PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

OSCILLATIONS

In Text Book Example Problems

1. Classify the following motions as periodic and non-periodic motions?

(a) Motion of Halley's comet.

(b) Motion of clouds.

(c) Moon revolving around the Earth.

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2. Which of the following functions of time represent periodic and non-periodic motion?

(a) $\sin \omega t + \cos \omega t$ (b) $e - \omega t$

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3. Which of the following represent simple harmonic motion?

(i) $x = A\sin\omega t + B\cos\omega t$ (ii)

$x = A\sin\omega t + B\cos 2\omega t$ (iii) $x = Ae^{i\omega t}$ (iv)

$x = A\ln\omega t$

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4. Consider a particle undergoing simple harmonic motion. The velocity of the particle at position x_1 is v_1 and velocity of the particle at position x_2 is v_2. Show that the ratio of time period and amplitude is

$$\frac{T}{A} = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2x_2^2 - v_2^2 - x_1^2}}$$

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5. A nurse measured the average heart beats of a patient and reported to the doctor in terms of time period as $0.8s$. Express the heart beat of the patient in terms of number of beats measured per minute.

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6. Calculate the amplitude, angular frequency, frequency, time period and initial phase for the simple harmonic oscillation given below:

(a) $y = 0.3\sin(40\pi t + 1.1)$ (b) $y = 2\cos(\pi t)$ (c) $y = 3\sin(2\pi t - 1.5)$

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7. Show that for a simple harmonic motion, the phase difference between.

(a) displacement and velocity is $\frac{\pi}{2}$ radian or

(b) velocity and acceleration is $\frac{\pi}{2}$ radian or 90°.

(c) displacement and acceleration is π radian or 180°

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8. A spring balance has a scale which ranges from 0 to 25 kg and the length of the scale is 0.25 m. It is taken to an unknown planet X where the acceleration due to gravity is $11.5ms^{-1}$. Suppose a body a mass M kg is suspended in this spring and made to oscillate with a period of 0.50 s. Compute the gravitational force acting on the body.

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9. Consider two springs whose force constants are $1Nm^{-1}$ and $2Nm^{-1}$ which are connected in series. Calculate the effective spring constant (k_s) and comment on k_s.

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10. Consider two springs with force constants $1Nm^{-1}$ and $2Nm^{-1}$ connected in parallel. Calculate the effective spring constant (k_p) and comment on k_p.

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11. Calculate the equivalent spring constant for the following system and also compute if all the spring constants are equal:

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12. A mass m moves with a speed v on a horizontal smooth surface and collides with a nearly massless spring whose spring constant is

k. If the mass stops after collision, compute the maximum compression of the spring.

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13. In simple pendulum experiment, we have used small angle approximation.

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14. If the length of the simple pendulum is increased by 44% from its original length,

calculate the percentage increase in time period of the pendulum.

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15. Write down the kinetic energy and total energy expressions in terms of linear momentum, For one-dimensional case.

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16. Compute the position of an oscillating particle when its kinetic energy and potential energy are

equal.

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Textual Evaluation Solved Multiple Choice Questions

1. In a simple harmonic oscillation, the acceleration against displacement for one complete oscillation will be.

A. an ellipse

B. a circle

C. a parabola

D. a straight line

Answer: D

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2. A particle executing SHM crossed points A and B with the same velocity. Having taken 3 s in passing from A to B, it returns to B after another 3s. The time period is :

A. 15s

B. 6s

C. 12s

D. 9s

Answer: C

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3. The length of a second's pendulum on the surface of the Earth is $0.9m$. The length of the same pendulum of surface of planet X such that the acceleration of planet X is n times greater than the Earth is :

A. 0.9n

B. $\frac{0.9}{n}m$

C. $0.9n^2m$

D. $\frac{0.9}{n^2}$

Answer: A

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4. A simple pendulum is suspended from the roof of a school bus which movies in a horizontal

direction with an acceleration a, then the time period is :

