PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

OSCILLATIONS

Jee Main 5 Years At A Glance

1. Two simple harmonic motions as shown below are at right angles .They are comibined to form Lissajous figures

$x(t) = A\sin(at + \delta)$

$y(t) = B\sin(bt)$

Identify the correct match below

A. Parameters: A = B, a = 2b, $\delta = \frac{\pi}{2}$, Curve : Circle

B. Parameters: A = B, a = b, $\delta = \frac{\pi}{2}$, Curve: Line

C. Parameters: $A \neq B, a = b, \delta = \frac{\pi}{2}$, Curve: Ellipse

D. Parameters: $A \neq B, a = b, \delta = 0$, Curve: Parabola

Answer: C

Watch Video Solution

2. A particle executes simple harmonic motion and is located at $x = a$, b at times $t_0, 2t_0$ and $3t_0$ respectively. The frequency of the oscillation is :

A. $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+b}{2c}\right)$

B. $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+b}{3c}\right)$

C. $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{2a+3c}{b}\right)$

D. $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+c}{2b}\right)$

Answer: D

Watch Video Solution

3. An oscillator of mass M is at rest in its equilibrium position in a potential $V = \frac{1}{2}k(x - X)^2$. A particle of mass m comes from right with speed u and collides completely inelastically with M and sticks to it. The process repeats every time the oscillator crosses its equilibrium position. The amplitude of oscilllations after 13 collisions is : (M=10, m=5, u=1 ,k=1)

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

B. $\frac{1}{\sqrt{3}}$

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

D. $\sqrt{\frac{3}{5}}$

Answer: B

Watch Video Solution

4. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of $10^{12}/\text{sec}$. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver = 108 and Avagadro number `=6.02xx10^(23)" gm "mole^(-1))

A. 6.4 N/m

B. 7.1 N/m

C. 2.2 N/m

D. 5.5 N/m

Answer: B

Watch Video Solution

5. The ratio of maximum acceleration to maximum velocity in a simple harmonic motion is $10s^{-1}$ At, t = 0 the displacement is 5 m. What is the maximum acceleration ? The initial phase is $\frac{\pi}{4}$

A. $500 \text{ m}/\text{s}(2)$

B. $500\sqrt{2} \text{ m}/\text{s}^2$

C. $750 \text{ m}/\text{s}^2$

D. $750\sqrt{2} \text{ m}/\text{s}^2$

Answer: B

Watch Video Solution

Watch Video Solution

6. A block of mass 0.1 kg is connected to an elastic spring of spring constant $640 \ \mathrm{Nm}^{-1}$ and oscillates in a medium of constant $10^{-2} \ \mathrm{kg\,s}^{-1}$. The system dissipates its energy gradually. The time taken for its mechanical energy of vibration to drop to half of its initial value, is closest to :

A. 2 s

B. 3.5 s

C. 5 s

D. 7 s

Answer: B

View Text Solution

7. In an experiment to determine the period of a simple pendulum of length 1 m, it is attached to different spherical bobs of radii r_1 and r_2. The two spherical bobs have uniform mass distribution. If the relative difference in the periods, is found to be 5×10^{-4} s, the difference in radii, $|r_1 - r_2|$ is best given by :

A. 1 cm

B. 0.1 cm

C. 0.5 cm

D. 0.01 cm

Answer: B

Watch Video Solution

8. A 1 kg block attached to a spring vibrates with a frequency of 1 Hz on a frictionless horizontal table. Two springs identical to the original spring are attached in parallel to an 8 kg block placed on the same table. So, the frequency of vibration of the 8 kg block is

A. $\frac{1}{4}Hz$

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

C. $\frac{1}{2}Hz$

D. $2Hz$

Answer: C

Watch Video Solution

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

A.

B.

C.

D.

Answer: B

Watch Video Solution

10. Two particles are in SHM in a straight line about same equilibrium position. Amplitude A and time period T of both the particles are equal. At time $t = 0$, one particle is at displacement $y_1 = + A$ and the other at $y_2 = - A/2$, and they are approaching towards each other. after what time they cross each other?

A. $\frac{5T}{6}$

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

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

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

Answer: D

Watch Video Solution

11. In an engine the piston undergoes vertical simple motion with amplitude$7cm$. A washer rests on top of the piston and moves with it. The motor speed is slowly increased. The frequency of the piston at which the washer no longer stays in contact with the piston, is close to :-

A. 0.7 Hz

B. 1.9 Hz

C. 1.2 Hz

D. 0.1 Hz

Answer: B

Watch Video Solution

12. A particle performs simple harmonic mition with amplitude A. Its speed is trebled at the instant that it is at a destance

$\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is:

A. $A\sqrt{3}$

B. $\frac{7A}{3}$

C. $\frac{A}{3}\sqrt{41}$

D. $3A$

Answer: B

Watch Video Solution

13. A simple harmonic oscillator of angular frequency $2 \text{rad} s^{-1}$ is acted upon by an external force $F = \sin t N$. If the oscillator is at rest in its equilibrium position at $t = 0$, its position at later times is proportional to :-

