# PHYSICS

# BOOKS - MBD

# OSCILLATIONS

## Example

1. What is periodic motion ? Give few examples

.

**2.** Define oscillatory motion. Give examples.

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**3.** A particle has maximum velocity at mean position and zero velocity at the extreme position. Is it sure test for SHM?

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**4.** Is restoring force necessary in S.H.M?

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**5.** Can a motion be periodic and not oscilatory?

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**6.** Are all periodic motions oscillatory?

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**7.** Are all oscillatory motions periodic?

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**8.** Can a motion be oscillatory but not simple harmonic?

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**9.** In an SHM, can velocity and displacement be in the same direction?

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**10.** What is the displacement of a particle executing SHM?

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**11.** What is the basic condition for the motion of a particle to be SHM?

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**12.** Can a body be accelerate without speeding up or slowing down?

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**13.** What are two basic characteristics of an oscillatory sytem?

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**14.** What is force constant and write its SI unit?

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**15.** Why a point on a rotating wheel cannot be considered as executing SHM?

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**16.** Which trigonometrical functions are suitable for expressing periodic motion and why?

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

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**18.** What is the effect on the time period of a simple pendulum, if the mass of the bob is doubled?

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**19.** Two simple pendulums of equal lengthcross each other at mean position. What is their phase difference?

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**20.** What is the time period of a simple pendulum of infinite length. Take R as the radius of earth.

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**21.** What will be the change in time period of a loaded spring when taken to moon?

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**22.** Which quantity remains constant throughout the vibratioin of a pendulum?

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**23.** Water in U-tube executes S.H.M. Will the time period for mercury filled up to the same height in the U-tube be lesser or greater than that in case of water?

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**24.** A simple pendulum moves from one end to the other in 1/2 second. What is the frequency?

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**25.** Is second's pendulum a simple pendulum?

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**26.** What factors determine the natural frequency of an oscillator?

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**27.** For an oscillating simple pendulum, is the tension constant throughout the oscillation ? If not when it is the least

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**28.** For an oscillating simple pendulum, is the tension constant throughout the oscillation ? If not when it is the greatest.

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**29.** Why are vibrations of a simple pendulum damped?

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**30.** A spring has mass m suspended from it. What will happen to the frequency of oscillations if the spring is cut into two halves?

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**31.** What determines the natural frequency of a body?

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**32.** How many times KE and PE of an oscillator in one vibration become maximum?

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**33.** When two unequal springs of same material are loaded with same load, which one will have the larger value of time period?

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**34.** Which of the following examples represent periodic motion?

A. A swimmer completing one (return ) trip from one bank of a river to the other and back.

B. A freely suspended bar magnet displaced from its N-S direction and released.

C. A hydrogen molecule rotating about its centre of mass

D. An arrow released from a bow.

**Answer:**

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**35.** Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion? The rotation of earth about its axis.

A. The rotation of the earth about its axis

B. Themotion of an oscillatory mercury column in a U-tube.

C. The motion of a ball-bearing inside a smooth curved bowl, when released from a point slightly above the4 lowermost position

D. General vibration of a polyatomic molecule about its equilibrium configuration position.

**Answer:**

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**36.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant): sin $\omega t - \cos \omega t$

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**37.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant):3 cos $\left(\left(\frac{\pi}{4}\right) - (2\omega t)\right)$

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**38.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant):

$\cos \omega t + \cos 3\omega t = \cos 5\omega t$

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**39.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant): $1 + \omega t + \omega^2 t^2$

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**40.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant):exp $\left(-\omega^2 t^2\right)$

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41. Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant):$\sin^3 \omega t$

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**42.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at the end A,

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**43.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at the end B,

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**44.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at the mid-point of AB going towards A,

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**45.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at 2 cm away from B going towards A,

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**46.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at 3 cm away from A going towards B, and

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**47.** A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is at 4 cm away from B going towards A

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**48.** Which of the following relationships between the acceleration and the displacement x of a particle involve simple harmonic motion?