A. $T = \propto \frac{1}{g^2 + a^2}$

B. $T = \propto \frac{1}{\sqrt{g^2 + a^2}}$

C. $T \propto \sqrt{g^2 + a^2}$

D. $T \propto \left(g^2 + a^2\right)$

Answer: A

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5. Two bodies A and B whose masses are in the ratio $1:2$ are suspended from two separate massless springs of force constants k_A and k_B respectively. If the two bodies oscillate vertically such that their maximum velocities are in the ratio $1:2$ the ratio of the amplitude A to that of B is :

A. $\sqrt{\frac{k_B}{2k_A}}$

B. $\sqrt{\frac{k_B}{8k_A}}$

C. $\sqrt{\frac{2k_B}{k_A}}$

D. $\sqrt{\frac{8k_B}{k_A}}$

Answer: B

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6. A spring is connected to a mass m suspended from it and its time period for vertical oscillation is T. spring is now cut into two equal halved and the same mass is suspended fron one of the havles. The period of vertical oscillation is :

A. $T' = \sqrt{2}T$

B. $T' = \frac{T}{\sqrt{2}}$

C. $T' = \sqrt{2T}$

D. $T' = \sqrt{\frac{T}{2}}$

Answer: B

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7. A simple pendulum has a time period T_1. When its point of suspension is moved vertically upwards according as $y = kt^2$, where y is vertical covered and $k = 1ms^{-2}$, its time period becomes T_2 then $\frac{T_1^2}{T_2^2}$ is $(g = 10ms^{-2})$

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

B. $\frac{11}{10}$

C. $\frac{6}{5}$

D. $\frac{4}{5}$

Answer: C

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8. An ideal spring of spring constant k, is suspended from the ceiling of a room and a blok of mass m is fastened to its lower end. If the block is released when the spring is un-stretched, then then maximum extension in the spring is :

A. $4\frac{Mg}{k}$

B. $\frac{Mg}{k}$

C. $2\frac{Mg}{k}$

D. $\frac{Mg}{2k}$

Answer: C

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9. A pendulum is hung in a very high building and is moving freely to and fro like a simple harmonic oscillator. If the acceleration of the bob is

$16ms^{-1}$ at a distance of 4 m from the mean position, then the time period is

A. 2s

B. 1s

C. $2\pi s$

D. πs

Answer: D

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10. A hollow sphere is filled with water . It is hung by a long thread . As the water flows out of a hole at the bottom , the period of oscillation will

A. first increase and then decrease

B. first decrease and then increase

C. increase continuously

D. decrease continuously

Answer: A

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11. The damping force on an oscillator is directly proportional to the velocity . The units of the constant of proportionality are

A. $kgms^{-1}$

B. $kgms^{-2}$

C. kgs^{-1}

D. kgs

Answer: C

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

A. $\frac{1}{5}$

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

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

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

Answer: D

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13. Which of the following different equations represents a damped harmonic oscillator ?

A. $\frac{d^2y}{dt^2} + y = 0$

B. $\frac{d^2y}{dt^2} + \gamma\frac{dy}{dt} + y = 0$

C. $\frac{d^2y}{dt^2} + k^2y = 0$

D. $\frac{dy}{dt} + y = 0$

Answer: B

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14. If the inertial mass and gravitational mass of the simple pendulum of length l are not equal, then the time period of the simple pendulum is :

A. $T = 2\pi\sqrt{\frac{m_i l}{m_g g}}$

B. $T = 2\pi\sqrt{\frac{m_g l}{m_i g}}$

C. $T = 2\pi\frac{m_g}{m_i}\sqrt{\frac{l}{g}}$

D. $T = 2\pi\frac{m_i}{m_g}\sqrt{\frac{l}{g}}$

Answer: A

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Textual Evaluation Solved Ii Short Answer Question

1. What is meant by periodic and non-periodic motion ? Give any two examples , for each motion ?

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2. What is meant by mean by force constant of a spring ?

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3. Define time period of simple harmonic motion.

4. Define frequency of simple harmonic motion.

5. what is an epoch ?

6. Write short notes on two springs connected in series.

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7. Write short notes on two springs connected in parallel.

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8. Write down the time period of simple pendulum.

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9. State the laws of simple pendulum.

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10. Write down the equation of time period for linear harmonic oscillator ?

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11. What is meant by free oscillation ?

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12. Explain damped oscillation . Give an example.

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13. Define forced oscillation . Give an example.