A. $\sin t + \frac{1}{2}\cos 2t$

B. $\cos t - \frac{1}{2}\sin 2t$

C. $\sin t - \frac{1}{2}\sin 2t$

D. $\sin t + \frac{1}{2}\sin 2t$

Answer: C

Watch Video Solution

14. A pendulum with time period of $1s$ is losing energy due to damping. At time its energy is $45J$. If after completing 15 oscillations, its energy has become $15J$. Its damping constant (in s^{-1}) is :-

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

B. $\frac{1}{30}\ln 3$

C. 2

D. $\frac{1}{15}\ln 3$

Answer: D

Watch Video Solution

15. A pendulumd made of a uniform wire of cross sectional area (A) has time T.When an additionl mass (M) is added to its bob, the time period changes to $T_M. IftheYoung's$ mod $\underline{u}softhematerialofthewireis(Y)then$ 1/Y` is equal to:

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

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

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

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

Answer: C

Watch Video Solution

16. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants ?

A. $a + bx - cx^2$

B. bx^2

C. $a - bx + cx^2$

D. $-bx$

Answer: D

Watch Video Solution

17. The angular frequency of the damped oscillator is given by $\omega = \sqrt{\frac{k}{m} - \frac{r^2}{4m^2}}$,where k is the spring constant, m is the mass of the oscillator and r is the damping constant. If the ratio $r^2 / (mk)$ is 8% ,the change in the time period compared to the undamped oscillator

A. increases by 1%

B. increases by 8%

C. decreases by 1%

D. decreases by 8%

Answer: B

Watch Video Solution

18. A particle moves with simple harmonic motion in a straight line. In first τs, after starting form rest it travels a destance a, and in next τs it travels 2a, in same direction, then:

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

Answer: D

Watch Video Solution

Exercise 1 Concept Builder Topic 1 Displacement Phase Velocity Acceleration And Energy In S H M

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

A. a circle

B. the figure of eight

C. a straight line

D. an ellipse

Answer: C

Watch Video Solution

2. when two displacements represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is

A. simple harmonic with amplitude $\frac{a}{b}$

B. simple harmonic with amplitude $\sqrt{a^2 + b^2}$

C. simple harmonic with amplitude $\frac{(a+b)}{2}$

D. not a simple harmonic

Answer: B

Watch Video Solution

3. Two simple harmonic motions with the same frequency act on a particle at right angles i.e., along X-axis and Y-axis. If the two amplitudes are equal and the phase difference is $\pi / 2$, the resultant motion will be

A. a circle

B. an ellipse with the major axis along y-axis

C. an ellipse with the major axis along x-axis

D. a straight line inclined at 45° to the x-axis

Answer: A

Watch Video Solution

4. A particle is subjected to two mutually perpendicular simple harmonic motions such that its X and y coordinates are given by $X = 2\sin\omega t$, $y = 2\sin\left(\omega + \frac{\pi}{4}\right)$

The path of the particle will be:

A. a straight line

B. a circle

C. an ellipse

D. a parabola

Answer: C

Watch Video Solution

5. A point mass oscillates along the $x-$ acis according to the law $x = x_0 \cos(\omega t - \pi/4)$ if the acceleration of the particle is written as, a $= A \cos(\omega + \delta)$, then :

A. $A = x_0\omega^2, \delta = 3\pi/4$

B. $A = x_0, \delta = -\pi/4$

C. $A = x_0\omega^2, \delta = \pi/4$

D. $A = x_0\omega^2, \delta = -\pi/4$

Answer: A

Watch Video Solution

6. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period T, then, which of the following does not change with time ?

A. aT/x

B. $aT + 2\pi v$

C. aT/v

D. $a^2T^2 + 4\pi^2v^2$

Answer: A

Watch Video Solution

7. A body executing linear simple harmonic motion has a velocity of 3 cm/s when its displacement is 4 cm and a velocity of 4 cm/s when its displacement is 3 cm. Then amplitude of oscillation with be

A. 5 cm

B. 7.5 cm

C. 10 cm

D. 12.5 cm

Answer: A

Watch Video Solution

Watch Video Solution

8. The amplitude of a executing SHM is $4cm$ At the mean position the speed of the particle is $16cm/s$ The distance of the particle from the mean position at which the speed the particle becomes $8\sqrt{3}cm/s$ will be

A. $2\sqrt{3}$ cm

B. $\sqrt{3}$ cm

C. 1 cm

D. 2 cm

Answer: D

Watch Video Solution

9. A particle of mass 1 kg is moving in SHM with an amplitude 0.02 m and a frequency of 60 Hz. The maximum force (in N) acting on the particle is

A. $144\pi^2$

B. $188\pi^2$

C. $288\pi^2$

D. None of these

Answer: C

Watch Video Solution

10. If $< E >$ and $< U >$ denote the average kinetic and the average potential energies respectively of mass describing a simple harmonic motion, over one period, then the correct relation is

A. $< E > \; = \; < U >$

B. $< E > \; = 2 < U >$

C. $< E > \; = \; - 2 < U >$

D. $< E > \; = \; - \; < U >$

Answer: A

View Text Solution

11. Suppose a tunnel is dug along a diameter of the earth. A particle is dropped from a point a distance h directly above the tunnel. The motion of the particle as seen from the earth is

A. simple harmonic with amplitude $\frac{a}{b}$

B. parabolic

C. oscillatory

D. none of these

Answer: C

Watch Video Solution

12. A particle starts with S.H.M. from the mean position as shown in figure below. Its amplitude is A and its time period is T. At one time, its speed is half that of the maximum speed. What is this displacement at that time ?

