PHYSICS

Oscillations

Speed TEST 13

Chapter-wise

No. of Questions	Maximum Marks	Time
45	180	1 Hour

GENERAL INSTRUCTIONS

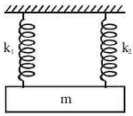
- This test contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solutions provided at the end of this book.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

1. 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) $a^2T^2 + 4\pi^2v^2$

2. 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) $t_0 = t_1 + t_2$

3. 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 $\frac{d\theta}{dt} = 2$ rad/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 $\frac{\pi}{2}$, the correct statement is

(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

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

(a) $2\pi^2ma^2\nu^2$ (b) $\pi^2ma^2\nu^2$

(c) $\frac{1}{4}ma^2\nu^2$ (d) $4\pi^2ma^2\nu^2$

5. A mass M attached to a spring oscillates with a period of 2s. If the mass is increased by 2 kg, then the period increases by 2s. Find the initial mass M assuming that Hooke's law is obeyed.

(a) $\frac{2}{3}$kg (b) $\frac{1}{3}$kg (c) $\frac{1}{2}$kg (d) 1 kg

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

6. The amplitude of a damped oscillator becomes $\left(\frac{1}{3}\right)^{rd}$ in 2 seconds. If its amplitude after 6 seconds is $\frac{1}{n}$ times the original amplitude, the value of n is
(a) 3^2 (b) 3^3 (c) $\sqrt[3]{3}$ (d) 2^3

7. Assume the earth to be perfect sphere of uniform density. If a body is dropped at one end of a tunnel dug along a diameter of the earth (remember that inside the tunnel the force on the body is – k times the displacement from the centre, k being a constant), it (body) will
(a) reach the earth's centre and stay there
(b) go through the tunnel and comes out at the other end
(c) oscillate simple harmonically in the tunnel
(d) stay somewhere between the earth's centre and one of the ends of tunnel.

8. A particle undergoes simple harmonic motion having time period T. The time taken in 3/8th oscillation is
(a) $\frac{3}{8}$T (b) $\frac{5}{8}$T (c) $\frac{5}{12}$T (d) $\frac{7}{12}$T

9. A particle is executing simple harmonic motion with amplitude A. When the ratio of its kinetic energy to the potential energy is $\frac{1}{4}$, its displacement from its mean position is
(a) $\frac{2}{\sqrt{5}}$A (b) $\frac{\sqrt{3}}{2}$A (c) $\frac{3}{4}$A (d) $\frac{1}{4}$A

10. The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is
(a) 11% (b) 21% (c) 42% (d) 10%

11. The time period of a mass suspended from a spring is T. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then the new time period will be
(a) $2T$ (b) $\frac{T}{4}$ (c) 2 (d) $\frac{T}{2}$

12. 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 counterclockwise
(c) an elllipse and the actual motion is clockwise
(d) a circle and the actual motion is counter clockwise

13. A point mass oscillates along the x-axis according to the law $x = x_0\cos(\omega t - \pi/4)$. If the acceleration of the particle is written as $a = A\cos(\omega t - \delta)$, 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) $A = x_0\omega^2, \delta = -\pi/4$

14. 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) $\frac{3}{5}$ (b) $\frac{25}{9}$ (c) $\frac{16}{9}$ (d) $\frac{5}{3}$

15. A body oscillates with a simple harmonic motion having amplitude 0.05 m. At a certain instant of time, its displacement is 0.01 m and acceleration is 1.0 m/s^2. The period of oscillation is
(a) 0.1 s (b) 0.2 s (c) $\frac{\pi}{10}$s (d) $\frac{\pi}{5}$s

16. 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 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 $2K_0$

17. 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

18. A particle moves with simple harmonic motion in a straight line. In first τs, after starting from rest it travels a distance a, and in next τ s 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

19. Two simple harmonic motions are represented by the equations $y_1 = 0.1\sin\left(100\pi t + \frac{\pi}{3}\right)$ and $y_2 = 0.1\cos\pi t$.
The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is
(a) $\frac{\pi}{3}$ (b) $\frac{-\pi}{6}$ (c) $\frac{\pi}{6}$ (d) $\frac{-\pi}{3}$

20. 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 $f_A = 2f_B$, then
(a) $L_A = 2L_B$ and $M_A = M_B/2$
(b) $L_A = 4L_B$ regardless of masses
(c) $L_A = L_B/4$ regardless of masses
(d) $L_A = 2L_B$ and $M_A = 2M_B$

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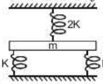
Space for Rough Work

21. In damped oscillations, the amplitude of oscillations is reduced to one-third of its inital 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) $a_0/9$

22. The spring constant from the adjoining combination of springs is
(a) K
(b) 2K
(c) 4K
(d) 5K/2



23. A body executes simple harmonic motion. The potential energy (P.E), the kinetic energy (K.E) and total energy (T.E) are measured as a function of displacement x. Which of the following statements is true?
(a) K.E. is maximum when $x = 0$
(b) T.E is zero when $x = 0$
(c) K.E is maximum when x is maximum
(d) P.E is maximum when $x = 0$

24. A simple harmonic wave having an amplitude a and time period T is represented by the equation $y = 5\sin\pi(t+4)m$. Then the value of amplitude (a) in (m) and time period (T) in second are
(a) a = 10, T = 2 (b) a = 5, T = 1
(c) a = 10, T = 1 (d) a = 5, T = 2