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14. What is meant by maintained oscillation ? Given an example.

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15. Explain resonance. Give an example .

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Textual Evaluation Solved Iii Long Answer Questions

1. What is meant by simple harmonic oscillation ?

Give example

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2. Describe Simple Harmonic Motion as a projection of uniform circular motion. The projection of uniform circular motion on a diameter of SHM

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3. What is meant by angular harmonic oscillations? Compute the time period of angular harmonic oscillation.

Time period and frequency of angular SHM:

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4. Write down the difference between simple harmonic motion and angular simple harmonic motion.

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5. Discuss the simple pendulum in detail.

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6. Explain the horizontal oscillations of a spring.

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7. Describe the vertical oscillations of a spring.

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8. Write shorts notes on the oscillations of liquid column in U-tube.

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9. Discuss in detail the energy in simple harmonic motion.

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10. Explain in detail the four different types of oscillations.

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Textual Evaluation Solved V Numerical Problems

1. Consider the Earth as a homogenous sphere of radius R and a straight hole is bored in it through its centre. Show that a particle dropped into the hole will execute a simple harmonic motion such that its time period is $T = 2\pi\sqrt{\frac{R}{g}}$

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2. Calculate the time period of the oscillation of a particle of mass m moving in the potential defined as $U(x) = \begin{cases} \frac{1}{2}kx^2, & x < 0 \\ mgx, & g > 0 \end{cases}$

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3. Consider a simple pendulum of length l = 0.9 m which is properly placed on a trolley rolling down on a inclined plane which is at $0 = 45^{\circ}$ with the horizontal. Assuming that the inclined plane is frictionless. Assuming that the time period of oscillation of the simple pendulum is T. Find the value of T.

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4. A piece of wood of mass m is floating erect in a liquid whose density is ρ . If it is slightly pressed down and released, then executes simple harmonic motion. Show that its time period of oscillation is $T = 2\pi\sqrt{\frac{m}{A\rho g}}$

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5. Consider two simple harmonic motion along x and y- axis having same frequencies but different amplitudes as $x = A\sin(\omega t + \varphi)$ (along x axis) and $y = B\sin\omega t$(along y axis).

then show that $\frac{x^2}{A^2}+\frac{y^2}{B^2}-\frac{2xy}{AB}\cos\varphi=\sin^2\varphi$

and also discuss the special cases when

$\varphi=\frac{\pi}{2}$ and $A=B$

Note : when a particle is subjected to two simple harmonic motion at right angle to each other the particle may move along different paths.

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6. Show that for a particle executing simple harmonic motion the average value of kinetic energy is equal to the average value of potential energy.

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7. Match the following :

Column I	Column II
1. Atto	*(i)* 10^{-15}
2. Fermi	*(ii)* 10^{18}
3. Femto	*(iii)* 10^{6}
4. Micro	*(iv)* 10^{-13}
	(v) 10^{-18}
	(vi) 10^{-6}

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Additional Questions Solved

1. The total energy of a particle vibrating in SHM is proportional to the square of its.....

A. velocity

B. acceleration

C. amplitude

D. none of these

Answer: A

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2. Write down the time period of simple pendulum.

A. its length should doubled

B. its length should be quadrupled

C. the mass of its bob should be doubled

D. the mass of its bob should be quadrupled

Answer: B

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3. A simple harmonic oscillator has amplitude A and time period T. Its maximum speed is.....

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

B. $\frac{2A}{T}$

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

D. $\frac{2\pi A}{T}$

Answer: D

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4. A simple harmonic oscillator has a period of 0.01 s and an amplitude of 0.2 m. The magnitude of the velocity in m/s at the centre of oscillation is.....

A. 20π

B. 40π

C. 60π

D. 80π

Answer: B

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5. A particle is executing SHM. Then the graph of acceleration as a function of displacement is.....

A. straight line

B. circle

C. ellipse

D. hyperbola

Answer: A

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6. A particle is executing SHM. Then the graph of velocity as a function of displacement is.....

A. straight line

B. circle

C. ellipse

D. hyperbola

Answer: C

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7. The amplitude of a vibrating body situated in a resisting medium.....