A. $\alpha = 0.7x$

B. $\alpha = -200x^2$

C. $\alpha = -10x$

D. $\alpha = 100x^2$

**Answer:**

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**49.** The motion of a particle executing simple harmonic motion is described by the displacement function, x(t) = A cos $(\omega t + \phi)$. If the initial (t = 0) position of the particle is 1 cm and its initial velocity is $\omega cm / s$, what are its amplitude and initial phase angle ? The angular frequency of the particle is $\pi s^{-1}$ s If instead of the cosine function, we choose the sine function to describe the 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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**50.** A spring balance has a scale that readsfrom 0 to 50 kg. The length of the scale is 20 cm. A body suspended from this balance, when displaced and released, oscillates with a period of 0.6 s. What is the weight of the body ?

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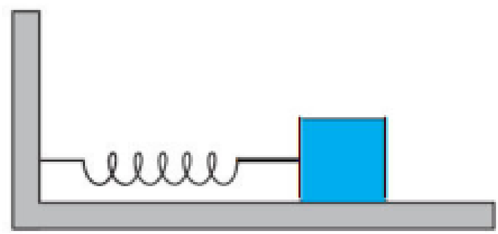
**51.** A spring having with a spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.Determine the frequency of oscillations,



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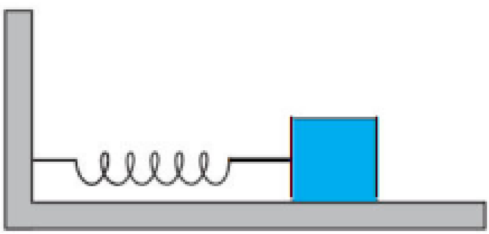
**52.** A spring having with a spring constant $1200Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.Determine maximum acceleration of the mass,



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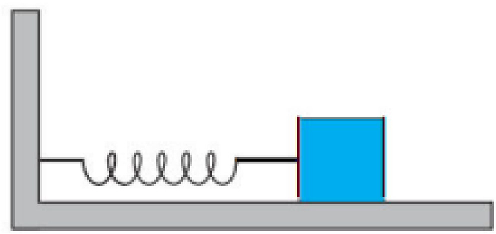
**53.** A spring having with a spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.Determine the maximum speed of the mass



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**54.** Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (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). x =-2 sin $(3t + (\pi / 3))$

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**55.** Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (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). $x = \cos(\pi / (6 - t))$

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**56.** Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (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). $x = 3\sin(2\pi t + (\pi/4))$

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**57.** Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (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). $x=2\cos \pi t$

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**58.** 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 $rad / \min$ , what is its maximum speed ?

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**59.** Answer the following questions : Time period of a particle in SHM depends on the force constant k and mass m of the particle: T=

$2\pi\sqrt{\frac{m}{k}}$.A simple pendulum executes SHM approximately. Why then is the time period of a pendulum independent of the mass of the pendulum?

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**60.** Answer the following questions : The motion of a simple pendulum is approximately simple harmonic for small angle oscillations. For larger angles of oscillation, a more involved analysis shows that T is greater than

$2\pi\sqrt{\frac{l}{g}}$ . Think of a qualitative argument to 9 appreciate this result

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**61.** Answer the following questions : A man with a wristwatch on his hand falls from the top of a tower. Does the watch give correct time during the free fall ?

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**62.** Answer the following questions : What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

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**63.** A simple pendulum of length 1 and having a bob of mass M is suspended in a car. The car is moving on a circular track of radius R with a uniform speed v. If the pendulum makessmall oscillations in a radial direction about its equilibrium position, what will be its time period ?

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**64.** A cylindrical piece of cork of density of base area Aand height h floats in a liquid of density $\rho_l$. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period

$T=2\pi\sqrt{\frac{h\rho}{\rho_1 g}}$ where p is the density of cork. (Ignore damping due to viscosity of the liquid)

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**65.** One end of a U-tube containing mercury is connected to a suction pump and the other end to atmosphere. A small pressure difference is maintained between the two columns. Show that, when the suction pump isremoved, the column of mercury in the U-tube executes simple harmonic motion.

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**66.** You are riding in 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 : the spring constant k.

