

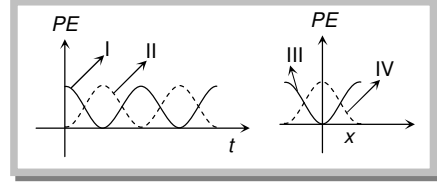
SHM Assignment

- Two particles execute S.H.M. of same amplitude and frequency along the same straight line. They pass one another when going in opposite directions, each time their displacement is half of their amplitude. The phase difference between them is
(a) 30° (b) 60° (c) 90° (d) 120°
- A particle executing S.H.M. of amplitude 4 cm and $T = 4\text{ sec}$. The time taken by it to move from positive extreme position to half the amplitude is
(a) 1 sec (b) $1/3\text{ sec}$ (c) $2/3\text{ sec}$ (d) $\sqrt{3/2}\text{ sec}$
- A particle is performing simple harmonic motion along x -axis with amplitude 4 cm and the period 1.2 sec . The minimum time taken by the particle to move from $x = 2\text{ cm}$ to $x = +4\text{ cm}$ and back again is given by
(a) 0.6 s (b) 0.4 s (c) 0.3 s (d) 0.2 s
- The S.H.M. of a particle is given by the equation $y = 3 \sin \omega t + 4 \cos \omega t$. The amplitude is
(a) 7 (b) 1 (c) 5 (d) 12
- The displacement y of a particle executing periodic motion is given by $y = 4 \cos^2(t/2) \sin(1000 t)$. This expression may be considered to be a result of the superposition of independent harmonic motions
(a) Two (b) Three (c) Four (d) Five
- A S.H.M. is represented by the equation $y = 10 \sin 20\pi t$. Its frequency is
(a) 10 Hz (b) $20\pi\text{ Hz}$ (c) 0.1 Hz (d) 20 Hz
- Equations $y_1 = A \sin \omega t$ and $y_2 = \frac{A}{2} \sin \omega t + \frac{A}{2} \cos \omega t$ represent S.H.M. The ratio of the amplitudes of the two motions is
(a) 1 (b) 2 (c) 0.5 (d) $\sqrt{2}$
- The general equation of S.H.M. is
(a) $y = a \sin(2\pi t + \alpha)$ (b) $y = a \sin\left(\frac{2\pi}{T} t + \alpha\right)$ (c) $y = a \sin(\omega T + \alpha)$ (d) $y = a \sin \omega t$
- The velocity of a particle in simple harmonic motion at displacement y from mean position is
(a) $\omega\sqrt{a^2 + y^2}$ (b) $\omega\sqrt{a^2 - y^2}$ (c) ωy (d) $\omega^2\sqrt{a^2 - y^2}$
- An object is attached to the bottom of a light vertical spring and set vibrating. The maximum speed of the object is 15 cm/sec and the period is 628 milli-seconds . The amplitude of the motion in centimeters is
(a) 3.0 (b) 2.0 (c) 1.5 (d) 1.0
- A particle in S.H.M. is described by the displacement function $x(t) = A \cos(\omega t + \theta)$. If the initial ($t = 0$) position of the particle is 1 cm and its initial velocity is $\pi\text{ cm/s}$. The angular frequency of the particle is $\pi\text{ s}^{-1}$, then its amplitude is
(a) 1 cm (b) $\sqrt{2}\text{ cm}$ (c) 2 cm (d) 2.5 cm
- If a simple pendulum oscillates with an amplitude of 50 mm and time period of 2 sec , then its maximum velocity is
(a) 0.10 m/s (b) 0.15 m/s (c) 0.8 m/s (d) 0.16 m/s
- If a particle under S.H.M. has time period 0.1 sec and amplitude $2 \times 10^{-3}\text{ m}$. It has maximum velocity
(a) $\frac{\pi}{25}\text{ m/s}$ (b) $\frac{\pi}{26}\text{ m/s}$ (c) $\frac{\pi}{30}\text{ m/s}$ (d) None of these
- A particle executes simple harmonic motion with an amplitude of 4 cm . At the mean position the velocity of the particle is 10 cm/s . The distance of the particle from the mean position when its speed becomes 5 cm/s is
(a) $\sqrt{3}\text{ cm}$ (b) $\sqrt{5}\text{ cm}$ (c) $2(\sqrt{3})\text{ cm}$ (d) $2(\sqrt{5})\text{ cm}$
- 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) $\frac{2}{3}E$

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16. 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

- (a) I, III
 (b) II, IV
 (c) II, III
 (d) I, IV



17. 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

18. When the displacement is half of the amplitude, then what fraction of total energy of a simple harmonic oscillator is kinetic

- (a) $3/4^{\text{th}}$ (b) $2/7^{\text{th}}$ (c) $5/7^{\text{th}}$ (d) $2/9^{\text{th}}$

