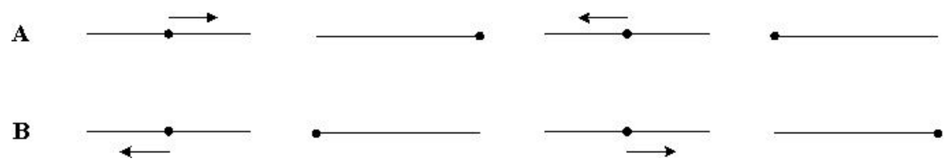
Wave and Motion : Objective and Subjective Questions (Typical)

No of Questions: 60 **Time Allotted: 3 Hours**

All questions are compulsory

[Note: Figures are conceptual only and not to the scale]

Q-01	A student says that he had applied a force $F = -\frac{k}{x}$ on a particle, and the particle moved in a simple harmonic motion. He refuses to tell whether k is constant or not. Assume that he has worked only with positive x and no other force acted on the particle . (a) As x increases k increases (b) As x increases k decreases (c) As x increases k remains constant (d) The motion cannot be simple harmonic.
Q-02	The time period of a particle in simple harmonic motion is equal to the time between consecutive appearances of the particle at a particular position in its position. This point is – (a) The mean position (b) An extreme position (c) Between mean position and positive extreme (d) Between the mean position and the negative extreme
Q-03	The time period of a particle in simple harmonic motion is equal to the smallest time between the particle acquiring a particular velocity $\vec{v}$. The value of v is – (a) v_{max} (b) 0 (c) Between 0 and v_{max} (d) Between 0 and $-v_{max}$
Q-04	The displacement of a particle in simple harmonic motion in one time period is (a) A (b) $2A$ (c) 4A (d) Zero
Q-05	The distance moved by a particle in simple harmonic motion in one time period is (a) A (b) $2A$ (c) 4A (d) Zero
Q-06	The average acceleration in one time period in a simple harmonic motion is (a) $A\omega^2$ (b) $\frac{A\omega^2}{2}$ (c) $\frac{A\omega^2}{\sqrt{2}}$ (d) Zero
Q-07	The motion of a particle is given by $x = A\sin\omega t + B\cos\omega t$. The motion of the particle is (a) Not simple harmonic motion (b) Simple harmonic motion with amplitude $A+B$ (c) Simple harmonic motion with amplitude $\frac{A+B}{2}$ (d) Simple harmonic motion with amplitude $\sqrt{A^2+B^2}$

Q-08	The displacement of a particle is given by $\vec{r} = A\left(\hat{i}\cos\omega t + \hat{j}\sin\omega t\right)$. The motion of the particle is (a) Simple harmonic (b) On a straight line (c) On a circle (d) With a constant acceleration
Q-09	A particle moves on the X-axis according to the equation $x = A + B\sin\omega t$. The motion is simple harmonic with amplitude (a) A (b) B (c) $A+B$ (d) $\sqrt{A^2+B^2}$
Q-10	Figure represents Two simple harmonic motions. The parameter which has different values in the two motions is (a) Amplitude (b) Frequency (c) Phase (d) Maximum velocity 
Q-11	The total mechanical energy of a spring-mass system 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 amplitude A remains the same. The new mechanical energy will (a) Become $2E$ (b) Become $\frac{E}{2}$ (c) Become $\sqrt{2}E$ (d) Remain E
Q-12	The average energy in one time period in simple harmonic motion is (a) $\frac{1}{2}m\omega^2 A^2$ (b) $\frac{1}{4}m\omega^2 A^2$ (c) $m\omega^2 A^2$ (d) Zero
Q-13	A particle executes simple harmonic motion with a frequency υ. The frequency with which the kinetic energy oscillates is (a) $\frac{\upsilon}{2}$ (b) υ (c) 2υ (d) Zero
Q-14	Consider that a particle executes simple harmonic motion under the restoring force provided by a spring. The time period is T. If the spring is divided in two equal parts and one part is used to continue the simple harmonic motion, the time period will (a) Remain T (b) Become $2T$ (c) Become $\frac{T}{2}$ (d) Become $\frac{T}{\sqrt{2}}$
Q-15	Two bodies A and B of equal mass are suspended from two mass less springs of spring constant k_1 and k_2 respectively. If the bodies oscillates vertically such that their maximum velocities are equal, the ratio of amplitudes of A to that of B is (a) $\frac{k_1}{k_2}$ (b) $\sqrt{\frac{k_1}{k_2}}$ (c) $\frac{k_2}{k_1}$ (d) $\sqrt{\frac{k_2}{k_1}}$
Q-16	A spring-mass system oscillates with a frequency υ. If it is taken in an elevator slowly accelerating upward the frequency will – (a) Increase (b) Decrease (c) Remain same (d) Become zero

