16. Simple Harmonic Motion – Multiple Choice Questions

1. Displacement of S.H.M. and Phase

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

(a) Only the position of the particle at time t

(b) Only the direction of motion of the particle at time t

(c) Both the position and direction of motion of the particle at time t

(d) Neither the position of the particle nor its direction of motion at time t

2. Which of the following equations does not represent a simple harmonic motion?

(a) $y = a\sin\omega t$ (b) $y = a\cos\omega t$

(c) $y = a\sin\omega t + b\cos\omega t$ (d) $y = a\tan\omega t$

3. A particle is moving in a circle with uniform speed. Its motion is

(a) Periodic and simple harmonic

(b) Periodic but not simple harmonic

(c) A periodic

(d) None of the above

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

(a) An elliptical path

(b) A circular path

(c) A parabolic path

(d) A straight line path inclined equally to x and $y-$axis

5. Out of the following functions representing motion of a particle which represents SHM

(1) $y = \sin\omega t - \cos\omega t$ (2) $y = \sin^3\omega t$

(3) $y = 5\cos\left(\frac{3\pi}{4} - 3\omega t\right)$ (4) $y = 1 + \omega t + \omega^2 t^2$

(a) Only (1) and (2)

(b) Only (1)

(c) Only (4) does not represent SHM

(d) Only (1) and (3)

6. The displacement of a particle along the x axis is given by $x = a\sin^2\omega t$. The motion of the particle corresponds to

(a) Simple harmonic motion of frequency $\omega/2\pi$

(b) Simple harmonic motion of frequency ω/π

(c) Simple harmonic motion of frequency $3\omega/2\pi$

(d) Non simple harmonic motion

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

(a) Simple harmonic with period $2\pi/\omega$

(b) Simple harmonic with period π/ω

(c) Periodic but not simple harmonic

(d) Non-periodic

8. 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) Simple harmonic with period $2\pi/\omega$

(d) Simple harmonic with period π/ω

9. The equation of motion of a particle is $x = a\cos(\alpha t)^2$. The motion is

(a) Periodic but not oscillatory

(b) Periodic and oscillatory

(c) Oscillatory but not periodic

(d) Neither periodic nor oscillatory

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

(a) The motion is oscillatory but not SHM

(b) The motion is SHM with amplitude $a + b$

(c) The motion is SHM with amplitude $a^2 + b^2$

(d) The motion is SHM with amplitude $\sqrt{a^2 + b^2}$

11. A particle is moving with constant angular velocity along the circumference of a circle. Which of the following statements is true

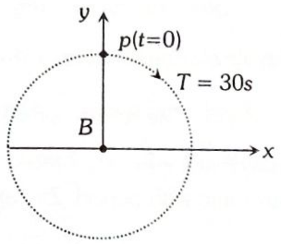
(a) The particle so moving executes S.H.M.

(b) The projection of the particle on any one of the diameters executes S.H.M.

(c) The projection of the particle on any of the diameters executes S.H.M.

(d) None of the above

12. Figure shows the circular motion of a particle. The radius of the circle, the period, sense of revolution and the initial position are indicated on the figure. The simple harmonic motion of the x-projection of the radius vector of the rotating particle P is



(a) $x(t) = B\sin\left(\frac{2\pi t}{30}\right)$ (b) $x(t) = B\cos\left(\frac{\pi t}{15}\right)$

(c) $x(t) = B\sin\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$ (d) $x(t) = B\cos\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$

13. Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05 sec and the velocity of the wave is 300 m/sec. What is the phase difference between the oscillations of two points?

(a) π (b) $\frac{\pi}{6}$

(c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$

14. Two particles executes S.H.M. of same amplitude and frequency along the same straight line. They pass one another when going in opposite directions, and each time their displacement is half of their amplitude. The phase difference between them is

(a) 30° (b) 60°

(c) 90° (d) 120°

15. A particle of mass m is under the influence of a force F which varies with the displacement x according to the relation $F = -kx + F_0$ in which k and F_0 are constants. The particle when disturbed will oscillate

(a) about $x = 0$, with $\omega \neq \sqrt{k/m}$

(b) about $x = 0$, with $\omega = \sqrt{k/m}$

(c) about $x = F_0/k$ with $\omega = \sqrt{k/m}$

(d) about $x = F_0/k$ with $\omega \neq \sqrt{k/m}$

2. Velocity of Simple Harmonic Motion

1. A simple pendulum performs simple harmonic motion about $X = 0$ with an amplitude A and time period T. The speed of the pendulum at $X = \frac{A}{2}$ will be

(a) $\frac{\pi A\sqrt{3}}{T}$ (b) $\frac{\pi A}{T}$

(c) $\frac{\pi A\sqrt{3}}{2T}$ (d) $\frac{3\pi^2 A}{T}$

2. A body is executing simple harmonic motion with an angular frequency 2 rad/s. The velocity of the body at 20 mm displacement, when the amplitude of motion is 60 mm, is

(a) 40 mm/s (b) 60 mm/s

(c) 113 mm/s (d) 120 mm/s

3. The angular velocities of three bodies in simple harmonic motion are ω_1, ω_2, ω_3 with their respective amplitudes as A_1, A_2, A_3,. If all the three bodies have same mass and velocity, then

(a) $A_1\omega_1 = A_2\omega_2 = A_3\omega_3$ (b) $A_1\omega_1^2 = A_2\omega_2^2 = A_3\omega_3^2$

(c) $A_1^2\omega_1 = A_2^2\omega_2 = A_3^2\omega_3$ (d) $A_1^2\omega_1^2 = A_2^2\omega_2^2 = A^2$

4. A particle is executing the motion $x = A\cos(\omega t - \theta)$. The maximum velocity of the particle is

(a) $A\omega\cos\theta$ (b) $A\omega$

(c) $A\omega\sin\theta$ (d) None of these

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

(a) $\frac{A}{2}$ (b) $\frac{A}{\sqrt{2}}$

(c) $\frac{A\sqrt{3}}{2}$ (d) $\frac{2A}{\sqrt{3}}$

6. A $1.00 \times 10^{-20} kg$ particle is vibrating with simple harmonic motion with a period of $1.00 \times 10^{-5} s$ and a maximum speed of $1.00 \times 10^3 m/s$. The maximum displacement of the particle is

(a) 1.59 mm (b) 1.00 m

(c) 10 m (d) None of these

7. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = a\sin(w + \pi/6)$. After the elapse of what fraction of the time period the velocity of the point will be equal to half its maximum velocity

(a) $\frac{T}{3}$ (b) $\frac{T}{12}$

(c) $\frac{T}{8}$ (d) $\frac{T}{6}$

8. A particle in SHM is described by the displacement equation $x(t) = A\cos(\omega t + \theta)$. If the initial ($t$=0) position of the particle is 1 cm and its initial velocity is π cm/s, what is its amplitude? The angular frequency of the particle is πs^{-1}

(a) 1 cm (b) $\sqrt{2}$ cm

(c) 2 cm (d) 2.5 cm

3. Acceleration of Simple Harmonic Motion

1. Which one of the following equations of motion represents simple harmonic motion?

(a) Acceleration $= -k_0x + k_1x^2$

(b) Acceleration $= -k(x + a)$

(c) Acceleration $= k(x + a)$

(d) Acceleration $= kx$

Where k, k_0, k_1 and a are all positive

2. 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

(a) $144\pi^2 m/s^2$ (b) $144 m/s^2$

(c) $\frac{144}{\pi^2} m/s^2$ (d) $288\pi^2 m/s^2$

3. Two simple harmonic motions of angular frequency 100 and 1000 $rad\,s^{-1}$ have the same displacement amplitude. The ratio of their maximum accelerations is

(a) $1:10^3$ (b) $1:10^4$

(c) 1:10 (d) $1:10^2$

4. What is the maximum acceleration of the particle doing the SHM $y = 2\sin\left[\frac{\pi t}{2} + \varphi\right]$ where 2 is in cm?