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**67.** Show that for a particle in linear SHM the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

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**68.** A circular disc of mass 10 kg is suspended by a wire attached 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. Determine the torsional spring constant of the wire. (Torsional spring constant $\alpha$ is defined by the relation J = $-\alpha\theta$, where J is the restoring couple and 0 the angle of twist).

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**69.** A body describes 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 0 cm.

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**70.** A body describes 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 3 cm.

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**71.** A body describes 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 0 cm.

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**72.** 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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**73.** The displacement of a particle is represented by the equations $y = 3\cos\left(\frac{\pi}{4} - 2\omega t\right)$. The motion of the particle is

A. simple harmonic with period $2\pi / \omega$

B. simple harmonic with period $\pi / \omega$

C. periodic but not simple harmonic

D. non-periodic.

**Answer:**

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**74.** The displacement of a particle is represented by the equation$y = \sin^3 \omega t$. The motion is

A. non-periodic

B. periodic but not simple harmonic

C. simpe harmonic with period $2\frac{\pi}{\omega}$

D. simple harmonic with period $\pi/\omega$

**Answer:**

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**75.** The relation between acceleration and displacement of four particles are given below Which one of the particles is executing simple harmonic motion?

A. $\alpha_x = +2x$

B. $\alpha_x = +2x^2$

C. $\alpha_x = -2x^2$

D. $\alpha_X = -2x$

**Answer:**

Watch Video Solution

**76.** Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion? motion of an oscillating mercury column in a U-tube.

A. periodic but nto simple harmonic

B. non-periodic

C. simple harmonic and time period is inependent of the density of the liquid

D. simple harmonic and time-period is directly proportional to the density of the liquid.

**Answer:**

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**77.** A particle is actedsimultaneously by mutually perpendicular simple hormonic motions $x = a\cos 1\omega t$ and $y = a\sin\omega t$. The trajectory of motion of the particle will be

A. an ellipse

B. a parabola

C. a circle

D. a straight line

**Answer:**

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**78.** The displacement of a particle varies with time according to the relation $y = \alpha \sin \omega t + b \cos \omega t.$

A. the motion is oscillatory but not S.H.M.

B. the motion is S.H.M.with amplitude a+b

C. The motion is S.H.M. with amplitude $a^2 + b^2$

D. The motion is S.H.M. with amplitude

$\sqrt{a^2 + b^2}$

**Answer:**

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**79.** The equation of motion of a particle is

$x = a\cos(at)^2$

A. periodic but not oscillatory

B. periodic and oscillatory

C. oscillatory but not periodic

D. neither periodic nor oscillatory

**Answer:**

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**80.** A particle executing S.H.M. has a maximum speed of 30 cm/s and maximum acceleration of $60cm/s^2$. The period of oscillation is

A. $\pi s$

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

C. $2\pi / 15s$

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

**Answer:**

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**81.** Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion? The rotation of earth about its axis.

A. periodic motion

B. simple harmonic motion

C. periodic but not simple harmonic motion

D. non-periodic motion.

**Answer:**

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**82.** Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion? motion of a ball bearing inside a smooth curved bowl, when released from a point slightly above the lower most point

A. simple harmonic motion

B. non-periodic motion

C. periodic motion

D. periodic but not S.H.M.

**Answer:**

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**83.** Which of the following statements is/are true for a simple harmonic oscillator?

A. Force acting is directly proportional to displacement from the mean position and opposite to it

B. Motion is periodic

C. Acceleration of the oscillator is constant

D. The velocity is periodic

**Answer:**

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**84.** A body is performing S.H.M. then its

A. average total energy per cycle is equal to its maximum kinetic energy

B. avrage kinetic energy per cycle is equal to half of its maximum kinetic energy

C. mean velocity over a complete cycle is equal to $\frac{2}{\pi}$ times of its maximum velocity

D. root mean square velocity is $\frac{1}{\sqrt{2}}$ times of its maximum velocity

**Answer:**

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**85.** What are the two basic characteristics of a simple harmonic motion?

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**86.** When will the motion of a simple pendulum be simple harmonic?

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**87.** What is the ratio of maximum acceleration to the maximum velocity of a simple harmonic oscillator?

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**88.** What is the ratio between the distance travelled by the oscillator in one time period and amplitude?