Q-17	A spring-mass system oscillates in a car. If the car accelerates on a horizontal road the frequency of oscillation will – (a) Increase (b) Decrease (c) Remain same (d) Become zero
Q-18	A pendulum clock that keeps correct time on earth is taken on moon. It will run (a) At correct rate (b) 6 times faster (c) $\sqrt{6}$ times faster (d) $\sqrt{6}$ times slower
Q-19	A wall clock uses a vertical spring-mass system to measure time. Each time the mass reaches an extreme position, the clock advances by a second. The clock gives correct time at equator. If the clock is taken to the poles it will (a) Run slow (b) Run fast (c) Stop working (d) Give correct time
Q-20	A pendulum clock keeping correct time is taken to high altitude. (a) It will keep correct time (b) Its length should be increased to keep correct time (c) Its length should be decreased to keep correct time (d) It cannot keep correct time even if the length is changed
Q-21	The free end of a simple pendulum is attached to the ceiling of a box. The box is taken to a height and the pendulum is oscillated. When the bob is at its lowest point, the box is released to fall freely. As seen from the box during this period the bob will (a) Continue its oscillation as before (b) Stop (c) Will go in a circular path (d) Move on a straight line
Q-22	Select the correct statements (a) A simple harmonic motion is necessarily periodic (b) A simple harmonic motion is necessarily oscillatory (c) An oscillatory motion is necessarily periodic (d) A periodic motion is necessarily oscillatory
Q-23	A particle moves in a circular path with a uniform speed. It motion is (a) Periodic (b) Oscillatory (c) Simple harmonic (d) Angular simple harmonic
Q-24	A particle is fastened at the end of a string and is whirled in a vertical circle with the other end of the string being fixed. The motion of the particle is (a) Periodic (b) Oscillatory (c) Simple harmonic (d) Angular simple harmonic
Q-25	A particle moves in a circular path with a continuously increasing speed. Its motion is (a) Periodic (b) Oscillatory (c) Simple harmonic (d) None of these

Q-26	Motion of a torsional pendulum is (a) Periodic (b) Oscillatory (c) Simple harmonic (d) Angular simple harmonic
Q-27	Which of the following quantities are always negative in simple harmonic motion? (a) $\vec{F}\cdot\vec{a}$ (b) $\vec{v}\cdot\vec{r}$ (c) $\vec{a}.\vec{r}$ (d) $\vec{F}\times\vec{r}$
Q-28	Which of the following are always positive in simple harmonic motion? (a) $\vec{F}\cdot\vec{a}$ (b) $\vec{v}\cdot\vec{r}$ (c) $\vec{a}.\vec{r}$ (d) $\vec{F}\times\vec{r}$
Q-29	Which of the following are always zero in simple harmonic motion? (a) $\vec{F}\times\vec{a}$ (b) $\vec{r}\times\vec{v}$ (c) $\vec{a}\times\vec{r}$ (d) $\vec{F}\times\vec{r}$
Q-30	Suppose a tunnel is dug along diameter of the earth. A particle is dropped from a point, a distance h is directly above the tunnel. Motion of the particle as seen from the earth is (a) Simple harmonic (b) Parabolic (c) Straight line (d) Periodic
Q-31	For a particle executing simple harmonic motion, the acceleration is proportional to (a) Displacement from the median (b) Distance from mean position (c) Distance travelled since $t=0$ (d) Speed
Q-32	A particle in the X-Y plane according to the equation $\vec{r}=\left(\hat{i}+2\hat{j}\right)A\cos\omega t$. The motion of the particle is (a) On a straight line (b) On an ellipse (c) Periodic (d) Simple harmonic
Q-33	A particle moves on the X-axis according to the equation $x=x_0\sin^2\omega t$, The motion is simple harmonic with (a) Amplitude x_0 (b) Amplitude $2x_0$ (c) With time period $\frac{2\pi}{\omega}$ (d) With time period $\frac{\pi}{\omega}$
Q-34	In simple harmonic motion (a) The potential energy is always equal to kinetic energy (b) The potential energy is never equal to kinetic energy (c) The average potential energy in any time interval is equal to average kinetic energy in that interval (d) The average potential energy in one time period is equal to average kinetic energy in this period