(a) $\frac{\pi}{2} cm/s^2$ (b) $\frac{\pi^2}{2} cm/s^2$

(c) $\frac{\pi}{4} cm/s^2$ (d) $\frac{\pi^2}{4} cm/s^2$

5. The relation between acceleration and displacement of four particles are given below

(a) $a_x = +2x$ (b) $a_x = +2x^2$

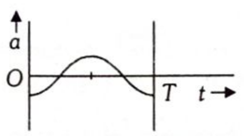
(c) $a_x = -2x^2$ (d) $a_x = -2x$

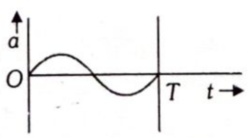
6. The oscillation of a body on a smooth horizontal surface is represented by the equation, X = Acos(ωt)

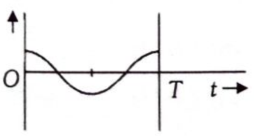
where X= displacement at time t

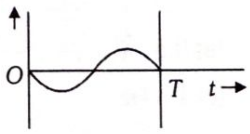
ω= frequency of oscillation

Which one of the following graphs shows correctly the variation a with t?

(a) 

(b) 

(c) 

(d) 

7. A 0.10 kg block oscillates back and forth along a horizontal surface. Its displacement from the origin is given by: $x = (10\,cm)\cos[(10\,rad/s)t + \pi/2\,rad]$. What is the maximum acceleration experienced by the block

(a) $10\ m/s^2$ (b) $10\pi\ m/s^2$

(c) $\frac{10\pi}{2} m/s^2$ (d) $\frac{10\pi}{3} m/s^2$

8. Which one of the following statements is true for the speed υ and the acceleration a of a particle executing simple harmonic motion?

(a) When υ is maximum, a is maximum

(b) Value of a is zero, whatever may be the value of υ

(c) When υ is zero, a is zero

(d) When υ is maximum, a is zero

9. The SHM of a particle is given by $X(t) = 5\cos\left(2\pi t + \frac{\pi}{4}\right)$ (in MKS units). Calculate the displacement and the magnitude of acceleration of the particle at $t = 1.5$ seconds.

(a) $-3.0m, 100m/s^2$ (b) $+2.54m, 200m/s^2$

(c) $-3.54m, 140m/s^2$ (d) $+3.55m, 120m/s^2$

4. Energy of Simple Harmonic Motion

1. When the potential energy of a particle executing simple harmonic motion is one-fourth of its maximum value during the oscillation, the displacement of the particle from the equilibrium position in terms of its amplitude a is

(a) $a/4$ (b) $a/3$

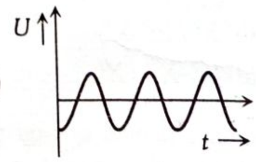
(c) $a/2$ (d) $2a/3$

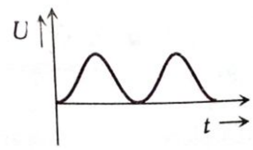
2. When a mass M is attached to the spring of force constant k, then the spring stretches by l. If the mass oscillates with amplitude l, what will be maximum potential energy stored in the spring

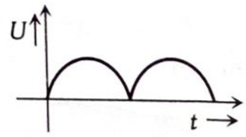
(a) $\frac{kl}{2}$ (b) $2kl$

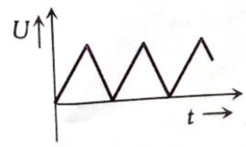
(c) $\frac{1}{2}Mgl$ (d) Mgl

3. As a body performs S.H.M., its potential energy U. varies with time as indicated in

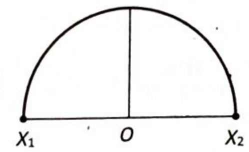
(a) 

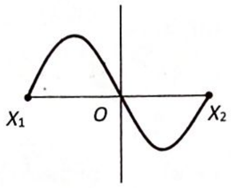
(b) 

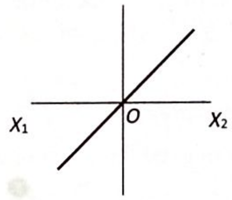
(c) 

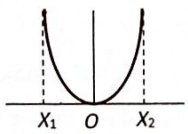
(d) 

4. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2, the equilibrium position being O. Its potential energy is plotted. It will be as given below in the graph

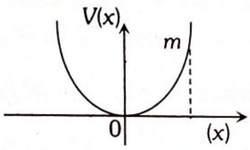
(a) 

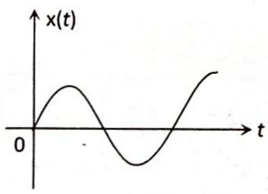
(b) 

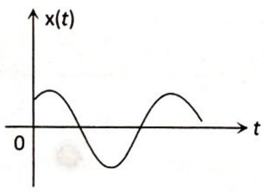
(c) 

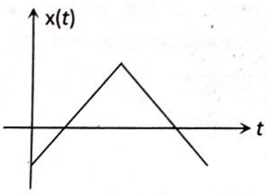
(d) 

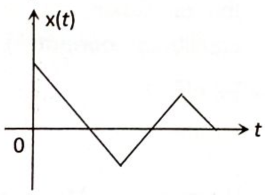
5. A particle of mass m is released from rest and follows a parabolic path as shown. Assuming that the displacement of the mass from the origin is small, which graph correctly depicts the position of the particle as a function of time



(a) 

(b) 

(c) 

(d) 

6. A particle is vibrating in a simple harmonic motion with an amplitude of 4 *cm*. At what displacement from the equilibrium position, is its energy half potential and half kinetic

(a) 1 *cm* (b) $\sqrt{2}$ *cm*

(c) 3 *cm* (d) $2\sqrt{2}$ *cm*

7. The angular velocity and the amplitude of a simple pendulum is ω and a respectively. At a displacement X from the mean position if its kinetic energy is T and potential energy is V, then the ratio of T to V is

(a) $X^2\omega^2/(a^2-X^2\omega^2)$ (b) $X^2/(a^2-X^2)$

(c) $(a^2-X^2\omega^2)/X^2\omega^2$ (d) $(a^2-X^2)/X^2$

8. Displacement between maximum potential energy position and maximum kinetic energy position for a particle executing S.H.M. is

(a) $-a$ (b) $+a$

(c) $\pm a$ (d) $\pm a/4$

9. A solid cylinder of mass 3 *kg* is rolling on a horizontal surface with velocity $4ms^{-1}$. It collides with a horizontal spring of force constant $200\,Nm^{-1}$. The maximum compression produced in the spring will be