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89. What will be the sign of the velocity of the point P', which is the projection of the velocity of the referenc particle P. P is moving in a circle of radius R in anticlockwise direction.

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90. Show that the motion of a particle represented by $y = \sin \omega t - \cos \omega t$ is simple harmonic with a period of $2\pi / \omega$.

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**91.** Draw a graph to show the variation s of P.E., K.E. and total energy of a simple harmonic oscillator with displacement.

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**92.** 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?

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**93.** Show that the motion of a particle represented by $y = \sin \omega t - \cos \omega t$ is simple harmonic with a period of $2\pi / \omega$.

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**94.** Find the displacement of a simple harmonic oscillator at which its P.E. is half of the maximum energy of the oscillator.

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**95.** A body of mass m is situated in a potential field U(x) $= (U_0(1 - \cos ax)$ when $U_0$ and a are constants. Find the time period of small oscillations.

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**96.** A mass of 2 kg is attached to the spring of spring constant $50 Nm^{-1}$. The lock is pulled to a distance of 5 cm from its equilibrium position at x = 0 on a horizontal frictionless surface from rest at t = 0. Write the expression for tis displacement at anytime t.

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**97.** Consider a pair of identical pendulums, which oscillate with equal amplitude independently such that when one pendulum is at its extreme position making angle of $2^\circ$ to the right with the vertical, the other pendulum makes and angle of $1^\circ$ to the left of the vertical. What is the phase difference between the pendulums?

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**98.** A person normally weighing 50 kg stands on a massless platform which oscillates up and down harmonically at a frequency of $2.0s^{-1}$ and an amplitude 5.0 cm. A wighing machine on the platform give s the persons weight against time Will there be any chage in weight of the body, during the oscillation?

**99.** A person normally weighing 50 kg stands on a massless platform which oscillates up and down harmonically at a frequency of $2.0s^{-1}$ and an amplitude 5.0 cm. A wighing machine on the platform give s the persons weight against time If answer to part is yes, what will be the maximum and minimum reading in the machine and at which position?

**100.** A body of mass m is attached to one end of a massless spring which is suspended vertically from a fixed point. The mass is held in hand so that the spring is neither stretched nor compressed. Suddenly the support of the hand is removed. The lowest position attained by the mass during oscillation is 4 cm below the point, where it held in hand. What is the amplitude of oscillation?

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**101.** A body of mass m is attached to one end of a massless spring which is suspended vertically from a fixed point. The mass is held in hand so that the spring is neither stretched nor compressed. Suddenly the support of the hand is removed. The lowest position attained by the mass during oscillation is 4 cm below the point, where it held in hand. Find the frequency of oscillation?

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**102.** A cylindrical log of wood of height h and area of cross-section A floasts in water. It is pressed and then released. Show that the log would execute S.H.M. with a time period $T = 2\pi\sqrt{m / A\rho g}$ where m is mass of the body and $\rho$ is density of the liquid.

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**103.** One end of a U-tube containing mercury is connected to a suction pump and the other end to atmosphere. A small pressure difference is maintained between the two columns. Show that, when the suction pump isremoved, the column of mercury in the U-tube executes simple harmonic motion.

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**104.** A tunnel is dug through the centre of the earth. Show that a body of mass m when dropped from rest from one end of the tunnel will execute simple harmonic motion.

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**105.** A particle executes S.H.M. Then the graph of velocity as a function of displacement is

A. A straight line

B. A circle

C. An ellipse

D. A hyperbola

**Answer:**

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**106.** The instantaneous acceleration of a particle executign S.H.M. Given by y = a sin $\omega t$, is

A. $+\omega^2 y$

B. $+\omega y$

C. $-\omega y^2$

D. $-\omega^2 y$

**Answer:**

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**107.** When the potential energy of a particle executive S.H.M. is one-fourth of the maximum value during the oscillation, its displacement from the equilibrium position in terms of its amplitude a is

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

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

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

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

**Answer:**

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**108.** If the equation of SHM is y = a sin $(4\pi t + \phi)$, how much is it frequency?