A. decreases linearly with time

B. decreases exponentially with time

C. decreases with time in some other manner

D. remains constant with time

Answer: B

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8. The frequency of a vibrating body situated in air.....

A. is the same as its nautral frequency

B. is higher than its natural frequency

C. is lower than its natural frequency

D. can have any value

Answer: C

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9. The equation $\frac{d^2y}{dt^2} + b\frac{dy}{dt} + \omega^2 y = 0$ represents the equation of motion for a.....vibration.

A. free

B. damped

C. forced

D. resonant

Answer: B

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10. The displacement equation of an oscillator is $y = 5\sin(0.2\pi t + 0.5\pi)$ in SI units. The time period of oscillation is.....

A. 10 s

B. 1 s

C. 0.2 s

D. 0.5 s

Answer: A

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11. A loaded spring vibrates with a period T. The spring is divided into four equal parts and the same load is suspended from one as these parts. The new time period is.....

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

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

C. 2 T

D. 4 T

Answer: B

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12. The vertical extension in a light spring by a weight of 1 kg, in equilibrium is 9.8 cm. The period of oscillation of the spring, in seconds, will be.....

A. $\frac{2\pi}{10}$

B. $\frac{2\pi}{100}$

C. 20π

D. 200π

Answer: A

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13. A particle executing SHM has an acceleration of $64cm/s^2$ with its displacement is 4 cm. Its time period, in seconds is.....

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

B. $\frac{\pi}{4}$

C. π

D. 2π

Answer: A

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14. A body describes simple harmonic motion with an amplitude of 5 cm and a period of 0.2s. Find the acceleration and velocity of the body when the displacement is 5 cm.

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

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

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

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

Answer: C

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15. The maximum displacement of a particle executing SHM is 1 cm and the maximum acceleration is $(1.57)^2 cm/s^2$. Its time period is.....

A. 0.25s

B. 4.0s

C. 1.57s

D. 3.14s

Answer: B

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16. The velocity of a particle, undergoing SHM is v at the position. If its amplitude is doubled, the velocity at the mean position will be.....

A. 2 v

B. 3 v

C. $2\sqrt{2}v$

D. 4v

Answer: A

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

A. The period will now be shorter

B. The period will now be longer

C. The period will remain unchanged

D. The period may become longer or shorter depending upon the height of the girl

Answer: A

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18. The equation of SHM of a particle is $\frac{d^2y}{dt^2} + ky = 0$, where k is a positive constant. The time period of motion is given by.....

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

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

C. $\frac{k}{2\pi}$

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

Answer: A

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19. The amplitude of a damped oscillator becomes half in one minute. The amplitude after 3 minutes will be $\frac{1}{x}$ time the original, where x is.....

A. 2×3

B. 2^3

C. 3^2

D. 3×2^2

Answer: B

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

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

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

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

Answer: C

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21. A massless spring, having force constant k, oscillates with a frequency n when a mass m is suspended from it. The spring is cut into two equal halves and a mass 2m is suspended from one of the parts. The frequency of oscillation will now be.....

A. n

B. $n\sqrt{2}$

C. $\frac{n}{\sqrt{2}}$

D. 2n

Answer: A

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22. For a simple pendulum the graph between length and time period will be a.....

A. hyperbola

B. Parabola

C. Straight line

D. none of these

Answer: B

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23. A particle is executing simple harmonic motion given by $x = 5\sin\left(4t - \frac{\pi}{6}\right)$. The velocity of the particle when its displacement is 3 units is.....

A. $\frac{2\pi}{3}$ units

B. $\frac{5\pi}{6}$ units

C. 20 units

D. 16 units

Answer: D

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24. When a particle oscillates simple harmonically, its potential energy varies periodically. If the frequency of oscillation of the particle is n, the frequency of potential energy variation is.....

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

B. n

C. 2n

D. 4n

Answer: C

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25. A particle, moving along the x-axis, executes simple harmonic motion when the force acting on it is given by (A and k are positive constant.).....

A. $-Akx$

B. $A\cos(kx)$

C. $A\exp(-kx)$

D. Akx

Answer: A

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26. The motion of a particle is expressed by the equation $a = -bx$, where x is the displacement

from the mean position, a is the acceleration and b is a constant. The periodic time is.....