19. When the displacement is half the amplitude, the ratio of potential energy to the total energy is

- (a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) 1 (d) $\frac{1}{8}$

20. The potential energy of a particle executing S.H.M. is 2.5 J, when its displacement is half of amplitude. The total energy of the particle be

- (a) 18 J (b) 10 J (c) 12 J (d) 2.5 J

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

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

22. Two springs with spring constants $K_1 = 1500 \text{ N/m}$ and $K_2 = 3000 \text{ N/m}$ are stretched by the same force. The ratio of potential energy stored in spring will be

- (a) 2 : 1 (b) 1 : 2 (c) 4 : 1 (d) 1 : 4

23. A body is executing Simple Harmonic Motion. At a displacement x its potential energy is E_1 and at a displacement y its potential energy is E_2 . The potential energy E at displacement $(x + y)$ is

- (a) $\sqrt{E} = \sqrt{E_1} - \sqrt{E_2}$ (b) $\sqrt{E} = \sqrt{E_1} + \sqrt{E_2}$ (c) $E = E_1 + E_2$ (d) $E = E_1 - E_2$

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

- (a) 10 rad s^{-1} (b) 0.1 rad s^{-1} (c) 100 rad s^{-1} (d) 1 rad s^{-1}

25. Two equal negative charges $-q$ are fixed at points $(0, a)$ and $(0, -a)$ on the Y-axis. A positive charge Q is released from rest at point $(2a, 0)$ on the X-axis. The charge Q will

- (a) Execute simple harmonic motion about origin
 (b) Move to the origin and remained at rest
 (c) Move to infinity
 (d) Execute oscillation but not simple harmonic motion

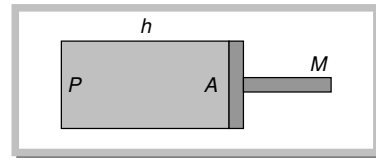
26. A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the piston is disturbed from its equilibrium position, it oscillates simple harmonically. The period of oscillation will be

(a) $T = 2\pi \sqrt{\left(\frac{M h}{P A}\right)}$

(b) $T = 2\pi \sqrt{\left(\frac{M A}{P h}\right)}$

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

(d) $T = 2\pi \sqrt{M P h A}$



27. A sphere of radius r is kept on a concave mirror of radius of curvature R . The arrangement is kept on a horizontal table (the surface of concave mirror is frictionless and sliding not rolling). If the sphere is displaced from its equilibrium position and left, then it executes S.H.M. The period of oscillation will be

(a) $2\pi \sqrt{\left(\frac{(R-r)1.4}{g}\right)}$

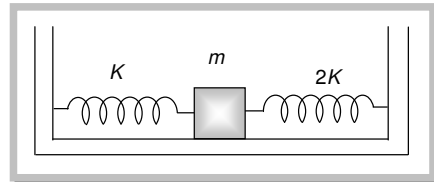
(b) $2\pi \sqrt{\left(\frac{R-r}{g}\right)}$