(a) 0.5 *m* (b) 0.6 *m*

(c) 0.7 *m* (d) 0.2 *m*

10. The total energy of a particle executing S.H.M. is proportional to

(a) Displacement from equilibrium position

(b) Frequency of oscillation

(c) Velocity in equilibrium position

(d) Square of amplitude of motion

11. The total energy of the body executing S.H.M. is E. Then the kinetic energy when the displacement is half of the amplitude, is

(a) $\frac{E}{2}$ (b) $\frac{E}{4}$

(c) $\frac{3E}{4}$ (d) $\frac{\sqrt{3}}{4}E$

12. There is a body having mass m and performing S.H.M. with amplitude a. There is a restoring force $F=-Kx$, where x is the displacement. The total energy of body depends upon

(a) K, x (b) K, a

(c) K, a, x (d) K, a, v

13. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is (where E is the total energy)

(a) $\frac{1}{8}E$ (b) $\frac{1}{4}E$

(c) $\frac{1}{2}E$ (d) $\frac{2}{3}E$

5. Time Period and Frequency

1. A particle moves such that its acceleration a is given by $a=-bx$, where x is the displacement from equilibrium position and b is a constant. The period of oscillation is

(a) $2\pi\sqrt{b}$ (b) $\frac{2\pi}{\sqrt{b}}$

(c) $\frac{2\pi}{b}$ (d) $2\sqrt{\frac{\pi}{b}}$

2. The displacement x (in *metres*) of a particle performing simple harmonic motion is related to time t (in *seconds*) as $x=0.05\cos\left(4\pi t+\frac{\pi}{4}\right)$. The frequency of the motion will be

(a) 0.5 *Hz* (b) 1.0 *Hz*

(c) 1.5 *Hz* (d) 2.0 *Hz*

3. A simple harmonic oscillator has an amplitude a and time period T. The time required by it to travel from $x = a$ to $x = a/2$ is

(a) $T/6$ (b) $T/4$

(c) $T/3$ (d) $T/2$

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

(a) $T/2$ (b) $T/4$

(c) $T/8$ (d) $T/12$

5. A particle executing SHM has a maximum speed of $30 cm/s$ and a maximum acceleration of $60 cm/s^2$. The period of oscillation is

(a) π sec (b) $\frac{\pi}{2}$ sec

(c) 2π sec (d) $\frac{\pi}{t}$ sec

6. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period T. Then

(a) $T \propto \frac{1}{\rho}$ (b) $T \propto \frac{1}{\sqrt{m}}$

(c) $T \propto \sqrt{\rho}$ (d) $T \propto \frac{1}{\sqrt{A}}$

6. Simple Pendulum

1. The period of oscillation of a simple pendulum of constant length at earth surface is T. Its period inside a mine is

(a) Greater than T (b) Less than T

(c) Equal to T (d) Cannot be compared

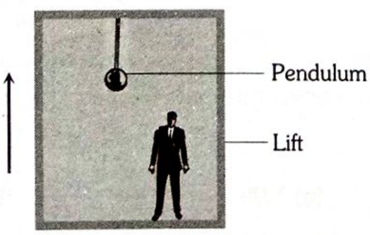
2. A man measures the period of a simple pendulum inside a stationary lift and finds it to be T s. If the lift accelerates upwards with an acceleration $g/4$, then the period of the pendulum will be

(a) T

(b) $\frac{T}{4}$

(c) $\frac{2T}{\sqrt{5}}$

(d) $2T\sqrt{5}$



3. A simple pendulum is suspended from the roof of a trolley which moves in a horizontal direction with an acceleration a, then the time period is given by $T = 2\pi\sqrt{\frac{l}{g'}}$, where g' is equal to

(a) g (b) $g-a$

(c) $g+a$ (d) $\sqrt{g^2+a^2}$

4. A simple pendulum, suspended from the ceiling of a stationary van, has time period T. If the van starts moving with a uniform velocity the period of the pendulum will be

(a) Less than T (b) Equal to $2T$

(c) Greater than T (d) Unchanged

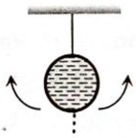
5. A simple pendulum is made of a body which is a hollow sphere containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will

(a) Remains unchanged

(b) Increase

(c) Decrease

(d) Become erratic



6. If the length of a pendulum is made 9 times and mass of the bob is made 4 times then the value of time period becomes

(a) $3T$ (b) $3/2T$

(c) $4T$ (d) $2T$

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

(a) 5 (b) 1

(c) 2 (d) 3

8. A clock which keeps correct time at $20^\circ C$, is subjected to $40^\circ C$. If coefficient of linear expansion of the pendulum is $12\times10^{-6}/^\circ C$. How much will it gain or loose in time

(a) 10.3 seconds / day (b) 20.6 seconds / day

(c) 5 seconds / day (d) 20 minutes / day

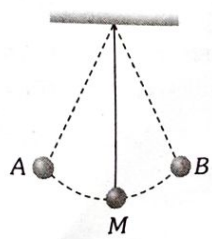
9. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 10cm (g = 9.8 m/s^2)

(a) 2.2 m/s

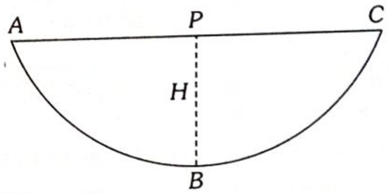
(b) 1.8 m/s

(c) 1.4 m/s

(d) 0.6 m/s



10. A simple pendulum with a bob of mass 'm' oscillates from A to C and back to A such that PB is H. If the acceleration due to gravity is 'g', then the velocity of the bob as it passes through B is



(a) mgH (b) $\sqrt{2gH}$

(c) $2gH$ (d) Zero

11. Length of a simple pendulum is l and its maximum angular displacement is θ, then its maximum K.E. is

(a) $mgl\sin\theta$ (b) $mgl(1+\sin\theta)$

(c) $mgl(1+\cos\theta)$ (d) $mgl(1-\cos\theta)$

12. A uniform rod of length $2.0\,m$ is suspended through an end and is set into oscillation with small amplitude under gravity. The time period of oscillation is approximately

(a) 1.60 s (b) 1.80 s

(c) 2.0 s (d) 2.40 s

13. A second's pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket

(a) Comes down with uniform acceleration

(b) Moves round the earth in a geostationary orbit

(c) Moves up with a uniform velocity

(d) Moves up with uniform acceleration

7. Spring Pendulum

1. If a spring extends by x on loading, then energy stored by the spring is (if T is the tension in the spring and K is the spring constant)

(a) $\frac{T^2}{2x}$ (b) $\frac{T^2}{2K}$

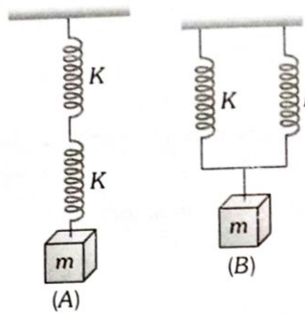
(c) $\frac{2K}{T^2}$ (d) $\frac{2T^2}{K}$

2. A spring has a certain mass suspended from it and its period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is now

(a) $\frac{T}{2}$ (b) $\frac{T}{\sqrt{2}}$

(c) $\sqrt{2}T$ (d) $2T$

3. Two identical springs of constant K are connected in series and parallel as shown in figure. A mass m is suspended from them. The ratio of their frequencies of vertical oscillations will be