A. 2

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

C. $2\pi$

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

**Answer:**

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**109.** An instaneous displacement of a simple harmonic oscillator is $x = A\cos\left(\omega t + \frac{\pi}{4}\right)$. It speed will be maximum at time

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

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

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

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

**Answer:**

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**110.** A body executes S.H.M. The P.E. and K.E and total energy (T.E) are measured as function of displacement x . Which of the following statement is true?

A. K.E is maximum when x is maximum

B. P.E is maximum when x = 0

C. K.E. is maximum when x = 0

D. T.E is zero when x = 0

**Answer:**

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**111.** The potential energy of a simple harmonic oscillator, when the particle is half way to its end pint is

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

B. $\frac{E}{8}$

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

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

**Answer:**

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**112.** Pendulum after some time becomes slow in motion and finally stops due to

A. Air friction

B. Earth's gravity

C. Mass of pendulum

D. None of these

**Answer:**

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**113.** If a metal bob of a simple pendulum is replaced by wooden bob, then its time period will

A. increase

B. decrease

C. Remain same

D. First 'a' and then 'b'.

**Answer:**

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**114.** To make the frequency double of an oscillator, we have to

A. Double the mass

B. Half the mass

C. Quadruple of mass

D. Reduce the mass to one-fourth.

**Answer:**

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**115.** In case of a forced vibration, the resonance wave becomes very sharp when the

A. Damping force is small

B. Restoring force is small

C. Applied periodic force is small

D. Quality factor is small.

**Answer:**

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**116.** A child swinigng on a wing in a silting position stands up, then the time period of the swing will

A. increases

B. decrease

C. Remain same

D. increase if the child is long and decrease if the child is short.

**Answer:**

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**117.** The total energy of the particle performing SHM depends on

A. k,A,m

B. k,A

C. k,A,x

D. k,x

**Answer:**

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**118.** The time period of a simple pendulum is 2 seconds. If its length is increased by 4 times, then its period becomes

A. 16s

B. 12s

C. 8s

D. 4s

**Answer:**

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**119.** A system exhibiting S.H.M. must possess

A. Elasticity as well as inertia

B. Elasticity, inertia and an external force

C. Elasticity only

D. Inertia only

**Answer:**

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**120.** The acceleration of a particle inS.H.M. is

A. always constant

B. Maximum at mean position

C. Maximum at extreme position

D. Always zero.

**Answer:**

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**121.** For a body of mass m attached to the spring, the spring factor is given by ($\omega$, the angular frequency)

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

B. $m\omega^2$

C. $m^2\omega$

D. $m^2\omega^2$

**Answer:**

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**122.** When a mass is attached to a spring, its length is increased by 20 cm. It is now further lowered and releases. The time period is

A. $2\frac{\pi}{7}\sec$

B. 7 sec

C. $2\pi \sec$

D. Enoough data not available.

**Answer:**

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**123.** A spring of force constnat K is cut into three equal parts. The force constant of each part will be

A. K

B. 3K

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

D. 9K

**Answer:**

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**124.** A small mass executes lineaer S.H.M. about a point O with amplitude r and period T. Its displacement form O at time $\frac{T}{8}$ after passing through O is

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

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

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

D. $\frac{r}{8}$

**Answer:**

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**125.** Fill in the blanks:

________ is the maximum value of displacement.

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**126.** Fill in the blanks:

In S.H.M. _____ is always directed towards the mean position.

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**127.** Fill in the blanks:

______ is necessary for S.H.M.

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**128.** Fill in the blanks:

A body can have ______ without velocity in S.H.M.

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**129.** Fill in the blanks:

SI unt of force constant______.

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**130.** Fill in the blanks:

The motion of the rotating point on a wheel is

_____ but not ______.

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**131.** Fill in the blanks:

There is ________ change in time period of a loaded spring when taken to moon.

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**132.** Fill in the blanks:

Vibration of a simple pendulum are _________.

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**133.** Write any two main characteristics of S.H.M.

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**134.** What are the two basic characteristics of an oscillating system?

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**135.** A spring has mass m suspended from it. What will happen to the frequency of oscillations if the spring is cut into two halves?

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**136.** At what point along the path of a simple pendulum is the tension maximum?