(c) $2\pi \sqrt{\left(\frac{r R}{g}\right)}$

(d) $2\pi \sqrt{\left(\frac{R}{g r}\right)}$

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28. A tunnel has been dug through the centre of the earth and a ball is released in it. It will reach the other end of the tunnel after
 (a) 84.6 minutes (b) 42.3 minutes (c) 1 day (d) Will not reach the other end
29. A 'U' tube of uniform bore of cross-sectional area 'a' has been set up vertically with open ends facing up. Now m gm of a liquid of density d is poured into it. The column of liquid in this tube will oscillate with a period T such that
 (a) $T = 2\pi\sqrt{\frac{m}{g}}$ (b) $T = 2\pi\sqrt{\frac{ma}{gd}}$ (c) $T = 2\pi\sqrt{\frac{m}{gda}}$ (d) $T = 2\pi\sqrt{\frac{m}{2adg}}$
30. A block of wood has dimensions a , b and c . Its relative density is d . It is floating in water such that the side a is vertical. It is now pushed down gently and released. The time period of its S.H.M. is
 (a) $T = 2\pi\sqrt{\frac{abc}{g}}$ (b) $T = 2\pi\sqrt{\frac{bc}{dg}}$ (c) $T = 2\pi\sqrt{\frac{g}{da}}$ (d) $T = 2\pi\sqrt{\frac{da}{g}}$
31. 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
 (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) $2\pi\sqrt{\frac{L}{g \tan \alpha}}$
32. If the length of simple pendulum is increased by 300%, then the time period will be increased by
 (a) 100% (b) 200% (c) 300% (d) 400%
33. If the length of second's pendulum is decreased by 2%, how many seconds it will lose per day
 (a) 3927 sec (b) 3727 sec (c) 3427 sec (d) 864 sec
34. A simple pendulum consisting of a ball of mass m is tied to a spring of length l is made to swing on a circular arc of angle θ in a vertical plane. At the end of this arc, another ball of mass m is placed at rest. The momentum transferred to this ball at rest by the swinging ball is
 (a) Zero (b) $m\theta\sqrt{\frac{g}{l}}$ (c) $\frac{m\theta}{l}\sqrt{\frac{l}{g}}$ (d) $\frac{m}{l}2\pi\sqrt{\frac{l}{g}}$
35. A simple pendulum is suspended from the roof of a train. The train is moving with acceleration 49 cm/sec^2 . By what angle to the vertical, its string will be inclined
 (a) 20° (b) 30° (c) Zero (d) 3° (approx.)
36. Infinite springs with force constants k , $2k$, $4k$ and $8k$... respectively are connected in series. The effective force constant of the spring will be
 (a) $2k$ (b) k (c) $k/2$ (d) 2048
37. A spring has length l and spring constant k . If spring is divided in two equal parts then spring constant is
 (a) k (b) $k/2$ (c) $2k$ (d) $4k$
38. A particle at the end of a spring executes simple harmonic motion with a period t_1 , while the corresponding period for another spring is t_2 . If the period of oscillation with the two springs in series is T , then
 (a) $T = t_1 + t_2$ (b) $T^2 = t_1^2 + t_2^2$ (c) $T^{-1} = t_1^{-1} + t_2^{-1}$ (d) $T^{-2} = t_1^{-2} + t_2^{-2}$
39. 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
 (a) $\frac{5}{3}$ (b) $\frac{3}{5}$ (c) $\frac{25}{9}$ (d) $\frac{16}{9}$
40. Two springs of force constants K and $2K$ are connected to a mass as shown below. The frequency of oscillation of the mass is
 (a) $(1/2\pi)\sqrt{(K/m)}$
 (b) $(1/2\pi)\sqrt{(2K/m)}$
 (c) $(1/2\pi)\sqrt{(3K/m)}$
 (d) $(1/2\pi)\sqrt{(m/K)}$



41. One-fourth length of a spring of force constant K is cut away. The force constant of the remaining spring will be
 (a) $\frac{3}{4}K$ (b) $\frac{4}{3}K$ (c) K (d) $4K$

42. The amplitude of a damped oscillator becomes half on one minute. The amplitude after 3 minute will be $\frac{1}{X}$ times the original, where X is

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- (a) 2×3 (b) 2^3 (c) 3^2 (d) 3×2^2
43. The maximum speed of a particle executing S.H.M. is 1 m/s and its maximum acceleration is 1.57 m/sec^2 . The time period of the particle will be
- (a) $\frac{1}{1.57} \text{ sec}$ (b) 1.57 sec (c) 2 sec (d) 4 sec
44. 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) $144 \pi^2 \text{ m / sec}^2$ (b) 144 m / sec^2 (c) $\frac{144}{\pi^2} \text{ m / sec}^2$ (d) $288 \pi^2 \text{ m / sec}^2$
45. A 0.10 kg block oscillates back and forth along a horizontal surface. Its displacement from the origin is given by: $x = (10 \text{ cm})\cos[(10 \text{ rad/s})t + \pi/2 \text{ rad}]$. What is the maximum acceleration experienced by the block
- (a) 10 m/s^2 (b) $10 \pi \text{ m/s}^2$ (c) $\frac{10\pi}{2} \text{ m/s}^2$ (d) $\frac{10\pi}{3} \text{ m/s}^2$
46. A particle of mass 10 grams is executing simple harmonic motion with amplitude of 0.5 m and periodic time of $(\pi/5) \text{ seconds}$. The maximum value of the force acting on the particle is
- (a) 25 N (b) 5 N (c) 2.5 N (d) 0.5 N
47. The acceleration of a particle performing S.H.M. is 12 cm/sec^2 at a distance of 3 cm from the mean position. Its time period is
- (a) 0.5 sec (b) 1.0 sec (c) 2.0 sec (d) 3.14 sec
48. A large horizontal surface moves up and down in S.H.M. 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
- (a) 0.5 Hz (b) 1.5 Hz (c) 5 Hz (d) 10 Hz
49. 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
- (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) $2\pi\frac{mL}{YA}$
50. The amplitude of vibration of a particle is given by $a_m = (a_0)/(a\omega^2 - b\omega + c)$; where a_0 , a , b and c are positive. The condition for a single resonant frequency is
- (a) $b^2 < 4ac$ (b) $b^2 > 4ac$ (c) $b^2 = 5ac$ (d) $b^2 = 7ac$