(a) 2 : 1 (b) 1 : 1

(c) 1 : 2 (d) 4 : 1

4. A block of mass 500 g is connected to a spring of spring constant $k = 312.5\,N/m$ on a frictionless table. The spring is held firmly at the other end. The block is pulled a distance of 5 cm and then released to make SHM. Calculate the time period of its oscillations

(a) 2.0 s (b) 1.75 s

(c) 0.5 s (d) 0.25 s

5. A spring having a spring constant 'K' is loaded with a mass 'm'. The spring is cut into two equal parts and one of these is loaded again with the same mass. The new spring constant is

(a) $K/2$ (b) K

(c) $2K$ (d) K^2

6. A mass m is vertically suspended from a spring of negligible mass; the system oscillates with a frequency n. What will be the frequency of the system if a mass 4 m is suspended from the same spring

(a) $n/4$ (b) $4n$

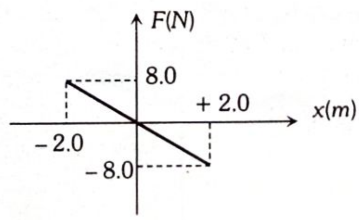
(c) $n/2$ (d) $2n$

7. If a body of mass 0.98 kg is made to oscillate on a spring of force constant 4.84 N/m, the angular frequency of the body is

(a) 1.22 rad/s (b) 2.22 rad/s

(c) 3.22 rad/s (d) 4.22 rad/s

8. A body of mass 0.01 kg executes simple harmonic motion (S.H.M.) about $x = 0$ under the influence of a force shown below: The period of the S.H.M. is



(a) 1.05 s (b) 0.52 s

(c) 0.25 s (d) 0.30 s

9. A mass m is suspended from the two coupled springs connected in series. The force constant for springs are K_1 and K_2. The time period of the suspended mass will be

(a) $T = 2\pi\sqrt{\left(\frac{m}{K_1+K_2}\right)}$ (b) $T = 2\pi\sqrt{\left(\frac{2m}{K_1+K_2}\right)}$

(c) $T = 2\pi\sqrt{\left(\frac{m(K_1+K_2)}{K_1K_2}\right)}$ (d) $T = 2\pi\sqrt{\left(\frac{mK_1K_2}{K_1+K_2}\right)}$

10. A mass m is suspended from a spring of length l and force constant K. The frequency of vibration of the mass is f_1. The spring is cut into two equal parts and the same mass is suspended from one of the parts. The new frequency of vibration of mass is f_2. Which of the following relations between the frequencies is correct?

(a) $f_1 = \sqrt{2}f_2$ (b) $f_1 = f_2$

(c) $f_1 = 2f_2$ (d) $f_2 = \sqrt{2}f_1$

11. Motion of an oscillating liquid column in a U-tube is

(a) Periodic but not simple harmonic

(b) Non-periodic

(c) Simple harmonic and time period is independent of the density of the liquid

(d) Simple harmonic and time period is directly proportional to the density of the liquid

12. A particle of mass 200 g is making SHM under the influence of a spring of force constant $k = 90\,N/m$ and a damping constant $b = 40\,g/s$. Calculate the time elapsed for the amplitude to drop to half its initial value (Given $\ell n(1/2) = -0.693$)

(a) 7 s (b) 9 s

(c) 4 s (d) 11 s

8. Superposition of S.H.M's and Resonance

1. The motion of a particle varies with time according to the relation $y = a(\sin\omega t + \cos\omega t)$, then

(a) The motion is oscillatory but not S.H.M.

(b) The motion is S.H.M. with amplitude a

(c) The motion is S.H.M. with amplitude $a\sqrt{2}$

(d) The motion is S.H.M. with amplitude $2a$

2. The resultant of two rectangular simple harmonic motions of the same frequency and unequal amplitudes but differing in phase by $\frac{\pi}{2}$ is

(a) Simple harmonic (b) Circular

(c) Elliptical (d) Parabolic

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

(a) Straight line (b) Circle

(c) Ellipse (d) Figure of eight

4. A particle is acted simultaneously by mutually perpendicular simple harmonic motion $x = a\cos\omega t$ and $y = a\sin\omega t$. The trajectory of motion of the particle will be

(a) An ellipse (b) A parabola

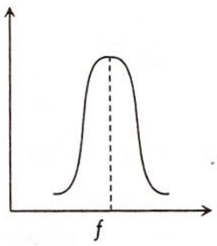
(c) A circle (d) A straight line

5. Resonance is an example of

(a) Tuning fork (b) Forced vibration

(c) Free vibration (d) Damped vibration

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



(a) Restoring force is small

(b) Applied periodic force is small

(c) Quality factor is small

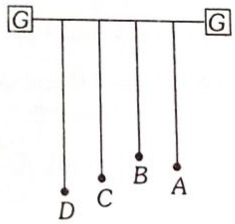
(d) Damping force is small

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

(a) $\omega_1 = \omega_0$ and $\omega_2 \neq \omega_0$ (b) $\omega_1 = \omega_0$ and $\omega_2 = \omega_0$

(c) $\omega_1 \neq \omega_0$ and $\omega_2 = \omega_0$ (d) $\omega_1 \neq \omega_0$ and $\omega_2 \neq \omega_0$

8. Four pendulums A, B, C and D are suspended from the same



elastic support as shown in figure. A and C are of the same length, while B is smaller than A and D is larger than A. If A is given a transverse displacement,

(a) D will vibrate with maximum amplitude

(b) C will vibrate with maximum amplitude

(c) B will vibrate with maximum amplitude

(d) All the four will oscillate with equal amplitude

9. IIT-JEE/AIEEE

1. A particle performs simple harmonic motion with amplitude A. Its speed is trebled at the instant that it is at distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is **[2016]**

(a) $3A$ (b) $A\sqrt{3}$

(c) $\frac{7A}{3}$ (d) $\frac{A}{3}\sqrt{41}$

2. Two simple harmonic motions are represented by the equations $y_1 = 0.1\sin\left(100\pi t + \frac{\pi}{3}\right)$ 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 **[2005]**

(a) $\frac{-\pi}{3}$ (b) $\frac{\pi}{6}$

(c) $\frac{-\pi}{6}$ (d) $\frac{\pi}{3}$

3. Two particles are executing simple harmonic motion of the same amplitude A and frequency ω along the x-axis. Their mean position is separated by distance $X_0 (X_0 > A)$. If the maximum separation between them is $(X_0 + A)$, the phase difference between their motion is **[2011]**

(a) $\pi/2$ (b) $\pi/3$

(c) $\pi/4$ (d) $\pi/6$

4. A point mass is subjected to two simultaneous sinusoidal displacements in x-direction, $x_1(t) = A\sin\omega t$ and $x_2(t) = A\sin\left(\omega t + \frac{2\pi}{3}\right)$. Adding a third sinusoidal displacement $x_3(t) = B\sin(\omega t + \phi)$ brings the mass to a complete rest. The values of B and ϕ **[2011]**

(a) $\sqrt{2}A, \frac{3\pi}{4}$ (b) $A, \frac{4\pi}{3}$

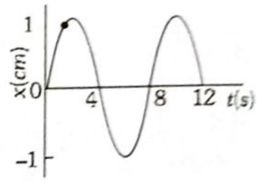
(c) $\sqrt{3}A, \frac{5\pi}{6}$ (d) $A, \frac{\pi}{3}$