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

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

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

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

Answer: B

View Text Solution

13. The particle executing simple harmonic motion has a kinetic energy $K_0 \cos^2 \omega t$. The maximum values of the potential energy and the energy are respectively

A. $K_0 / 2$ and K_0

B. K_0 and $2K_0$

C. K_0 and K_0

D. 0 and $2K_0$

Answer: C

Watch Video Solution

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

A. $A/4$

B. $A/2$

C. $3A/4$

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

Answer: B

Watch Video Solution

15. In S.H.M. the ratio of kinetic energy at mean position to the potential energy when the displacement is half of the amplitude is

A. $\frac{4}{1}$

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

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

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

Answer: A

View Text Solution

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

A. $\frac{1}{6}s$

B. $\frac{1}{4}s$

C. $\frac{1}{3}s$

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

Answer: A

Watch Video Solution

17. 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. $E=E_1-E_2$

Answer: B

Watch Video Solution

18. A particle of mass 10 gm is describing S.H.M. along a straight line with period of 2 sec and amplitude of 10 cm . Its kinetic energy when it is at 5 cm from its equilibrium position is

A. $37.5\pi^2$ erg

B. $3.75\pi^2$ erg

C. $375\pi^2$ erg

D. $0.375\pi^2$ erg

Answer: C

Watch Video Solution

19. A particle executes SHM with time period 8 s. Initially, it is at its mean position. The ratio of distance travelled by it in the 1st second to that in the 2nd second is

A. $\sqrt{2}:1$

B. $1:(\sqrt{2}-1)$

C. $(\sqrt{2}+1):\sqrt{2}$

D. $(\sqrt{2}-1):1$

Answer: D

Watch Video Solution

20. A body is in simple harmonic motion with time period T - 0.5 s and amplitude A - 1 cm. Find the average velocity in the interval in which it moves from equilibrium position to half of its amplitude.

A. $4\quad cm/s$

B. $6\quad cm/s$

C. $12\quad cm/s$

D. $16\quad cm/s$

Answer: C

Watch Video Solution

21. A boby is moving in a room with a velocity of $20m/s$ perpendicular to the two walls separated by 5 meters .There is no friction and the collisionnn with the walls are elastic.

A. not periodic

B. periodic but not simple harmonic

C. periodic and simple harmonic

D. periodic with variable time period

Answer: B

Watch Video Solution

22. Two particles P and Q describe $S.H.M.$ of same amplitude a, same frequency f along the same straight line from the same mean position. The maximum distance between the two particles is a $\sqrt{2}$, If the initial phase difference between the particles is $\frac{\pi}{N}$ then find N :

A. zero

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

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

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

Answer: B

Watch Video Solution

23. 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

A. at the mean position of the platform

B. for an amplitude of $\frac{g}{\omega^2}$

C. for an amplitude of $\frac{g^2}{\omega^2}$

D. at the highest position of the platform

Answer: B

Watch Video Solution

24. A body of mass 5 gm is executing S.H.M. about a point with amplitude 10 cm . Its maximum velocity is 100 cm / sec . Its velocity will be 50 cm / sec at a distance

A. 5

B. $5\sqrt{2}$

C. $5\sqrt{3}$

D. $10\sqrt{2}$

Answer: C

Watch Video Solution

25. If y = 2 (cm) $\sin\left[\frac{\pi t}{2} + \phi\right]$ then the maximum acceleration of the particle doing the S.H.M. is

A. $\frac{\pi}{2} \quad \mathrm{cm} / \mathrm{s}^2$

B. $\frac{\pi^2}{2} \quad \mathrm{cm} / \mathrm{s}^2$

C. $\frac{\pi^2}{4} \quad \mathrm{cm} / \mathrm{s}^2$

D. $\frac{\pi}{4} \quad \mathrm{cm} / \mathrm{s}^2$

Answer: B

View Text Solution

26. A body is executing simple harmonic motion. At a displacement x from mean position, its potential energy is $E_1 = 2J$ and at a displacement y from mean position, its potential energy is $E_2 = 8J$. The potential energy E at a displacement $(x + y)$ from mean position is