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**137.** Justify the statement, "sometimes a wine glass is broken by the powerful voice of celebrated singer."

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**138.** At a certain speed of bus, its whole body starts vibrating strongly. Explain.

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**139.** What is the time period of simple pendulum in a spaceship?

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**140.** Why the motion of a satellite around a planet cannot be taken as S.H.M?

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**141.** What will be the change in time period of a loaded spring when taken to moon?

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**142.** The bob of an oscillating pendulum is made of ice. How will the time period change when ice starts melting?

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**143.** What is the time period of second's pendulum?

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**144.** Is it true that P.E. at mean position is zero?

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**145.** Answer the following questions : What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

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**146.** A pendulum clock is in a lift that descends at a constant velocity. Does it keep correct time?

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**147.** Is there any relation between uniform circular motion and S.H.M?

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**148.** If the instantaneous velocity of a particle is zero will its instantaneous acceleration be necessarily zero?

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**149.** What is meant by free oscillations?

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**150.** Are all oscillatory motions periodic?

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**151.** Are all periodic motions oscillatory?

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**152.** Answer the following questions : What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

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**153.** What is the length of a seconds pendulum?

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**154.** Is spring constant a dimensionsless constant?

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**155.** Simple harmonic motion is possible only about the position of ____________ equilibrium.

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**156.** A SHM may be expressed in terms of a ________ function.

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**157.** Every __________ motion is periodic, but all _ motions are not necessarily SHM.

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**158.** In SHM, the velocity of the particle decreases, as it moves from ______ to ____ position.

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**159.** In SHM, acceleration of the particle increases, as it moves from ________ to _________ position.

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**160.** The force constant of a spring gives an idea about the _____ of the spring.

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**161.** Ideal simple pendulum can _____ be realized in practice.

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**162.** Can we use pendulum watch in an artificial satellite?

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**163.** When soldiers cross a suspension bridge, they are advised to break the steps. Why?

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**164.** At what distance from mean position is K.E equal to P.E?

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

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**166.** A hollow sphere is filled with water through a small hole in it. It is hung by long thread and as water slowly flows out from the hole at the bottom, one finds that the periods of oscillation first increases and then decreases. Explain. Why.

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**167.** Define seconds pendulum.

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**168.** A pendulum is taken to moon. Will it go faster or slower in comparison with the earth?

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**169.** Discuss whether a simple pendulum experiment can be done inside a satellite.

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**170.** What change in mass is required to double the frequency of a harmonic oscillator?

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**171.** Is spring constant a dimensional or non-dimensional quantity?

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**172.** Velocity and displacement of a particle executing S.H.M. are out of phase by $\frac{\pi}{2}$. Explain why?

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**173.** The displacemnt of a particle inS.H.M. may be given by $y = r\sin(\omega t + \phi_0)$. Show that if the time t is increased by $\frac{2\pi}{\omega}$ the value of y remains unchanged.

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**174.** The amplitude of a simple harmonic oscillator is doubled. How does this affect the period

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**175.** The amplitude of a simple harmonic oscillator is doubled. How does this affect the total energy.

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**176.** The amplitude of a simple harmonic oscillator is doubled. How does this affect the maximum velocity of the oscillator?

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**177.** How are periodic motions represented by functions?

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**178.** How S.H.M is represented by a function? Describe it from Fourier series.

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**179.** Define S.H.M show that S.H.M is the motion of the projection of uiform circular motion.

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**180.** Draw time-displacement curve for a body moving in S.H.M.

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**181.** calculate velocity of a particle executing S.H.M and show that it is maximum at the mean position and minimum (i.e. zero) at the extreme position.

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**182.** Derive expressions for accelerations, for acceleration in S.H.M.

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**183.** The velocity of a particle executing SHM is $V_1$ when displacement is $X_1$ and $V_2$ when displacement is $x_2$. What is the amplitude of vibration of the particle?

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**184.** Give the graphical repesentation of displcament, velocity and acceleration of particle in S.H.M.

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**185.** Obtain an expression for the frequency of a mass attached to a massless spring when it vibrates in a horizontal direction.

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**186.** Show that motion of a massless loaded spring is S.H. Motion.