5. A particle executing simple harmonic motion of amplitude 5 *cm* has maximum speed of 31.4 *cm/s*. The frequency of its oscillation is **[2006]**

(a) 3 *Hz* (b) 2 *Hz*

(c) 4 *Hz* (d) 1 *Hz*

6. The *x-t* graph of a particle undergoing simple harmonic motion is shown below. The acceleration of the particle at $t = 4/3$ s is **[2009]**



(a) $\frac{\sqrt{3}}{32}\pi^2\ cm/s^2$ (b) $\frac{-\pi^2}{32}\ cm/s^2$

(c) $\frac{\pi^2}{32}\ cm/s^2$ (d) $-\frac{\sqrt{3}}{32}\pi^2\ cm/s^2$

7. 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 **[2009]**

(a) $a^2T^2 + 4\pi^2v^2$ (b) aT/x

(c) $aT + 2\pi v$ (d) aT/v

8. A particle executes simple harmonic motion with a frequency f. The frequency with which its kinetic energy oscillates is **[1973]**

(a) $f/2$ (b) f

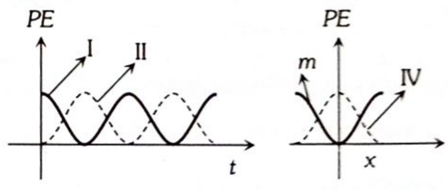
(c) $2f$ (d) $4f$

9. Starting from the origin a body oscillates simple harmonically with a period of 2s. After what time will its kinetic energy be 75% of the total energy **[2006]**

(a) $\frac{1}{4}s$ (b) $\frac{1}{3}s$

(c) $\frac{1}{12}s$ (d) $\frac{1}{6}s$

10. For a particle executing S.H.M. 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 **[2003]**



(a) I, III (b) II, IV

(c) II, III (d) I, IV

11. In a simple harmonic oscillator, at the mean position **[2002]**

(a) Kinetic energy is minimum, potential energy is maximum

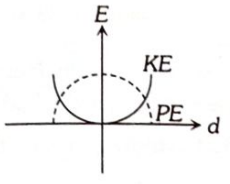
(b) Both kinetic and potential energies are maximum

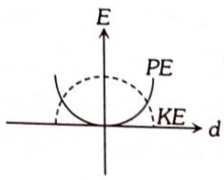
(c) Kinetic energy is maximum, potential energy is minimum

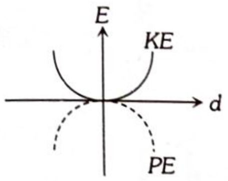
(d) Both kinetic and potential energies are minimum

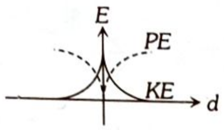
12. For a simple pendulum, a graph is plotted between its kinetic energy (KE) and potential energy (PE) against its displacement d. Which one of the following represents these correctly

(graphs are schematic and not drawn to scale) **[2015]**

(a) 

(b) 

(c) 

(d) 

13. An ideal spring with spring-constant K is hung from the ceiling and a block of mass M is attached to its lower end. The mass is released with the spring initially unstretched. Then the maximum extension in the spring is **[2002]**

(a) $4\,Mg/K$ (b) $2\,Mg/K$

(c) Mg/K (d) $Mg/2K$

14. A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as a function of displacement x. Which of the following statements is true? **[2003]**

(a) P.E. is maximum when $x = 0$

(b) K.E. is maximum when $x = 0$

(c) T.E. is zero when $x = 0$

(d) K.E. is maximum when x is maximum

15. The total energy of a particle, executing simple harmonic motion is **[2004]**

(a) $\propto x$ (b) $\propto x^2$

(c) Independent of x (d) $\propto x^{1/2}$

16. The equation of motion of a particle is $\frac{d^2y}{dt^2} + Ky = 0$, where K is positive constant. The time period of the motion is given by **[2005]**

(a) $\frac{2\pi}{K}$ (b) $2\pi K$

(c) $\frac{2\pi}{\sqrt{K}}$ (d) $2\pi\sqrt{K}$

17. The function $\sin^2(\omega t)$ represents **[2005]**

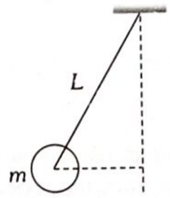
(a) A simple harmonic motion with a period $2\pi/\omega$

(b) A simple harmonic motion with a period π/ω

(c) A periodic but not simple harmonic motion with a period $2\pi/\omega$

(d) A periodic but not simple harmonic, motion with a period π/ω

18. A ball of mass (m) 0.5 kg is attached to the end of a string having length (L) 0.5 m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324 N. The maximum possible value of angular velocity of ball (in radian/s) is **[2011]**



(a) 9

(b) 18

(c) 27

(d) 36

19. A particle moves with simple harmonic motion in a straight line. In first τ s, after starting from rest it travels a distance a, and in next τ s it travels $2a$, in same direction, then **[2014]**

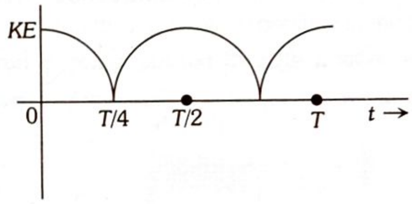
(a) Amplitude of motion is $3a$

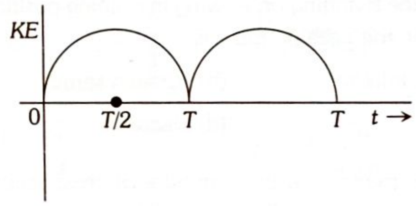
(b) Time period of oscillations is 8τ

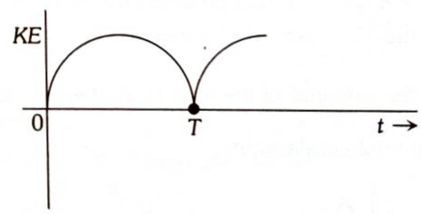
(c) Amplitude of motion is $4a$

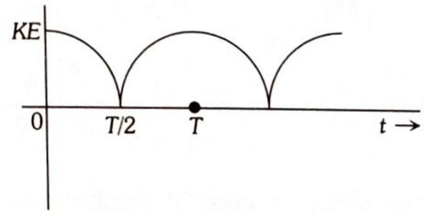
(d) Time period of oscillations is 6τ

20. A particle is executing simple harmonic motion with a time period T. At time = 0, it is at its position of equilibrium. The kinetic energy-time graph of the particle will look like **[2017]**

(a) 

(b) 

(c) 

(d) 

21. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12} /sec. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of siver = 108 and Avogadro number $= 6.02 \times 10^{23}\ g\,mole^{-1}$) **[2018]**

(a) $2.2\,N/m$ (b) $5.5\,N/m$

(c) $6.4\,N/m$ (d) $7.1\,N/m$

22. The mass and diameter of a planet are twice those of earth. The period of oscillation of pendulum on this planet will be (If it is a second's pendulum on earth) **[1973]**

(a) $\frac{1}{\sqrt{2}}$ s (b) $2\sqrt{2}$ s

(c) 2 s (d) $\frac{1}{2}$ s

23. 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 α, is given by **[2000]**

(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) $2\pi\sqrt{\frac{L}{g\tan\alpha}}$

