OSCILLATIONS

1. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal, when displacement (amplitude = a) is :

(a) $a\sqrt{2}$ (b) $\frac{a}{2}$

(c) $\frac{a\sqrt{2}}{3}$ (d) $\frac{a}{\sqrt{2}}$

2. A man measures the period of simple pendulum inside a stationary lift and finds it to be T sec. If the lift accelerates upwards with an acceleration g/4, then the period of pendulum will be :

(a) $2T\sqrt{5}$ (b) T

(c) $\frac{2T}{\sqrt{5}}$ (d) $\frac{T}{4}$

3. A mass m is suspended from the two coupled springs connected in series. The force constant for springs are K_1 and K_2. The time period of the suspended mass will be :

(a) $T = 2\pi\sqrt{\frac{m}{K_1 - K_2}}$ (b) $T = 2\pi\sqrt{\frac{mK_1K_2}{K_1 + K_2}}$

(c) $T = 2\pi\sqrt{\frac{m}{K_1 + K_2}}$ (d) $T = 2\pi\sqrt{\frac{m(K_1 + K_2)}{K_1K_2}}$

4. The motion of a particle executing S.H.M. is given by $x = 0.01 \sin 100\pi (t + 0.05)$, where x is in metres and time t is in seconds. The time period is:

(a) 0.2 sec (b) 0.1 sec

(c) 0.02 sec (d) 0.01 sec

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

(a) circle (b) figure of eight

(c) straight line (d) ellipse

6. A spring having a spring constant K is loaded with a mass m. The spring is cut into two equal parts and one of these is loaded again with the same mass. The new spring constant is :

(a) K (b) 2K

(c) $\frac{K}{2}$ (d) K^2

7. A spring has a force constant K and a mass m is suspended from it. The spring is cut in half and the same mass is suspended from one of the halves. If the frequency of oscillation in the first case is α, then frequency in the second case will be :

(a) α (b) $\frac{\alpha}{2}$

(c) $\alpha\sqrt{2}$ (d) 2α

8. 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 simple harmonic oscillations with a time period T. If the mass is increased by m, then the time period becomes $\left(\frac{5}{4}T\right)$. The ratio of $\frac{m}{M}$ is :

(a) $\frac{9}{16}$ (b) $\frac{5}{4}$

(c) $\frac{25}{16}$ (d) $\frac{4}{5}$

9. The angular 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 V, then the ratio of T to V 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) $\frac{(a^2 - x^2)}{x^2}$ (d) $\frac{x^2}{(a^2 - x^2)}$

10. 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 K.E. is 8×10^{-3} J. the equation of motion of this particle, if its initial phase of oscillation is 45^o is :

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

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

(c) $y = 0.1 \sin\left(4t - \frac{\pi}{4}\right)$

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

11. The displacement y of a particle executing periodic motion is given by $y = 4 \cos^2\left(\frac{t}{2}\right)$ sin (1000 t). This expression may be considered to be a result of the superposition of how many independent harmonic motions :

(a) five (b) two

(c) three (d) four

12. For a simple pendulum the graph between L and T will be :

(a) A straight line (b) Hyperbola

(c) A curved line (d) Parabola

13. a particle of mass 1 kg is moving in S.H.M. with an amplitude 0.02 m and a frequency of 60 Hz. The maximum force in Newton acting on the particle is:

(a) 188 N^2 (b) 144 N^2

(c) 288 N^2 (d) none

14. The S.H.M. of a particle is given by the equation

$y = 3 \sin \omega t + 4 \cos \omega t$. The amplitude is :

(a) 7 (b) 12

(c) 1 (d) 5

15. The length of a simple pendulum is increased by 1%. Its time period will :

(a) increase by 2% (b) increase by 1%

(c) increase by 0.5% (d) decrease by 0.5%

16. The length of the spring is l and its force constant is K. When a weight W is suspended from it, its length increases by x. If the spring is cut into two equal parts and put in parallel and same weight W is suspended from them, then the extension will be:

