watch Video Solution

221. A spring of spring constant $5 \times 10^{2} \mathrm{Nm}$ is streched initially by 5 cm from the unstriched position. Then the work required to streach is further by another 5 cm is
A. 6.25 N m
B. 12.50 Nm
C. 18.75 N m
D. 25.00 Nm

## Answer:

## - Watch Video Solution

222. A child swinging on a swing in sitting position, stands up, then the time period of the swing will.
A. increase
B. decrease
C. remain the same
D. increase, if the child is long and decrease, if the child is short.

## Answer:

## - Watch Video Solution

223. The length of a simple pendulum executing simple harmonic motion is increased by $21 \%$. The percentage increase in the time period of the pendulum of increased length is
A. 0.5
B. 0.21
C. 0.3
D. 0.1

## Answer:

## - Watch Video Solution

224. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillating bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would
A. first increase and then decrease to the original value
B. first decrease and then increase to the original value
C. remain unchanged
D. increase towards a saturation value.

## Answer:

## - Watch Video Solution

225. The bob of a simple pendulum executm simple harmonic motion in water with a period t , while the period of oscillation of the bob is $t_{0}$ in air. Negleting frictional force of water and given that the density of the bob is $(4 / / 3) \times x 1000 \mathrm{~kg} / / \mathrm{m}^{\wedge}(3)$.

What relationship between t and $t_{0}$ is true.
A. $t=t_{0}$
B. $t=t_{0} / 2$
C. $t=2 t_{0}$
D. $t=4 t_{0}$

## Answer:

226. A cylindrical of wood (density $=600 \mathrm{kgm}^{-3}$ ) of base area $30 \mathrm{~cm}^{2}$ and height 54 cm , floats in a liquid of density $900 \mathrm{~kg}^{-3}$ The block is deapressed slightly and then released. The time period of the resulting oscillations of the block would be equal to that of a simple pendulum of length (nearly) :
A. 52 cm
B. 65 cm
C. 39 cm
D. 26 cm

## Answer:

## - Watch Video Solution

227. If a simple pendulum has significant amplitude (up to a factor of1//e of original) only in the period between $t-0 s \rightarrow t=\tau s$, then $\tau$
may be called the average life of the pendulum. When the sphetical bob of the pendulum suffers a retardation (due to viscous drag) proportional to its velocity with b as the constant of propotional to average life time of the pendulum is (assuming damping is small) in seconds:
A. $\frac{0.693}{b}$
B. $b$
C. $\frac{1}{b}$
D. $\frac{2}{b}$

## Answer:

## ( Watch Video Solution

228. The amplitude of damped oscillator decreased to 0.9 times its original magnitude is $5 s$. In another $10 s$ it will decrease to $\alpha$ times its original magnitude, where $\alpha$ equals.
A. 0.7
B. 0.81
C. 0.729
D. 0.6

## Answer:

## - Watch Video Solution

229. A pendulum with time period of $1 s$ is losing energy due to damping. At time its energy is $45 J$. If after completing 15 oscillations, its energy has become 15 J . Its damping constant (in $s^{-1}$ ) is :-
A. $\frac{1}{2}$
B. $\frac{1}{30} \operatorname{In} 3$
C. 2
D. $\frac{1}{15} \operatorname{In} 3$

## Answer:

## - Watch Video Solution

230. A particle is executing simple harmonic motion with a time period
$T$. At time $t=0$, it is at its position of equilibium. The kinetice energy time graph of the particle will look like
A.
B.
C.
D.

## Answer:

## - Watch Video Solution

231. Two particles are in $S H M$ in a straight line about same equilibrium position. Amplitude $A$ and time period $T$ of both the particles are equal. At time $t=0$, one particle is at displacement $y_{1}=+A$ and the other at $y_{2}=-A / 2$, and they are approaching towards each other. after what time they cross each other?
A. $\frac{T}{4}$
B. $5 \frac{T}{6}$
C. $\frac{T}{3}$
D. $\frac{T}{6}$

## Answer:

## - Watch Video Solution

232. A particle performs simple harmonic mition with amplitude A. Its speed is trebled at the instant that it is at a destance
A. 3A
B. $A \sqrt{3}$
C. $7 \frac{A}{3}$
D. $\left(\frac{A}{3}\right) \sqrt{41}$

## Answer:

233. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of $10^{12} / \mathrm{sec}$. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver $=108$ and Avagadro number $\begin{aligned} & =6.02 \times x 10^{\wedge}(23) " ~ g m ~ " m o l e \\ & \\ & \wedge \\ & (-1))\end{aligned}$
A. $6.4 N / m$
B. $7.1 \mathrm{~N} / \mathrm{m}$
C. $2.2 N / m$
D. $5.5 \mathrm{~N} / \mathrm{m}$

## Answer:

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