A. 10J

B. 14J

C. 18J

D. 4J

Answer: C

Watch Video Solution

27. The amgular 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 U, then the ratio of T to U is

A. $\frac{(a^2 - x(2)\omega^2)}{x^2\omega^2}$

B. $\frac{x^2\omega^2}{(a^2 - x^2\omega^2)}$

C. $\dfrac{(a^2 - x^2)}{x^2}$

D. $\dfrac{x^2}{(a^2 - x^2)}$

Answer: C

Watch Video Solution

Exercise 1 Concept Builder Topic 2 Time Period Frequency Simple Pendulum And Spring Pendulum

1. If a particle takes 0.5 sec to reach position of minimum velocity from previous such position, then

A. T = 6 sec, v = 1/6 Hz

B. T =2 sec, v = 1 Hz

C. T = 3 sec, v = 3 Hz

D. T = 1 sec, v = 1 Hz

Answer: D

View Text Solution

2. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. The time taken for it to go from $0 \rightarrow A/2 is T_1$ and $\rightarrow goom A/2 \rightarrow (A) is (T_2)$. Then.

A. $T_1 < T_2$

B. $T_1 > T_2$

C. $T_1 = T_2$

D. $T_1 = 2T_2$

Answer: A

Watch Video Solution

3. A simple pendulum oscillates in air with time period T and amplitude A . As the time passes

A. T and A both decrease

B. T increases and A is constant

C. T remains same and A decreases

D. T decreases and A is constant

Answer: C

Watch Video Solution

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

A. remain unchanged

B. increase

C. decrease

D. become erratic

Answer: B

View Text Solution

5. If the magnitude of displacement is numerically equal to that of acceleration, then the time period is

A. 1 second

B. π second

C. 2π second

D. 4π second

Answer: C

Watch Video Solution

6. A simple pendulum has a metal bob, which is negatively charged. If it is allowed to oscillate above a positively charged metallic plate, then its time period will

A. increase

B. decrease

C. become zero

D. remain the same

Answer: B

View Text Solution

7. Identify the wrong statement from the following

A. If the length of a spring is halved, the time period of each part becomes $\frac{1}{\sqrt{2}}$ times the original

B. The effective spring constant K of springs in parallel is given by $\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2} + \dots$

C. The time period of a stiffer spring is less than that of a soft spring

D. The spring constant is inversely proportional to the spring length

Answer: B

Watch Video Solution

8. A verticle mass-spring system executed simple harmonic ascillation with a period $2s$ quantity of this system which exhibits simple harmonic motion with a period of $1 \sec$ are

A. velocity

B. potential energy

C. phase difference between acceleration and displacement

D. difference between kinetic energy and potential energy

Answer: B

Watch Video Solution

9. The maximum velocity a particle, executing simple harmonic motion with an amplitude 7 mm, 4.4 m//s. The period of oscillation is.

A. 0.01 s

B. 10 s

C. 0.1 s

D. 100 s

Answer: A

Watch Video Solution

10. The graph shown in figure represents

A. motion of a simple pendulum starting from mean position

B. motion of a simple pendulum starting from extreme position

C. simple pendulum describing a horizontal circle

D. None of these

Answer: A

View Text Solution

11. A body at the end of a spring executes SHM with a period t_1, while the corresponding period for another spring is t_2, If the period of oscillation with the two spring in series is T, then

A. $T^{-1} = t_1^{-1} + t_2^{-1}$

B. $T^2 = t_1^2 + t_2^2$

C. $T = t_1 + t_2$

D. $T^{-2} = t_1^{-2} + t_2^{-2}$

Answer: B

Watch Video Solution

12. Two particles A and B of equal masses are suspended from two massless springs of spring constants k_1 and k_2, respectively, If the maximum velocities, during oscillation, are equal, the ratio of amplitude of A and B is

A. $\sqrt{\frac{k_1}{k_2}}$

B. $\frac{k_2}{k_1}$

C. $\sqrt{\frac{k_2}{k_1}}$

D. $\frac{k_1}{k_2}$

Answer: C

View Text Solution

13. The graph of time period (T) of simple pendulum versus its length (l) is

A.

B.

C.

D.

Answer: A

View Text Solution

14. A particle moves such that its acceleration a is given by a = -bx , where x is the displacement from equilibrium positionand is a constant. The period of oscillation is

A. $2\pi / b$

B. $2\pi / \sqrt{b}$

C. $\sqrt{2\pi / b}$

D. $2\sqrt{\pi / b}$

Answer: B

Watch Video Solution

15. The total mechanicla energy of a spring mass sytem in simple harmonic motion is $E = \frac{1}{2} m\omega^2 A^2$. Suppose the oscillating particle is replaced by another particle of double the mass while the amplitude A remains the same. The new mechanical energy will

A. become 2E

B. become E/2

C. become $\sqrt{2}E$

D. remain E

Answer: D

Watch Video Solution

16. A block of mass m is kept on smooth horizontal surface and connected with two springs as shown in figure. Initially springs are in their natural length. Time period of small horizontal oscillation of the block is :