(a) x (b) 2x

(c) $\frac{x}{4}$ (d) $\frac{x}{2}$

17. A particle of mass 200 gm executes S.H.M. The restoring force is provided by a spring of force constant 80 N/m. The time period of oscillations is:

(a) 0.15 sec (b) 0.02 sec

(c) 0.31 sec (d) 0.05 sec

18. A particle has simple harmonic motion. The equation of its motion is $x = 5 \sin\left(4t - \frac{\pi}{6}\right)$, where x is its displacement. If the displacement of the particle is 3 units, then its velocity is :

(a) 20 (b) $\frac{5}{6}\pi$

(c) 16 (d) $\frac{2}{3}\pi$

19. A particle moves such that its acceleration a is given by a = –bx, where x is displacement from equilibrium position and b is a constant. The period of oscillation is :

(a) $\frac{2\pi}{\sqrt{b}}$ (b) $2\sqrt{\frac{\pi}{b}}$

(c) $2\pi\sqrt{b}$ (d) $\frac{2\pi}{b}$

20. A linear oscillator of force constant 2×10^6 N/m and amplitude 0.01 m has a total mechanical energy of 160 joules. its :

(a) minimum P.E. is zero

(b) maximum P.E. is 160 J

(c) maximum K.E. is 100 J

(d) maximum P.E. is 100 J

21. A particle execute simple harmonic motion with a frequency f. the frequency with which its kinetic energy oscillates is :

(a) f (b) 2f

(c) 4f (d) $\frac{f}{2}$

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

(a) $\frac{2}{7}$th (b) $\frac{3}{4}$th

(c) $\frac{2}{9}$th (d) $\frac{5}{7}$th

23. a particle executing S.H.M. of amplitude 4 cm and T = 4 se(c) The time taken by it to move from positive extreme position to half the amplitude is :

(a) $\sqrt{\frac{3}{2}}$ sec (b) 1 sec

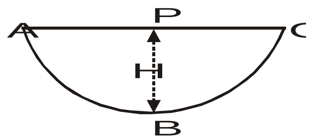
(c) $\frac{1}{3}$ sec (d) $\frac{2}{3}$ sec

24. A body is executing S.H.M. when its displacement from the mean position is 4 cm and 5 cm; the corresponding velocity of the body is 10 cm/sec and 8 cm/sec. Then the time period of the body is:

(a) π sec (b) $\frac{\pi}{2}$ sec

(c) 2π sec (d) $\frac{3\pi}{2}$ sec

25. A simple pendulum with a bob of mass m oscillates from A to C and back to A such that PB is H. If the acceleration due to gravity is g, then the velocity of the bob as it passes through B is :



(a) zero (b) 2gh

(c) mgH (d) $\sqrt{2gH}$

26. A particle is performing simple harmonic motion along x–axis with amplitude 4 cm and time period 1.2 se(c) The minimum time taken by the particle to move from x = + 2 to x = + 4 cm and back again is given by:

(a) 0.4 s (b) 0.3 s

(c) 0.2 s (d) 0.6 s

27. A body executing simple harmonic motion has a maximum acceleration equal to 24 metre/sec^2 and maximum velocity equal to 16 metre/sec. The amplitude of simple harmonic motion is :

(a) $\frac{3}{32}$ metres (b) $\frac{32}{3}$ metres

(c) $\frac{64}{9}$ metres (d) $\frac{1024}{9}$ metres

28. A particle starts S.H.M. from the mean position. Its amplitude is A and time period is T. At the time when its speed is half of the maximum speed, its displacement y is :

(a) $\frac{A}{2}$ (b) $\frac{A}{\sqrt{2}}$

(c) $\frac{A\sqrt{3}}{2}$ (d) $\frac{2A}{\sqrt{3}}$

29. 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) $\frac{a}{3}$ (b) $\frac{a}{2}$

(c) $\frac{2a}{3}$ (d) $\frac{a}{4}$

30. A hollow sphere is filled with water through a small hole in it. It is hung by a long thread and made to oscillate. As the water slowly flows out of the hole at the bottom, the period of oscillation will :