A. $\frac{2\pi}{b}$

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

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

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

Answer: B

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27. The angular velocity and the amplitude of a simple pendulum are ω and a, respectively. The ratio of its kinetic and potential energies at a displacement x from the mean position is.....

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

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

C. $\frac{a^2 - x^2\omega^2}{x^2\omega^2}$

D. $\frac{a^2 - x^2}{x^2}$

Answer: D

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28. A particle is oscillating according to the equation $x = 5\cos(0.5\pi t)$ where t is in seconds. The particle moves from the position of equilibrium to the position of maximum displacement in time.....

A. 1 s

B. 2 s

C. 0.5 s

D. 4 s

Answer: A

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29. A seconds pendulum is placed in a space laboratory orbiting around the Earth at a height 3R from the Earth's surface where R is the radius of the Earth. The time period of the pendulum will be.....

A. zero

B. $2/3s$

C. 4 s

D. inifinite

Answer: D

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30. 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 4m is suspended from the same spring?

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

B. 2n

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

D. 4n

Answer: A

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31. Two simple pendulums of lengths 0.5m and 2.0m respectively are given small linear displacement in one direction at the same time. They will again be in phase when the pendulum of shorter length has completed.....oscillations.

A. 5

B. 3

C. 1

D. 2

Answer: D

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32. A body is executing simple harmonic motion with an angular frequency 2 rad/sec. The velocity

of the body at 20mm displacement, when the amplitude of motion is 60mm, is

A. 90 mm/s

B. 113 mm/s

C. 118 mm/s

D. 131 mm/s

Answer: B

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33. If the displacement of a particle executing SHM, is given by $y = 0.30\sin(220t + 0.64)$ in metre, then the frequency and the maximum velocity of the particle are (t is in seconds).....

A. 35 Hz, 66 m/s

B. 45 Hz, 66 m/s

C. 58 Hz, 113 m/s

D. 35 Hz, 132 m/s

Answer: A

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34. The kinetic energy of a particle, executing SHM, is 16 J when it is at its mean position. If the amplitude of oscillations is 25 cm, and the mass of the particle is 5.12 kg, the time period of its oscillation is.....

A. $\pi / 5s$

B. $2\pi s$

C. $20\pi s$

D. $5\pi s$

Answer: A

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35. A particle of mass m is executing oscillations about the origin on the x-axis. Its potential energy is $V(x) = kx^2$. 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. independent of a

C. proportional to $\sqrt{a}$

D. proportional to $a^{3/2}$

Answer: B

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36. The amplitude of a damped oscillation reduces to one third of its original value a_0 in 20s. The amplitude of such oscillation after a period of 40s will be.....

A. $a_0 / 9$

B. $a_0 / 6$

C. $a_0 / 2$

D. $a_0 / 27$

Answer: A

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37. Masses m_A and m_B hanging from the ends of strings of lengths l_A and l_B are executing. Simple harmonic motions. If their frequencies are related as $f_A = 2f_B$, then.....

A. $l_A = 2l_B$ and $m_A = m_B$?

B. $l_A = 4l_B$ **regardless of masses.**

C. $l_A = l_B/4$ regardless of masses

D. $l_A = 2l_B$ and $m_A = 2m_B$

Answer: C

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38. Two simple harmonic motions act on a particle. These harmonic motions are

$x = A\cos(\omega t + \delta), y = A\cos(\omega t + \alpha)$

When $\delta = \alpha + \frac{\pi}{2}$**, the resulting motion is.....**

A. A circle and the actual motion is clockwise

B. an ellipse and the actual motion is counter clockwise

C. a ellipse and the actual motion is clockwise

D. a circle and the actual motion is counter clockwise

Answer: D

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39. A metal bob is suspended from a coiled spring. When set into vertical vibrations on the

earth. It oscillates up and down with frequency f. If the same experiment is carried out in a satellite circling the Earth the frequency of vibration will be.....

A. f

B. zero

C. infinite

D. depend on the distance of the satellite from the earth

Answer: A

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40. In forced oscillations of a particle, the amplitude is maximum for a frequency ω_1 of the force, while the energy is maximum for a frequency ω_2 of the force. Then.....