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

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

C. $\pi\sqrt{\frac{m}{k}}$

D. $\left(\pi+\frac{2}{\sqrt{3}}\right)\sqrt{\frac{m}{k}}$

Answer: C

View Text Solution

17. If T_1 and T_2 are the time-periods of oscillation of a simple pendulum on the surface of earth (of radius R) and at a depth d, the d is equal to

A. $\left(1-\frac{T_1^2}{T_2^2}\right)R$

B. $\left(1-\frac{T_2^2}{T_1^2}\right)R$

C. $\left(1-\frac{T_1}{T_2}\right)R$

D. $\left(1-\frac{T_2}{T_1}\right)R$

Answer: A

Watch Video Solution

18. A wall clock uses a vertical spring mass system to measure the time. Each time the mass reaches an extrem position, the clock advances by a second. The clock gives correct time at the equator. If the clock is taken to the poles it will

A. run slow

B. run fast

C. stop working

D. give correct time

Answer: D

Watch Video Solution

Watch Video Solution

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

A. $T \propto m$

B. $T \propto \rho$

C. $T \propto 1/A$

D. $T \propto 1/\rho$

Answer: A

Watch Video Solution

20. A block rests on a horizontal table which is executing SHM in the horizontal plane with an amplitude A. What will be the frequency of oscillation, the block will just start to slip? Coefficient of friction $= \mu$.

A. $\frac{1}{2\pi}\sqrt{\frac{\mu g}{a}}$

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

C. $2\pi\sqrt{\frac{a}{\mu g}}$

D. $\sqrt{\frac{a}{\mu g}}$

Answer: A

Watch Video Solution

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

A. proportional to $\frac{1}{\sqrt{a}}$

B. proportional to $\sqrt{a}$

C. independent $a^{\frac{3}{2}}$

D. None of these

Answer: A

Watch Video Solution

22. The velocity of the bob of a simple pendulum in the mean position is v. If its amplitude is doubled, by keeping the same length, then its velocity in the mean position will be

A. v/2

B. v

C. 2 v

D. 4 v

Answer: C

Watch Video Solution

23. A circular hoop of radius R is hung over a knife edge. The period of oscillation is equal to that of a simple pendulum of length

A. R

B. 2R

C. 3R

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

Answer: B

Watch Video Solution

24. On Earth, a body suspended on a spring of negligible mass causes extension L and undergoes oscillations along length of the spring with frequency f. On the Moon, the same quantities are L/n and f' respectively. The ratio f'/f is

A. n

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

C. $n^{-1/2}$

D. 1

Answer: D

View Text Solution

25. If the mass shown in figure is slightly displaced and then let go, then the system shall oscillate with a time period of

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

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

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

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

Answer: B

View Text Solution

26. A simple pendulum attached to the roof of a lift has a time period of 2s in a stationary lift. If the lift is allowed to fall freely the frequency of oscillations of pendulum will be

A. zero

B. 2 Hz

C. 0.5 Hz

D. infinity

Answer: A

View Text Solution

27. A second's pendulum is placed in a space laboratory orbiting around the earth at a height $3R$, where R is the radius of the earth. The time period of the pendulum is

A. zero

B. $2\sqrt{3}$

C. $4 \quad \sec$

D. infinite

Answer: D

Watch Video Solution

28. A simple spring has length l and force constant K. It is cut into two springs of lengths $l_1 \text{and} l_2$ such that $l_1 = nl_2$ (n = an integer). The force constant of spring of length l_1 is

A. $K(1+n)$

B. $(K/n)(1+n)$

C. K

D. $K/(n+1)$

Answer: B

Watch Video Solution

29. The length of a second's pendulum at the surface of earth is 1 m. The length of second's pendulum at the surface of moon where g is 1/6th that at earth's surface is

A. 1/6 m

B. 6 m

C. 1/36 m

D. 36 m

Answer: A

Watch Video Solution

30. A small ball of density $4\rho_0$ is released from rest just below the surface of a liquid. The density of liquid increases with depth as $\rho = \rho_0(1 + ay)$ where $a = 2m^{-1}$ is a constant. Find the time period of its oscillation. (Neglect the viscosity effects).

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

B. $\frac{\pi}{\sqrt{5}}\sec$

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

D. $\frac{3\pi}{2\sqrt{5}}\sec$

Answer: A

Watch Video Solution

31. Two springs, each of spring constant k = 100 N/m, are attached to a block of mass 2 kg as shown in the figure. The block can slide smoothly along a horizontal platform clamped to the opposite walls of the trolley of mass 5kg. If the block is displaced by x cm. and released, the period of oscillation in seconds is

A. $T=2\pi\sqrt{\frac{1}{20}}$

B. $T=2\pi\sqrt{\frac{7}{1000}}$

C. $T=2\pi\sqrt{\frac{1}{140}}$

D. $T=2\pi\frac{49}{100}$

Answer: C

View Text Solution

Exercise 1 Concept Builder Topic 3 Damped Forced Oscillations And Resonance

1. In forced oscillation of a particle the amplitude is maximum for a frequency ω_2 of the force while the energy is maximum for a frequecyomega_(2) of the force, then .