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**187.** Two identical springs, one of spring factor $k_1$ and other of spring factor $k_2$ are first connected in parallel and then in , series with same rigid support. Deduce the spring constant, when a body of weight mg is connected to each of combination.

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**188.** What is a simple pendulum? Show that motion of simple pendulum is S.H.M.

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**189.** Derive expression for vertical oscillations of a floating body.

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**190.** A tunnel is dug through the centre of the earth. Show that a body of mass m when dropped from rest from one end of the tunnel will execute simple harmonic motion.

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**191.** Explain the oscillation of a liquid in a U-tube. Find its time period.

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**192.** Derive an expressionfor total energy of a body at any instant.

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**193.** Show that the total energy of a body moving with S.H.M. is conserved.

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**194.** Show that for a particle in linear SHM the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

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**195.** Explain damped and undamped oscillations.

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**196.** Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (co is any positive constant): sin $\omega t - \cos \omega t$

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**197.** Which of the following functions of time represent simple harmonic, periodic but not simple harmonic and non-periodic motion?

Give the period of periodic motion ($\omega$ is any positive constant).

$\sin \omega t + \cos 2\omega t + \sin 3\omega t$

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198. Which of the following functions of time represent simple harmonic, periodic but not simple harmonic and non-periodic motion? Give the period for each case of periodic motion ($\omega$ is any positive constant).

$e^{-\omega}t$

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**199.** Which of the following functions of time represent simple harmonic, periodic but not simple harmonic and non-periodic motion? Give the period for each case of periodic motion ($\omega$ is any positive constant).

$$2\cos\left(\omega\frac{t}{2}+\frac{\pi}{6}\right)$$

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**200.** Which of the following functions of time represent simple harmonic, periodic but not simple harmonic and non-periodic motion? Give the period for each case of periodic motion ($\omega$ is any positive constant).

$\sin^2 \omega t + \cos^2 \omega t$

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**201.** Which of the following functions of time represent simple harmonic, periodic but not simple harmonic and non-periodic motion? Give the period for each case of periodic motion ($\omega$ is any positive constant).

$\log \omega t$.

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**202.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce amplitude

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**203.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce period

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**204.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce angular frequency

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**205.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce wavelength

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**206.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce amplitude

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**207.** A displacement wave is represented by $y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$. Deduce amplitude

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**208.** A 0.5 kg mass is suspended vertically from a point fixed on the Earth by a spring having a stiffness of 5 N/mm. What is its static displacement in (mm and m)? Solve by changing the unit into 'm' as well as 'mm'.

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**209.** Two bodies of masses 1 kg and 3 kg respectively are connected rigidly by a vertical spring. The body of mass 3 kg rests on a smooth horizontal surface. The force constant of the spring is 484Nm^(-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.

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**210.** Two springs are joined and connected to a mass m . If the spring force constants are $k_1$ and $k_2$ show that the frequency of oscillation of mass m is

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**211.** The masses $m_1$ and $m_2$ together are suspended from a massless spring of constant k. When masses are in equilibrium, $m_2$ is removed without disturbing the system. Find the amplitude of oscillation and angular frequency of $m_1$

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Exercise

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

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**2.** Why S.H.M. so called?

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**3.** Why a point on a rotating wheel cannot be considered as executing SHM?

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**4.** A restoring force is a must for a body to execute S.H.M. Explain why.

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**5.** At what points energy of a simple harmonic oscillator will be entirely potential? Explain.

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**6.** Will the time period of a spring change when vibrated with the same load on the surface of moon?

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**7.** While performing experiments with pendulums, we take small angular amplitudes. Why

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**8.** A particle executes S.H.M. of period 8 secons. After what time of its passing through the mean position will the energy be half kinetic and half potential?

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**9.** Derive expressions for accelerations, for acceleration in S.H.M.

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**10.** An elastic spring has a mass suspended at its lower end, its upper end being fixed to support. The mass is puled down to a certain distance and released. Calculate the time period of its oscilaltions.

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**11.** Derive expressions for kinetic energy and potential energy of a simple harmonic oscillator. Show that the total energy is constant. In which position of the oscillator is the energy totally kinetic.

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