(a) first increase and then decrease

(b) first decrease and then increase

(c) continuously increase

(d) continuously decrease

31. The bob of a pendulum of length l is pulled aside from its equilibrium position through an angle θ and then release(d) The bob will then pass through its equilibrium position with a speed v, where v equals :

(a) $\sqrt{2gl(1-\cos\theta)}$ (b) $\sqrt{2gl(1+\sin\theta)}$

(c) $\sqrt{2gl(1-\sin\theta)}$ (d) $\sqrt{2gl(1+\cos\theta)}$

32. The acceleration of a particle performing S.H.M. is 12 cm/sec^2 at a distance of 3 cm from the mean position. Its time period is :

(a) 2.0 sec (b) 3.14 sec

(c) 0.5 sec (d) 1.0 sec

33. A block of mass m, attached to a spring of spring constant K, oscillate on a smooth horizontal table. The other end of the spring is fixed to a wall. The block has a speed v when the spring is at its natural length. Before coming to an instantaneous rest, if the block moves a distance x from the mean position, then :

(a) $x = \frac{1}{v}\sqrt{\frac{m}{K}}$ (b) $x = v\sqrt{\frac{m}{K}}$

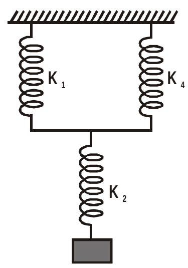
(c) $x = \sqrt{\frac{mv}{K}}$ (d) $x = \sqrt{\frac{m}{K}}$

34. A pendulum bob has a speed of 3 m/s at its lowest position. The pendulum is 0.5 m long. The speed of the bob, when the length makes an angle of 60^o to the vertical, will be (If g = 10 m/s^2)

(a) $\frac{1}{2}$ m/s (b) 2 m/s

(c) 3 m/s (d) $\frac{1}{3}$ m/s

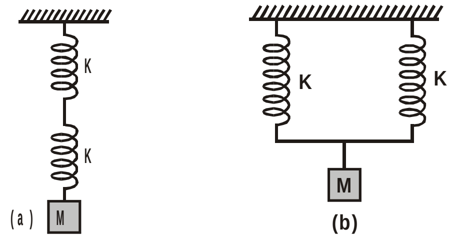
35. What will be the force constant of the spring system shown in figure :



(a) $\frac{K_1}{2} + K_2$ (b) $\left[\frac{1}{2K_1} + \frac{1}{K_2}\right]^{-1}$

(c) $\frac{1}{2K_1} + \frac{1}{K_2}$ (d) $\left[\frac{2}{K_1} + \frac{1}{K_1}\right]^{-1}$

36. Two identical springs of constant K are connected in series and parallel as shown in figure. A mass M is suspended from them. The ratio of their frequencies of vertical oscillations will be :



(a) 2 : 1 (b) 1 : 2

(c) 1 : 4 (d) 4 : 1

37. A simple pendulum of length l is suspended from the roof of a train which moves in a horizontal direction with an acceleration (a) Then the time period T is given by :

(a) $2\pi\sqrt{\frac{l}{g}}$ (b) $2\pi\sqrt{\frac{l}{\sqrt{a^2+g^2}}}$

(c) $2\pi\sqrt{\frac{l}{g+a}}$ (d) $2\pi\sqrt{\frac{l}{g-a}}$

38. If a spring extends by x on loading, then the energy stored by the spring is (if T is tension in the spring and k is spring constant) :

(a) $\frac{T^2}{2x}$ (b) $\frac{T^2}{2k}$

(c) $\frac{2k}{T^2}$ (d) $\frac{2T^2}{k}$

39. The mass and diameter of a planet are twice that of earth; the time period of pendulum on this planet is:

(a) $\left(\frac{1}{\sqrt{2}}\right)$ times that of earth

(b) $\sqrt{2}$ times that of earth

(c) the same

(d) none of these

40. 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 :

(a) 5 (b) 1

(c) 2 (d) 3

41. 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 4 m is suspended from the same spring :