A. $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large

B. $\omega_1 > \omega_2$

C. $\omega_1 = \omega_2$

D. $\omega_1 < \omega_2$

Answer: C

Watch Video Solution

2. A block connected to a spring oscillates vertically. A damping force F_d, acts on the block by the surrounding medium. Given as $F_d = -bV$, b is a positive constant which depends on :

A. viscosity of the medium

B. size of the block

C. shape of the block

D. All of these

Answer: D

Watch Video Solution

3. The frequency of the simple harmonic motion attained in forced oscillations, after the forced oscillation die out, is

A. the natural frequency of the particle

B. the frequency of the driving force

C. double the frequency of the driving force

D. double the natural frequency of the particle

Answer: B

View Text Solution

4. A rod is hinged vertically at one end and is forced to oscillate in a vertical plane with hinged end at the top, the motion of the rod:

A. is simple harmonic

B. is oscillatory but not simple harmonic

C. is pericolic but not oscillatory

D. may be simple harmonic

Answer: D

View Text Solution

5. 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

Answer: D

Watch Video Solution

6. In damped oscillations, the amplitude is reduced to one-third of its initial value a_0 at the end of 100 oscillations. When the oscillator completes 200 oscillations ,its amplitude must be

A. $a_0 / 2$

B. $a_0 / 4$

C. $a_0 / 6$

D. $a_0 / 9$

Answer: D

Watch Video Solution

7. The amplitude of velocity of a particle is given by, $V_m = V_0 / \left(a\omega^2 - b\omega + c\right)$ where V_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. $b^2 = 7ac$

Answer: B

Watch Video Solution

8. When a dampled harmonic oscillator completes 100 oscillations, its amplitude is reduced to $\frac{1}{3}$ of its initial value. When will be its amplitude when it completes 200 oscillations?

A. $\frac{1}{8}$

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

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

D. $\frac{1}{9}$

Answer: D

Watch Video Solution

9. A forced oscillator is acted upon by a force, $F = F_0 \sin \omega t$. The amplitude of the oscillator is given by $A = \dfrac{55}{\sqrt{(2\omega^2 - 36\omega + 9)}}$

What is the resonance angular freuqnecy (in rad/s)?

A. 2 unit

B. 9 unit

C. 18 unit

D. 36 unit

Answer: B

Watch Video Solution

10. The amplitude of damped oscillator decreased to 0.9 times its original magnitude is $5s$. In another $10s$ it will decrease to α times its original magnitude, where α equals.

A. 0.7

B. 0.81

C. 0.729

D. 0.6

Answer: C

Watch Video Solution

11. The amplitude of damped oscillator becomes $\frac{1}{3}$ in $2s$. Its amplitude after $6s$ is $1/n$ times the original. The value of n is

A. 3^2

B. 3^3

C. $\sqrt[3]{3}$

D. 2^3

Answer: B

Watch Video Solution

Exercise 2 Concept Applicator

1. A point particle of mass 0.1 kg is executing SHM of amplitude 0.1m. When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} J$. Obtain the equation of motion of the particle if the initial phase of oscillation is 45°

A. $y = 0.1 \sin\left(\pm 4t + \frac{\pi}{4}\right)$

B. $y = 0.2 \sin\left(\pm 4t + \frac{\pi}{4}\right)$

C. $y = 0.1 \sin\left(\pm 2t + \frac{\pi}{4}\right)$

D. $y = 0.2 \sin\left(\pm 2t + \frac{\pi}{4}\right)$

Answer: A

Watch Video Solution

2. A particle performs SHM on x- axis with amplitude A and time period period T .The time taken by the particle to travel a distance $A/5$ string from rest is

A. $\frac{T}{20}$

B. $(T)(2\pi)\cos^{-1}\left(\frac{4}{5}\right)$

C. $\frac{T}{2\pi}\cos^{-1}\left(\frac{1}{5}\right)$

D. $\frac{T}{2\pi}\sin^{-1}\left(\frac{1}{5}\right)$

Answer: B

Watch Video Solution

3. A mass is suspended separately by two different springs in successive order then time periods is t_1 and t_2 respectively. It is connected by both springs as shown in fig. then time period is t_0, the correct relation is

A. $t_0^2 = t_1^2 + t_2^2$

B. $t_0^{-2} = t_1^{-2} + t_2^{-2}$

C. $t_0^{-1} = t_1^{-1} + t_2^{-1}$

D. $t_0 = t_1 + t_2$

Answer: B

View Text Solution

4. Two particles execute SHM of same amplitude and frequency on parallel lines. They pass one another when moving in opposite directions each time their displacement is one third their amplitude. What is the phase difference between them?