24. A simple pendulum has time period T_1. The point of suspension is now moved upward according to equation $y = kt^2$ where $k = 1\,m/s^2$. If new time period is T_2 then ratio $\frac{T_1^2}{T_2^2}$ will be **[2005]**

(a) 2/3 (b) 5/6

(c) 6/5 (d) 3/2

25. A chimpanzee swinging on a swing in a sitting position, stands up suddenly, the time period will **[2002]**

(a) Become infinite (b) Remain same

(c) Increase (d) Decrease

26. A pendulum made of a uniform wire of cross sectional area A has time period T. When an additional mass M is added to its bob, the time period changes to T_M. If the Young's modulus of the material of the wire is Y then $\frac{1}{Y}$ is equal to (g = gravitational acceleration) **[2015]**

(a) $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{A}{Mg}$ (b) $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{Mg}{A}$

(c) $\left[1 - \left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$ (d) $\left[1 - \left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$

27. A plate oscillates with time period 'T'. Suddenly, another plate put on the first plate, then time period **[2002]**

(a) Will decrease (b) Will increase

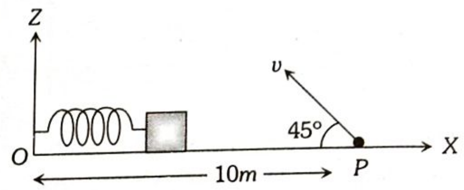
(c) Will be same (d) None of these

28. A particle executes simple harmonic motion (amplitude = A) between $x = -A$ and $x = +A$. The time taken for it to go from 0 to $A/2$ is T_1 and to go from $A/2$ to A is T_2. Then **[2001]**

(a) $T_1 < T_2$ (b) $T_1 > T_2$

(c) $T_1 = T_2$ (d) $T_1 = 2T_2$

29. A small block is connected to one end of a massless spring of un-stretched length $4.9m$. The other end of the spring (see the figure) is fixed. The system lies on a horizontal frictionless surface. The block is stretched by $0.2m$ and released from rest at $t = 0$. It then executes simple harmonic motion with angular frequency $\omega = \frac{\pi}{3} rad/s$. Simultaneously at $t = 0$, a small pebble is projected with speed v from point P at an angle of 45° as shown in the figure. Point P is at a horizontal distance of 10 m from O. If the pebble hits the block at $t = 1s$, the value of v is (take $g = 10m/s^2$) **[2012]**



(a) $\sqrt{50}m/s$ (b) $\sqrt{51}m/s$

(c) $\sqrt{52}m/s$ (d) $\sqrt{53}m/s$

30. 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 will **[2005]**

(a) Continuously decrease

(b) Continuously increase

(c) First decrease and then increase to original value

(d) First increase and then decrease to original value

31. Two bodies M and N of equal masses are suspended from two separate massless springs of force 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 M to that of N is **[1988]**

(a) k_1/k_2 (b) $\sqrt{k_1/k_2}$

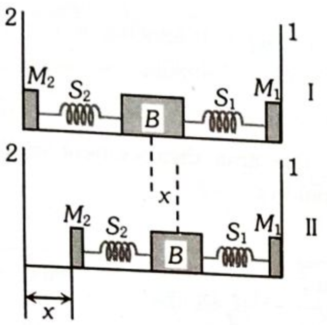
(c) k_2/k_1 (d) $\sqrt{k_2/k_1}$

32. A mass M, attached to a horizontal spring, executes SHM with a amplitude A_1. When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of $\left(\frac{A_1}{A_2}\right)$ is **[2011]**

(a) $\frac{M}{M+m}$ (b) $\frac{M+m}{M}$

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

33. A block (B) is attached to two unstretched springs S_1 and S_2 with spring constants k and 4 k, respectively (see figure I). The other ends are attached to identical supports M_1 and M_2 not attached to the walls. The springs and supports have negligible mass. There is no friction anywhere. The block B is displaced towards wall 1 by a small distance x (figure II) and released. The block returns and moves a maximum distance y towards wall 2. Displacements x and y are measured with respect to the equilibrium position of the block B. The ratio $\frac{y}{x}$ is **[2008]**



(a) 4 (b) 2

(c) $\frac{1}{2}$ (d) $\frac{1}{4}$

34. A particle of mass m is executing oscillations about the origin on the x-axis. Its potential energy is $U(x) = |x|^3$, where k is a positive constant. If the amplitude of oscillation is a, then its time period T is **[1998]**

(a) Proportional to $\frac{1}{\sqrt{a}}$ (b) Independent of a

(c) Proportional to $\sqrt{a}$ (d) Proportional to $a^{3/2}$

35. 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 S.H.M. of time period T. If the mass is increased by m, the time period becomes $5T/3$. Then the ratio of m/M is **[2003]**

(a) 5/3 (b) 3/5

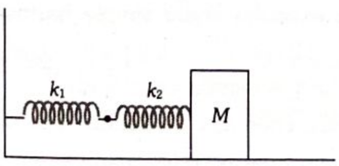
(c) 25/9 (d) 16/9

36. 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 **[1999]**

(a) $(2/3)k$ (b) $(3/2)k$

(c) $3k$ (d) $6k$

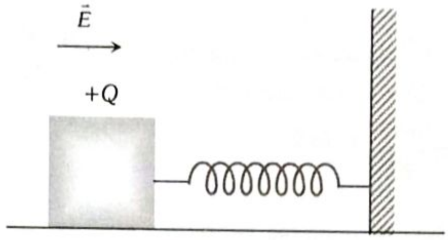
37. The mass M shown in the figure oscillates in simple harmonic motion with amplitude A. The amplitude of the point P is **[2009]**



(a) $\frac{k_1 A}{k_2}$ (b) $\frac{k_2 A}{k_1}$

(c) $\frac{k_1 A}{k_1 + k_2}$ (d) $\frac{k_2 A}{k_1 + k_2}$

38. A wooden block performs SHM on a frictionless surface with frequency, υ_0. The block carries a charge $+Q$ on its surface. If now a uniform electric field $\vec{E}$ is switched-on as shown, then SHM of the block will be **[2011]**



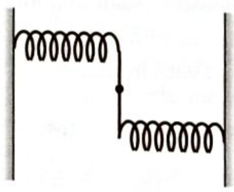
(a) Of the same frequency and with shifted mean position

(b) Of the same frequency and with the same mean position

(c) Of changed frequency and with shifted mean position

(d) Of changed frequency and with the same mean position

39. A uniform rod of length L and mass M is pivoted at the centre. Its two ends are attached to two springs of equal spring constants k. The springs are fixed to rigid supports as shown in the figure, and the rod is free to oscillate in the horizontal plane. The rod is gently pushed through a small angle θ in one direction and released. The frequency of oscillation is **[2009]**



(a) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$

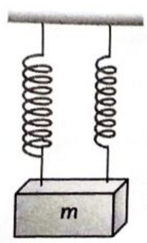
(c) $\frac{1}{2\pi}\sqrt{\frac{6k}{M}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{24k}{M}}$

40. If a spring has time period T, and is cut into n equal parts, then the time period of each part will be **[2002]**

(a) $T\sqrt{n}$ (b) $T/\sqrt{n}$

(c) nT (d) T

41. A mass m is suspended separately by two different springs of spring constant K_1 and K_2 gives the time-period t_1 and t_2 respectively. If same mass m is connected by both springs as shown in figure then time-period t is given by the relation **[2004]**