(a) $\frac{n}{4}$ (b) 4 n

(c) $\frac{n}{2}$ (d) 2n

42. Two spring of constants k_1 and k_2, have equal highest velocities, when executing SHM. Then, the ratio of their amplitudes (given their masses are equal) will be :

(a) $\frac{k_1}{k_2}$ (b) $\left(\frac{k_1}{k_2}\right)^{\frac{1}{2}}$

(c) $\frac{k_2}{k_1}$ (d) $\left(\frac{k_2}{k_1}\right)^{\frac{1}{2}}$

43. the displacement x (in metres) of a particle performing Simple Harmonic Motion is related to time t (in seconds) as x = 0.05 cos $\left(4\pi t+\frac{\pi}{4}\right)$. The frequency of the motion will be :

(a) 0.5 Hz (b) 1.0 Hz

(c) 1.5 Hz (d) 2.0 Hz

44. If the metal bob of a simple pendulum is replaced by a wooden bob, then its time period will :

(a) increase (b) decrease

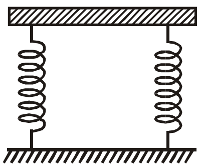
(c) remain the same (d) first 'a' then 'b'

45. Two springs of the same material and same length have their tensions in the ratio 4 : 1 and radii in the ratio 2 : 1. The ratio of their fundamental frequencies is :

(a) 2 (b) $\frac{1}{2}$

(c) 1 (d) 4

46. A uniform circular disc of mass 12 kg is held by two identical springs as shown in the figure. When the disc is pressed down slightly and released, it executes SHM with a time period of 2s. The force constant of each spring is :



(a) 236 N m^{-1} (b) 118.3 Nm^{-1}

(c) 59.13 Nm^{-1} (d) None of these

47. the length of a spring is α when a force of 4 N is applied on it. The length is β when 5 N force is applie(d) the length of spring when 9 N force is applied is :

(a) $5\beta - 4\alpha$ (b) $\beta - \alpha$

(c) $5\alpha - 4\beta$ (d) $9(\beta - \alpha)$

48. To make the frequency double of an oscillator, we have to :

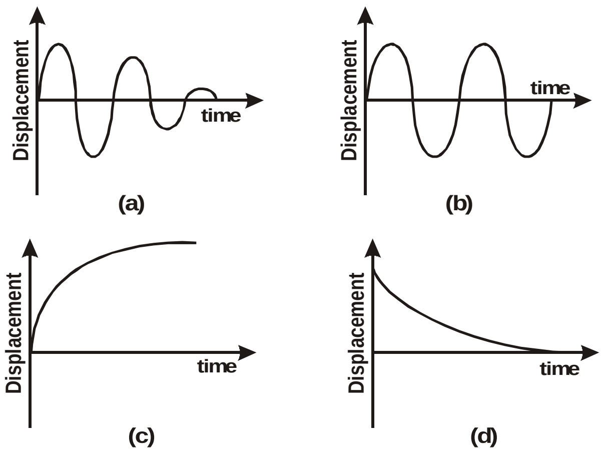
(a) double the mass

(b) half the mass

(c) quadruple the mass

(d) reduce the mass to one–fourth

49. What of the following figure(s) represent(s) damped simple harmonic motions :



(a) figure 1 alone (b) fig. 2 alone

(c) fig. 4 alone (d) fig. 3 and 4

50. A particle execute simple harmonic motion with an angular velocity and maximum acceleration of 3.5 rad/sec and 7.5 m/s^2 respectively. Amplitude of the oscillation is

(a) 0.28 m b) 0.36 m

(c) 0.53 m (d) 0.61 m

ANSWERS KEY

1	D	11	C	21	B	31	A	41	C
2	C	12	D	22	B	32	B	42	D
3	D	13	C	23	D	33	B	43	D
4	C	14	D	24	A	34	B	44	C
5	C	15	C	25	D	35	B	45	C
6	B	16	C	26	A	36	B	46	C
7	C	17	C	27	B	37	B	47	A
8	A	18	C	28	C	38	B	48	D
9	C	19	A	29	B	39	B	49	A
10	D	20	B,C	30	A	40	B	50	D