A. $5\pi / 6$

B. $2\pi / 3$

C. $\pi / 3$

D. $\pi / 6$

Answer: B

Watch Video Solution

5. If a simple pendulum has significant amplitude (up to a factor of1//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 sphetical bob of the pendulum suffers a retardation (due to viscous drag) proportional to its velocity with b as the constant of propotional to average life time of the pendulum is (assuming damping is small) in seconds:

A. $\frac{0.693}{b}$

B. b

C. $\frac{1}{b}$

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

Answer: D

Watch Video Solution

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

A. $\frac{25}{9}$

B. $\frac{16}{9}$

C. $\frac{5}{3}$

D. $\frac{3}{5}$

Answer: B

Watch Video Solution

7. A bent tube of uniform cross-section area A has a non-viscous liquid of density rop. The mass of liquid in the tube is m. The time period of oscillation of the liquid is

A. $2\pi\sqrt{\frac{m}{\rho gA}}$

B. $2\pi\sqrt{\frac{m}{2\rho gA}}$

C. $2\pi\sqrt{\frac{2m}{\rho gA}}$

D. None of these

Answer: A

View Text Solution

8. A particle performs SHM about $x = 0$ such that at $t = 0$ it is at $x = 0$ and moving towards positive extreme. The time taken by it to go from $x = 0$ to $x = \frac{A}{2}$ is time the time taken to go from $x = \frac{A}{2}$ to a. The most suitable option for the blank space is

A. 2

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

C. $\frac{11}{12}$

D. $\frac{12}{11}$

Answer: B

Watch Video Solution

9. A particle of mass m = 2 kg executes SHM in xy plane between points A and B under the action of force $\overline{F} = F_x \hat{i} + F_y \hat{j}$. Minimum time taken by the particle to move from A to B is 1 s. At t = 0 the particle is at x = 2 and y = 2. Then F_x as function of time t is

A. $-4\pi^2 \sin \pi t$

B. $-4\pi^2 \cos \pi t$

C. $-6\pi^2 \cos \pi t$

D. None of these

Answer: B

10. A simple harmonic motion along the x-axis has the following properties: amplitude $= 0.4m$ the time to go from one extreme position to other is $2s$ and $x = 0.3m$ at $t = 0.5$

a. the general equation of the simple harmonic motion is

A. $x = (0.5 \text{ m})\sin\left[\frac{\pi t}{2} + 8^\circ\right]$

B. $x - (0.5 \text{ m})\sin\left[\frac{\pi t}{2} - 8^\circ\right]$

C. $x = (0.5 \text{ m})\cos\left[\frac{\pi t}{2} + 8^\circ\right]$

D. $x = (0.5 \text{ m})\cos\left[\frac{\pi t}{2} - 8^\circ\right]$

Answer: B

Watch Video Solution

11. Two simple harmonic are represented by the equation

$y_1 = 0.1\sin\left(100\pi + \frac{\pi}{3}\right)$ and $y_2 = 0.1\cos \pi t.$

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

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

B. $\frac{-\pi}{6}$

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

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

Answer: B

Watch Video Solution

12. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density σ at equilibrium position. When the cylinder is given a downward push and released, it starts oscillating vertically with a small amplitude. The time period T of the oscillations of the cylinder will be :

A. Smaller than $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{\frac{1}{2}}$

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

C. Larger than $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{\frac{1}{2}}$

D. $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{\frac{1}{2}}$

Answer: A

View Text Solution

13. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density σ at equilibrium position. When the cylinder is given a downward push and released, it starts oscillating vertically with a small amplitude. The time period T of the oscillations of the cylinder will be :

A. $5\text{cm}, \frac{\pi}{10}s$

B. $5\text{cm}, \frac{\pi}{5}s$

C. $4\ \ \text{cm}, \frac{2\pi}{5}s$

D. $4\text{cm}, \frac{\pi}{3}s$

Answer: A

View Text Solution

14. A body executes simple harmonic motion under the action of a force F_1 with a time period js. If the force is changed to F_2, it executes SHM with time period $\frac{3}{5}s$. If both the forces F_1 and F_2 act simultaneously in the same direction on the body, its time period (in seconds) is

A. $\frac{12}{25}$

B. $\frac{7}{5}$

C. $\frac{24}{25}$

D. $\frac{5}{7}$

Answer: A

Watch Video Solution

15. A simple pendulum attached to the ceiling of a stationary lift has a time period T. The distance y covered by the lift moving upwards varies with time t as $y = t^2$ where y is in metres and t in seconds. If $g = 10 m / s^2$, the time period of pendulum will be

A. $\sqrt{\frac{4}{5}}T$

B. $\sqrt{\frac{5}{6}}T$

C. $\sqrt{\frac{5}{4}}T$

D. $\sqrt{\frac{6}{5}}T$

Answer: B

Watch Video Solution

16. Two bodies of masses 1 kg and 4 kg are connected to a vertical spring, as shown in the figure. The smaller mass executes simple harmonic motion of angular frequency 25 rad/s, and amplitude 1.6 cm while the bigger mass remains stationary on the ground. The maximum force exerted by the system on the floor is (take $g = 10 \ \text{ms}^{-2}$)

A. 20 N

B. 10 N

C. 60 N

D. 40 N

Answer: C

View Text Solution

17. A particle of mass m oscillates with a potential energy $U = U_0 + \alpha x^2$, where U_0 and α are constants and x is the displacement of particle from equilibrium position. The time period of oscillation is