(a) $t = t_1 + t_2$

(b) $t = \frac{t_1 . t_2}{t_1 + t_2}$

(c) $t^2 = t_1^2 + t_2^2$

(d) $t^{-2} = t_1^{-2} + t_2^{-2}$

42. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to massless spring of spring constant K. A mass m hangs freely from the free end of the spring. The area of cross-section and Young's modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released, it will oscillate with a time period T equal to **[1993]**

(a) $2\pi\left(\frac{m}{K}\right)$ (b) $2\pi\left\{\frac{(YA+KL)m}{YAK}\right\}^{1/2}$

(c) $2\pi\frac{mYA}{KL}$ (d) $2\pi\frac{mL}{YA}$

43. The bob of a simple pendulum executes simple harmonic motion 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 (4/3) $\times 1000$ kg/m^3. What relationship between t and t_0 is true **[2004]**

(a) $t = t_0$ (b) $t = t_0/2$

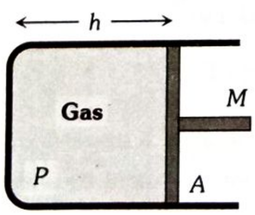
(c) $t = 2t_0$ (d) $t = 4t_0$

44. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylinder have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency **[2013]**

(a) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$ (b) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$

(c) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

45. A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the piston is disturbed from its equilibrium position, it oscillates simple harmonically. The period of oscillation will be **[1981]**



(a) $T = 2\pi\sqrt{\left(\frac{Mh}{PA}\right)}$

(b) $T = 2\pi\sqrt{\left(\frac{MA}{Ph}\right)}$

(c) $T = 2\pi\sqrt{\left(\frac{M}{PAh}\right)}$

(d) $T = 2\pi\sqrt{MPhA}$

46. The amplitude of a damped oscillator becomes half in one minute. The amplitude after 3 *minute* will be $\frac{1}{X}$ times the original, where X is **[2013]**

(a) 2×3 (b) 2^3

(c) 3^2 (d) 3×2^2

47. If a simple pendulum has significant amplitude (up to a factor of $1/e$ of original) only in the period between $t = 0s$ to $t = \tau s$, then τ may be called the average life of the pendulum. When the spherical bob of the pendulum suffers a retardation (due to viscous drag) proportional to its velocity, with 'b' as the constant of proportionality, the average life time of the pendulum is (assuming damping is small) in seconds **[2012]**

(a) $0.693/b$ (b) b

(c) $1/b$ (d) $2/b$

48. A particle of mass m is attached to a spring of spring constant k and has a natural angular frequency ω_0 -An external force F (t) proportional to $\cos\omega t((\omega \neq \omega_0)$ is applied to the oscillator. The time displacement of the oscillator will be proportional to **[2004]**

(a) $\frac{m}{\omega_0^2-\omega^2}$ (b) $\frac{1}{m(\omega_0^2-\omega^2)}$

(c) $\frac{1}{m(\omega_0^2+\omega^2)}$ (d) $\frac{m}{\omega_0^2+\omega^2}$

49. The displacement of a particle varies according to the relation $x = 4(\cos\pi t + \sin\pi t)$. The amplitude of the particle is **[2003]**

(a) 8 (b) – 4

(c) 4 (d) $4\sqrt{2}$

50. The displacement y of a particle executing periodic motion is given by $y = 4\cos^2(t/2)\sin(1000t)$. This expression may be considered to be a result of the superposition of .... independent harmonic motions **[1992]**

(a) Two (b) Three

(c) Four (d) Five

10. NEET/AIPMT

1. When two displacement represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is **[2015]**

(a) Simple harmonic with amplitude $\frac{a}{b}$

(b) Simple harmonic with amplitude $\sqrt{a^2+b^2}$

(c) Simple harmonic with amplitude $\frac{(a+b)}{2}$

(d) Not a simple harmonic

2. A particle executes linear simple harmonic motion with an amplitude of 2 cm. When the particle is at 1 cm from the mean position the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is **[2017]**

(a) $\frac{1}{2\pi\sqrt{3}}$ (b) $2\pi\sqrt{3}$

(c) $\frac{2\pi}{\sqrt{3}}$ (d) $\frac{\sqrt{3}}{2\pi}$

3. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then its time period of vibration will be **[2015]**

(a) $\frac{\alpha}{\beta}$ (b) $\frac{\beta^2}{\alpha}$

(c) $\frac{2\pi\beta}{\alpha}$ (d) $\frac{\beta^2}{\alpha^2}$

4. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are V_1 and V_2 respectively. Its time period is **[2015]**

(a) $2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$ (b) $2\pi\sqrt{\frac{V_1^2 + V_2^2}{x_1^2 + x_2^2}}$

(c) $2\pi\sqrt{\frac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$ (d) $2\pi\sqrt{\frac{x_1^2 + x_2^2}{V_1^2 - V_2^2}}$

5. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is $20 m/s^2$ at a distance of $5 m$ from the mean position. The time period of oscillation is **[2018]**

(a) $2\pi s$ (b) πs

(c) $2 s$ (d) $1 s$

6. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by 1 *kg*, the time period of oscillations becomes 5s. The value of m in *kg* is **[2016]**

(a) $\frac{9}{16}$ (b) $\frac{3}{4}$

(c) $\frac{4}{3}$ (d) $\frac{16}{9}$

7. A spring of force constant k is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is k'. Then they are connected in parallel and force constant is k''. Then $k' : k''$ is **[2017]**

(a) 1 : 6 (b) 1 : 9

(c) 1 : 11 (d) 1 : 14

11. AIIMS

1. Which of the following function represents a simple harmonic oscillation? **[2005]**

(a) $\sin\omega t - \cos\omega t$ (b) $\sin^2 \omega t$

(c) $\sin\omega t + \sin 2\omega t$ (d) $\sin\omega t - \sin 2\omega t$

2. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is **[2007]**

(a) $0.5\ \pi$ (b) π

(c) 0.707π (d) Zero

3. If a simple pendulum oscillates with an amplitude of 50 *mm* and time period of 2 *s*, then its maximum velocity is **[1998]**

(a) 0.10 *m/s* (b) 0.15 *m/s*

(c) 0.8 *m/s* (d) 0.26 *m/s*

4. A large horizontal surface moves up and down in SHM with an amplitude of 1 *cm*. If a mass of 10 *kg* (which is placed on the surface) is to remain continually in contact with it, the maximum frequency of S.H.M. will be **[1995]**

(a) 0.5 *Hz* (b) 1.5 *Hz*

(c) 5 *Hz* (d) 10 *Hz*

5. A particle executes harmonic motion with an angular velocity and maximum acceleration of 3.5 *rad/s* and 7.5 m/s^2 respectively. The amplitude of oscillation is **[1999]**

(a) 0.28 *m* (b) 0.36 *m*

(c) 0.53 *m* (d) 0.61 *m*

6. A coin is placed on a horizontal platform which undergoes vertical simple harmonic motion of angular frequency ω. The amplitude of oscillation is gradually increased. The coin will leave contact with the platform for the first time **[2008]**