Q-35	In simple harmonic motion (a) Maximum potential energy equals the maximum kinetic energy (b) Minimum potential energy equals the minimum kinetic energy (c) Minimum potential energy equals the maximum kinetic energy (d) Maximum potential energy equals the minimum kinetic energy
Q-36	An object is released from rest. The time it takes to fall through a distance h and the speed of the object as it falls through this distance are measured with a pendulum clock. The entire apparatus is taken on moon and the experiment is repeated (a) The measured times are same (b) The measured speeds are same (c) The actual times on the fall are equal (d) The actual speeds are equal
Q-37	Which of the following will change the time period as they are taken to the moon? (a) A simple pendulum (b) A physical pendulum (c) A torsional pendulum (d) A spring-mass system
Q-38	A particle executes simple harmonic motion with an amplitude of 10 cm and time period 6 s. At $t=0$ it is at position 5 cm going toward positive . (a) Write the equation for displacement x at time t. (b) Find the magnitude of the acceleration of the particle at $t=4$ s.
Q-39	The position, velocity and acceleration of a particle executing simple harmonic motion are found to have magnitude 2 cm, 1 m.s^{-1}, and 10 m.s^{-2} at a certain instant. Find the amplitude and time period of the motion.
Q-40	A particle executes simple harmonic motion with an amplitude of 10 cm. At what distance from mean position are kinetic and potential energies are equal?
Q-41	The maximum speed and acceleration of a particle executing simple harmonic motion are 10 cm.s^{-1} and 50 cm.s^{-2}. Find the position(s) of the particle when the speed is 8 cm.s^{-1}.
Q-42	A particle in a spring-mass system having mass 10 g oscillates according to the equation $x=(2.0)\sin\left[(100)t+\frac{\pi}{6}\right]$ cm. Find (a) The amplitude, the time period and the spring constant (b) The position, the velocity and acceleration at $t=0$
Q-43	The equation of motion of a particle started at $t=0$ is given by $x=5\sin\left(20t+\frac{\pi}{3}\right)$ where x is in centimeter and t is in second. When does the particle (a) First comes to rest (b) First have zero acceleration (c) First have maximum speed

Q-44	Consider a particle moving in simple harmonic motion according to equation $x = 2.0\cos\left(50\pi t + \tan^{-1} 0.75\right)$ where x is in centimeter and t is in second. The motion is started at $t = 0$. (a) When does the particle comes to rest for the first time? (b) When does the acceleration have its maximum magnitude for the first time? (c) When does the particle comes to rest for the second rime?
Q-45	Consider a simple harmonic motion of time period T. Calculate the time taken for the displacement to change value from half the amplitude to amplitude.
Q-46	The pendulum of a clock is replaced by a spring-mass system with the spring having spring constant 0.1 $N.m^{-1}$. What mass should be attached to the spring?
Q-47	A block suspended from a vertical spring is in equilibrium. Show that extension of the spring equals the length of an equivalent simple pendulum i.e. a pendulum having frequency same as that of the block.
Q-48	A block of mass 0.5 kg hanging from a vertical spring executes simple harmonic motion of amplitude 0.1 m and time period 0.314 s. Find maximum force exerted by spring on the block.
Q-49	A body of mass 2 kg suspended through a vertical spring executes simple harmonic motion of period 4 s. If the oscillations are stopped and the body hangs in equilibrium, find the potential energy stored in the spring.
Q-50	A spring stores 5 J of energy when stretched by 25 cm. It is kept vertical with lower end fixed. A block fastened to its other end is made to undergo small oscillations. If the block makes 5 oscillations each second, what is the mass of the block?

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