A. $2\pi\sqrt{\frac{m}{\alpha}}$

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

C. $\pi\sqrt{\frac{2m}{\alpha}}$

D. $2\pi\sqrt{\frac{m}{\alpha^2}}$

Answer: B

Watch Video Solution

18. Two simple pendulums of length 0.5 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 [$nT_1 = (n-1)T_2$, where T_1 is time period of shorter length & T_2 be time period of longer length and n are no. of oscillations completed]

A. 5

B. 1

C. 2

D. 3

Answer: B

Watch Video Solution

19. A uniform pole of length l = 2 L is laid on smooth horizontal table as shown in figure. The mass of pole is M and it is connected to a frictionless axis at O.A spring with force constant k is connected to the other end. The pole is displaced by a small angle θ_0 from equilibrium position and released such that it performs small oscillations. Then

A. $\omega_0 = \sqrt{\frac{M}{3k}}$

B. $\omega_0 = \sqrt{\frac{k}{3M}}$

C. $\omega_0 = \sqrt{\frac{3k}{M}}$

D. $\omega_0 = \sqrt{\frac{k}{2M}}$

Answer: C

View Text Solution

20. A particle of mass m executes simple harmonic motion with amplitude a and frequency v. The average kinetic energy during its motion from the position of equilibrium to the ends is

A. $2\pi^2 ma^2 v^2$

B. $\pi^2 ma^2 v^2$

C. $\frac{1}{4} ma^2 v^2$

D. $4\pi^2 ma^2 v^2$

Answer: B

Watch Video Solution

21. Three masses of 500 g, 300 g and 100 g are suspended at the end of a spring as shown, and are in equilibrium. When the 500 g mass is removed, the system oscillates with a period of 2 second. When the 300 g mass is also removed, it will oscillate with a period of

A. 2 s

B. 4 s

C. 8 s

D. 1 s

Answer: D

View Text Solution

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

A. 52 cm

B. 65 cm

C. 39 cm

D. 26 cm

Answer: C

Watch Video Solution

23. A rod of length l is in motion such that its ends A and B are moving along x-axis and y-axis respectively. It is given that $\frac{d\theta}{dt} = 2$ red/sec always. P is a fixed point on the rod. Let M be the projection of P on x-axis. For the time interval in which θ changes from 0 to $\frac{\pi}{2}$, choose the correct statement.

A. The acceleration of M is always directed towards right

B. M executes SHM

C. M moves with constant speed

D. M moves with constant acceleration

Answer: B

View Text Solution

24. The following figure depict a circular motion. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated on the figure.

The simple harmonic motion of the x-projection of the radius vector of the rotating particle P can be shown as :

A. $x(t) = a\cos\left(\frac{2\pi t}{4} + \frac{\pi}{4}\right)$

B. $x(t) = a\cos\left(\frac{\pi t}{4} + \frac{\pi}{4}\right)$

C. $x(t) = a\sin\left(\frac{2\pi t}{4} + \frac{\pi}{4}\right)$

D. $x(t) = a\cos\left(\frac{\pi t}{3} + \frac{\pi}{2}\right)$

Answer: A

View Text Solution

25. In the figure shown, the spring is light and has a force constant k. The pulley is light and smooth and the strring is light. The suspended block has a mass m. On giving a slight displacement vartically to the block in the downward direction from its equilibrium position the block executes S.H.M. on being released with time period T. Then

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

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

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

D. $T = 4\pi\sqrt{\frac{m}{k}}$

Answer: D

View Text Solution

26. A mass m is suspended from a spring of force constant k and just touches another identical spring fixed to the floor as shown in the figure. The time period of small oscillations is

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

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

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

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

Answer: D

View Text Solution

27. Consider two identical masses m attached to 3 identical spring as shown in the figure. They can be set in motion in two different ways as follows :

(I) $x_1(t) = x_0 \cos \omega t$ and $x_2(t) = x_0 \cos \omega t$

(II) $x_1 = (t) = x_0 \cos \omega t$ and $x_2(t) = - x_0 \cos \omega t$

Here $x_1(t)$ and $x_2(t)$ denote the displacements from the unstreched positions. Then the potential energy stored in the system is

A. larger for I than II at t = 0

B. larger for I than II at $t = \pi / \omega$

C. equal for I and II at t = 0

D. smaller for I than II at $t = 2\pi / \omega$

Answer: D

View Text Solution

View Text Solution

28. A mass m fall on spring of spring constant k and negligible mass from a height h. Assuming it sticks to the pan and executes simple harmonic motion, the maximum height upto which the pan will rise is

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

B. $\frac{mg}{k}\left[\sqrt{1+\frac{2kh}{mg}}-1\right]$

C. $\frac{mg}{k}\left[\sqrt{1+\frac{2kh}{mg}}+1\right]$

D. $\frac{mg}{k}\left[\sqrt{1+\frac{kh}{mg}}-1\right]$

Answer: B

View Text Solution