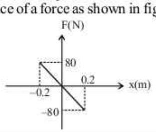
25. A particle moves such that its acceleration 'a' is given by a = – zx where x is the displacement from equilibrium position and z is constant. The period of oscillation is
(a) $2\pi/z$ (b) $2\pi/\sqrt{z}$ (c) $\sqrt{2\pi/z}$ (d) $2\sqrt{\pi/z}$

26. The displacement of an object attached to a spring and executing simple harmonic motion is given by $x = 2\times10^{-2}\cos\pi t$ metre. The time at which the maximum speed first occurs is
(a) 0.25 s (b) 0.5 s (c) 0.75 s (d) 0.125 s

27. A tunnel has been dug through the centre of the earth and a ball is released in it. It executes S.H.M. with time period
(a) 42 minutes (b) 1 day
(c) 1 hour (d) 84.6 minutes

28. The displacement equation of a particle is $x = 3\sin 2t + 4\cos 2t$. The amplitude and maximum velocity will be respectively
(a) 5, 10 (b) 3, 2 (c) 4, 2 (d) 3, 4

29. A body of mass 0.01 kg executes simple harmonic motion about x = 0 under the influence of a force as shown in figure. The time period of SHM is
(a) 1.05 s
(b) 0.52 s
(c) 0.25 s
(d) 0.03 s



30. Two oscillators are started simultaneously in same phase. After 50 oscillations of one, they get out of phase by π, that is half oscillation. The percentage difference of frequencies of the two oscillators is nearest to
(a) 2% (b) 1% (c) 0.5% (d) 0.25%

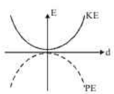
31. The length of a second's pendulum at the surface of earth is 1 m. The length of second's pendulum at the surface of moon where g is 1/6th that at earth's surface is
(a) 1/6 m (b) 6 m (c) 1/36 m (d) 36 m

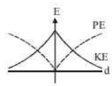
32. A simple spring has length l and force constant K. It is cut into two springs of lengths l_1 and l_2 such that $l_1 = n\,l_2$ (n = an integer). The force constant of spring of length l_1 is
(a) K (1 + n) (b) (K/n) (1 + n)
(c) K (d) K/(n + 1)

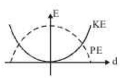
33. The displacement of a particle from its mean position (in metre) is given by $y = 0.2\sin(10\pi t + 1.5\pi)\cos(10\pi t + 1.5\pi)$. The motion of particle is
(a) periodic but not SHM
(b) non-periodic
(c) simple harmonic motion with period 0.1s
(d) simple harmonic motion with period 0.2s.

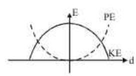
34. A point particle of mass 0.1 kg is executing S.H.M. of amplitude 0.1 m. When the particle passes through the mean position, its kinetic energy is 8×10^{-3} joule. Obtain the equation of motion of this particle, if the initial phase of oscillation is 45°.
(a) $y = 0.1\sin\left(\pm4t+\frac{\pi}{4}\right)$ (b) $y = 0.2\sin\left(\pm4t+\frac{\pi}{4}\right)$
(c) $y = 0.1\sin\left(\pm2t+\frac{\pi}{4}\right)$ (d) $y = 0.2\sin\left(\pm2t+\frac{\pi}{4}\right)$

35. For a simple pendulum, a graph is plotted between its kinetic energy (KE) and potential energy (PE) against its displacement d. Which one of the following represents these correctly? (*graphs are schematic and not drawn to scale*)

(a)


(b)


(c)


(d)


RESPONSE GRID					
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ
	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ
	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ

Space for Rough Work

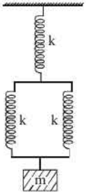
36. The equation of a simple harmonic wave is given by

$$y = 3\sin\frac{\pi}{2}(50t - x)$$

Where x and y are in meters and t is in seconds. The ratio of maximum particle velocity to the wave velocity is

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

37. 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) $2\pi\sqrt{\frac{3m}{2k}}$

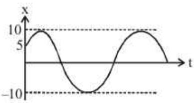
(c) $2\pi\sqrt{\frac{2m}{3k}}$

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

38. 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) go on increasing
(d) go on decreasing

39. The figure shows a position time graph of a particle executing SHM. If the time period of SHM is 2 sec, then the equation of SHM is



(a) $x = 10\cos\pi t$

(b) $x = 5\sin\left(\pi t + \frac{\pi}{3}\right)$

(c) $x = 10\sin\left(\pi t + \frac{\pi}{3}\right)$

(d) $x = 10\sin\left(\pi t + \frac{\pi}{6}\right)$

40. 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

41. The bob of a simple pendulum executes simple harmonic motion in water with a period t, while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is $(4/3) \times 1000$ kg/m^3. The relationship between t and t_0 is

(a) $t = 2t_0$ (b) $t = t_0/2$ (c) $t = t_0$ (d) $t = 4t_0$

42. Starting from the origin a body oscillates simple harmonically with a period of 2 s. After 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

43. A body executes simple harmonic motion under the action of a force F_1 with a time period $\frac{4}{5}$ s. If the force is changed to F_2, it executes S.H.M. 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 second is

(a) $\frac{12}{25}$ (b) $\frac{7}{5}$ (c) $\frac{24}{25}$ (d) $\frac{5}{7}$

44. 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

45. If a simple pendulum of length l has maximum angular displacement θ, then the maximum K.E. of bob of mass m is

(a) $\frac{1}{2}$ ml/g (b) mg/2l
(c) mg$l$(1 – cos θ) (d) mg$l$ sin θ/2

RESPONSE GRID					
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	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ

PHYSICS CHAPTERWISE SPEED TEST-13			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work