(a) For an amplitude of g/ω^2

(b) For an amplitude of g^2/ω^2

(c) At the highest position of the platform

(d) At the mean position of the platform

7. What is the effect on the time period of a simple pendulum if the mass of the bob is doubled? **[1998]**

(a) Halved (b) Doubled

(c) Becomes eight times (d) No effect

8. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is **[2007]**

(a) $\frac{T}{4}$ (b) $\frac{T}{8}$

(c) $\frac{T}{12}$ (d) $\frac{T}{2}$

9. A particle is performing simple harmonic motion along *x*-axis with amplitude 4 *cm* and time period 1.2 *s*. The minimum time taken by the particle to move from $x = 2$ *cm* to $x = +4$ *cm* and back again is given by **[1995]**

(a) 0.6 *s* (b) 0.4 *s*

(c) 0.3 *s* (d) 0.2 *s*

10. A simple pendulum is executing simple harmonic motion with a time period T. If the length of the pendulum is increased by 21%, the percentage increase in the time period of the pendulum of increased length is **[2001]**

(a) 10% (b) 21%

(c) 30% (d) 50%

11. A horizontal platform with an object placed on it is executing S.H.M. in the vertical direction. The amplitude of oscillation is $3.92\times10^{-3}m$. What must be the least period of these oscillations, so that the object is not detached from the platform **[1999]**

(a) 0.1256 s (b) 0.1356 s

(c) 0.1456 s (d) 0.1556 s

12. If the period of oscillation of mass m suspended from a spring is 2 s, then the period of mass $4m$ will be **[1998]**

(a) 1 s (b) 2 s

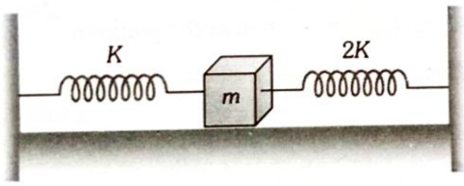
(c) 3 s (d) 4 s

13. A mass m attached to a spring oscillates every 2 s. If the mass is increased by 2 kg, then time-period increases by 1 s. The initial mass is **[2000]**

(a) 1.6 kg (b) 3.9 kg

(c) 9.6 kg (d) 12.6 kg

14. Two springs of force constants K and $2K$ are connected to a mass as shown below. The frequency of oscillation of the mass is **[2003]**



(a) $(1/2\pi)\sqrt{(K/m)}$ (b) $(1/2\pi)\sqrt{(2K/m)}$

(c) $(1/2\pi)\sqrt{(3K/m)}$ (d) $(1/2\pi)\sqrt{(m/K)}$

15. A mass of 2.0kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released the mass executes a simple harmonic motion. The spring constant is 200 N/m. What should be the minimum amplitude of the motion so that the mass gets detached from the pan (Take $g = 10m/s^2$) **[2007]**

(a) 8.0 cm

(b) 10.0 cm

(c) Any value less than 12.0 cm

(d) 4.0 cm

12. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Water in a U–tube executes SHM, the time period for mercury filled up to the same height in the U–tube be greater than that in case of water.

Reason : The amplitude of an oscillating pendulum goes on increasing.

2. Assertion : Ocean waves hitting a beach are always found to be nearly normal to the shore.

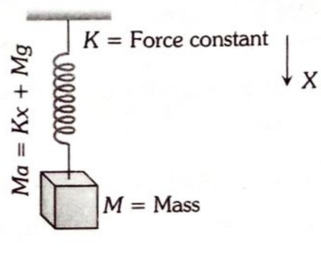
Reason : Ocean waves hitting a beach are assumed as plane waves.

3. Assertion : Resonance is special case of forced vibration in which the natural frequency of vibration of the body is the same as the impressed frequency of external periodic force and the amplitude of forced vibration is maximum.

Reason : The amplitude of forced vibrations of a body increases with an increase in the frequency of the externally impressed periodic force.

4. Assertion : Consider motion for a mass spring system under gravity, motion of M is not a simple harmonic motion unless Mg is negligibly small.

Reason : For simple harmonic motion acceleration must be proportional to displacement and is directed towards the mean position.



5. Assertion : In simple harmonic motion, the velocity is maximum when acceleration is minimum.

Reason : Displacement and velocity of S.H.M. differ in phase by.

6. Assertion : In a S.H.M., kinetic and potential energies become equal when the displacement is times the amplitude.

Reason : In SHM, kinetic energy is zero when potential energy is maximum.

7. Assertion : For an oscillating simple pendulum, the tension in the string is maximum at the mean position and minimum at the extreme position.

Reason : The velocity of oscillating bob in simple harmonic motion is maximum at the mean position.

8. Assertion : The spring constant of a spring is k. When it is divided into n equal parts, then spring constant of one piece is k/n.

Reason : The spring constant is independent of material used for the spring.

9. Assertion : The periodic time of a hard spring is less as compared to that of a soft spring.

Reason : The periodic time depends upon the spring constant, and spring constant is large for hard spring.

10. Assertion : Soldiers are asked to break steps while crossing the bridge.

Reason : The frequency of marching may be equal to the natural frequency of bridge and may lead to resonance which can break the bridge.

11. Assertion : In S.H.M., the motion is 'to and fro' and periodic.

Reason : Velocity of the particle $(v) = \omega\sqrt{k^2 - x^2}$ (where x is the displacement and k is amplitude).

12. Assertion : The amplitude of an oscillating pendulum decreases gradually with time.

Reason : The frequency of the pendulum decreases with time.

16. Simple Harmonic Motion – Answers Keys

1. Displacement of S.H.M. and Phase

1	c	2	d	3	b	4	b	5	d
6	d	7	b	8	b	9	c	10	d
11	c	12	a	13	d	14	d	15	c

2. Velocity of Simple Harmonic Motion

1	a	2	c	3	a	4	b	5	c
6	a	7	b	8	b				

3. Acceleration of Simple Harmonic Motion

1	b	2	a	3	d	4	b	5	d
6	a	7	a	8	d	9	c		

4. Energy of Simple Harmonic Motion

1	c	2	b	3	b	4	d	5	a
6	d	7	d	8	c	9	b	10	d
11	c	12	b	13	b				

5. Time Period and Frequency

1	b	2	d	3	a	4	d	5	a
6	d								

6. Simple Pendulum

1	a	2	c	3	d	4	d	5	b
6	a	7	c	8	a	9	c	10	b
11	d	12	d	13	d				

7. Spring Pendulum

1	b	2	b	3	a	4	d	5	c
6	c	7	b	8	d	9	c	10	d
11	c	12	a						

8. Superposition of S.H.M's and Resonance

1	c	2	c	3	a	4	c	5	b
6	d	7	c	8	b				

9. IIT-JEE/AIEEE

1	c	2	c	3	b	4	b	5	d
6	d	7	b	8	c	9	d	10	a
11	c	12	b	13	b	14	b	15	c
16	c	17	d	18	d	19	d	20	a
21	d	22	b	23	a	24	c	25	d
26	a	27	c	28	a	29	a	30	d
31	d	32	d	33	c	34	a	35	d
36	b	37	d	38	a	39	c	40	b
41	d	42	b	43	c	44	c	45	a
46	b	47	d	48	b	49	d	50	b

10. NEET/AIPMT

1	b	2	c	3	c	4	a	5	b
6	a	7	c						

11. AIIMS

1	a	2	a	3	b	4	c	5	d
6	a	7	d	8	c	9	b	10	a
11	a	12	d	13	a	14	c	15	b

12. Assertion and Reason

1	d	2	a	3	c	4	e	5	b
6	b	7	b	8	d	9	a	10	a
11	b	12	c						