A. $\omega_1 < \omega_2$

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

C. $\omega_1 > \omega_2$

D. $\omega_1 = \omega_2$

Answer: D

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

A. When v is maximum, a is maximum

B. Value of a is zero, whatever may be the value of v

C. When v is zero, a is zero

D. When v is maximum, a is zero

Answer: D

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42. The function $\sin^2(\omega t)$ represents

A. a simple harmonic motion with a period π / ω

B. a simple harmonic motion with a period $2\pi / \omega$

C. a periodic, but not simple harmonic motion with a period π / ω

D. a periodic, but not simple harmonic motion with a period $2\pi / \omega$

Answer: A

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43. A particle executing simple harmonic motion has a kinetic energy $K_o \cos^2 \omega t$. The maximum

values of the potential energy and the total 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

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

A. 3 Hz

B. 4 Hz

C. 2 Hz

D. 1 Hz

Answer: D

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45. The phase difference between the instantaneous velocity & acceleration of a particle executing simple harmonic motion is

A. 0.5π

B. π

C. 0.707π

D. zero

Answer: A

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46. 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

Answer: B

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47. Which of the following functions represent SHM?

I. $y = \sin \omega t - \cos \omega t$ II. $y = \sin^3 t$

III. $Y = 5 \cos\left(\frac{3\pi}{4} - 3\omega t\right)$

A. I and III

B. I and II

C. only I

D. I, II and III

Answer: A

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48. Two simple harmonic motions of angular frequencies 100 and 1000 rad/s have the same displacement amplitude. The ratio of their maximum acceleration is.....

A. $1:10$

B. $1:10^2$

C. $1:10^3$

D. $1:10^4$

Answer: B

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49. The period of oscillation of a simple pendulum is T in a stationary lift. If the lift moves upwards with an acceleration of 8g, the period will.....

A. remain the same

B. decrease by T/2

C. increase by T/3

D. none of these

Answer: C

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50. A simple harmonic oscillator consist of a particle of mass m and an ideal spring with spring constant k. The particle oscillates with a time period T. The spring is cut into two equal parts.

If one part oscillates with the same particle, the time period will be.....

A. $T/2$

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

C. $\sqrt{2}T$

D. 2T

Answer: B

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

A. 3 Hz

B. 4 Hz

C. 2 Hz

D. 1 Hz

Answer: D

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Additional Questions Solved 2 Marks Questions

1. What is Oscillatory motion?

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2. Define simple harmonic motion (S.H.M)

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3. What is meant by displacement in SHM?

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4. Define velocity in SHM.

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5. Define acceleration.

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6. What is meant by phase of a particle executing SHM ?

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7. What is meant by angular oscillation?

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8. Define amplitude of the wave.

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Additional Questions Solved 3 Marks Questions

1. Derive the expression for resultant spring constant when two springs having constant k_1 and k_2 are connected in series.

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2. Derive the expression for resultant spring constant when two springs having constant k_1 and k_2 are connected in parallel.

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Additional Questions Solved Iv Numerical Problems

1. 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

$20ms^{-2}$ at a distance of 5 m from the mean position. To find the time period of oscillation.

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2. The acceleration dula to gravity on the surface of moon is $1.7ms^{-2}$. What is the time period of a simple pendulum on the surface of moon if its time period on the surface of earth is 3.5s ?

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3. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then find its time period in seconds.

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4. A body of mass m is attached to 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. Find the value of m is kg.

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5. Two simple harmonic motions are represented by the equations:

$x_1 = 5\sin\left(2\pi t + \frac{\pi}{4}\right), x^2 = 5\sqrt{2}(\sin 2\pi t + \cos 2\pi t)$

What is the ratio of their amplitudes?

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

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7. A 5 kg collar is attached to a spring of spring constant 500 N m^{-1}. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by 10.0 cm and released. Calculate

(a) the period of oscillation,

(b) the maximum speed and

(c) maximum acceleration of the collar.

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

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9. 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 5T/3. What is the ratio m/M?

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10. A body describes simple harmonic motion with an amplitude of 5 cm and a period of 0.2s. Find the acceleration and velocity of the body when the displacement is 5 cm.

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