1. A particle of mass m is executing S.H.M. If amplitude is a and frequency n, the value of its force constant will be :

(1) mn^2 (2) $4mn^2a^2$ (3) ma^2 (4) $4\pi^2mn^2$

2. The equation of motion of a particle executing S.H.M. where letters have usual meaning is :

(1) $\frac{d^2x}{dt^2} = -\frac{k}{m}x$ (2) $\frac{d^2x}{dt^2} = +\omega^2x$

(3) $\frac{d^2x}{dt^2} = -\omega^2x^2$ (4) $\frac{d^2x}{dt^2} = -kmx$

3. The equation of motion of a particle executing simple harmonic motion is $a+16\pi^2x = 0$. In this equation, a is the linear acceleration in m/s^2 of the particle at a displacement x in metre. Find the time period.

(1) 0.50 (2) 0.15

(3) 0.155 (4) 0.25

4. Out of the following functions representing motion of a particle which represents SHM :

(A) $y = \sin\omega t - \cos\omega t$ (B) $y = \sin^3\omega t$

(C) $y = 3\cos\left(\frac{3\pi}{4} - 5\omega t\right)$ (D) $y = 1 + \omega t + \omega^2t^2$

(1) Only (A)

(2) Only (D) does not represent SHM

(3) Only (A) and (C)

(4) Only (A) and (B)

5. The phase of a particle in SHM at time t is $\pi/6$. The following inference is drawn from this:

(1) The particle is at $x = a/2$ and moving in + X-direction

(2) The particle is at $x = a/2$ and moving in – X-direction

(3) The particle is at $x = -a/2$ and moving in + X-direction

(4) The particle is at $x = -a/2$ and moving in – X-direction

6. A particle executes SHM of type $x = a\sin\omega t$. It takes time t_1 from $x = 0$ to $x = \frac{a}{2}$ and t_2 from $x = \frac{a}{2}$ to $x = a$. The ratio of $t_1 : t_2$ will be :

(1) 1 : 1 (2) 1 : 2 (3) 1 : 3 (4) 2 : 1

7. The period of a particle is 8s. At t = 0 it is at the mean position. The ratio of distance covered by the particle in first second and second will be-

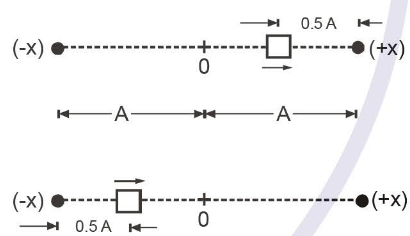
(1) $\frac{\sqrt{2}-1}{\sqrt{2}}$ (2) $\frac{1}{\sqrt{2}}$

(3) $\frac{1}{\sqrt{2}-1}$ (4) $[\sqrt{2}-1]$

8. A particle is executing SHM with time period T. Starting from mean position, time taken by it to complete $\frac{5}{8}$ oscillations, is :-

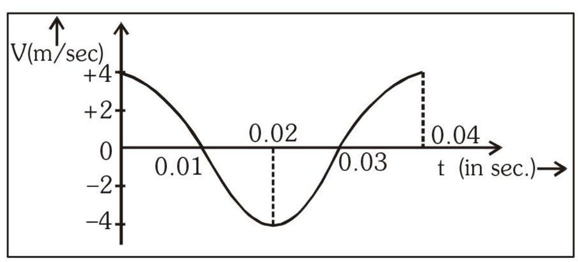
(1) $\frac{T}{12}$ (2) $\frac{T}{6}$ (3) $\frac{5T}{12}$ (4) $\frac{7T}{12}$

9. Two bodies performing S.H.M. have same amplitude and frequency. Their phases at a certain instant are as shown in the figure. The phase difference between them is



(1) $\frac{11}{6}\pi$ (2) π (3) $\frac{\pi}{3}$ (4) $\frac{3}{5}\pi$

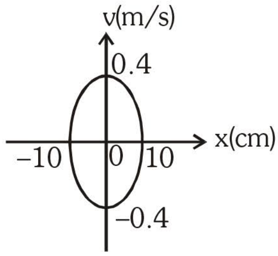
10. The velocity-time diagram of a harmonic oscillator is shown in the adjoining figure. The frequency of oscillation is :



(1) 25 Hz (2) 50 Hz

(3) 12.25 Hz (4) 33.3 Hz

11. The plot of velocity (v) versus displacement (x) of a particle executing simple harmonic motion is shown in figure. The time period of oscillation of particle is :-



(1) $\frac{\pi}{2}$s (2) π s (3) 2π s (4) 3π s

12. A particle is executing S.H.M. of frequency 300 Hz and with amplitude 0.1 cm. Its maximum velocity will be :

(1) 60π cm/s (2) 0.6π cm/s

(3) 0.50π cm/s (4) 0.05π cm/s

13. Average velocity of a particle performing SHM in one time period is :-

(1) Zero (2) $\frac{A\omega}{2}$

(3) $\frac{A\omega}{2\pi}$ (4) $\frac{2A\omega}{\pi}$

14. A particle performing S.H.M. is found at its equilibrium at t = 1 s and it is found to have a speed of 0.25 m/s at t = 2 s. If the period of oscillation is 6s. Calculate amplitude of oscillation

(1) $\frac{3}{2\pi}$ m (2) $\frac{3}{4\pi}$ m

(3) $\frac{6}{\pi}$ m (4) $\frac{3}{8\pi}$m

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

(1) $\frac{-\pi}{6}$ (2) $\frac{\pi}{3}$ (3) $\frac{-\pi}{3}$ (4) $\frac{\pi}{6}$

16. Two identical pendulums oscillate with a constant phase difference $\frac{\pi}{4}$ and same amplitude. If the maximum velocity of one is v, the maximum velocity of the other will be

(1) v (2) $\sqrt{2}$v (3) 2v (4) $\frac{v}{\sqrt{2}}$

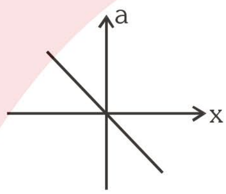
17. The acceleration of a particle in SHM at 5 cm from its mean position is 20 cm/sec^2. The value of angular velocity in radian/second will be :

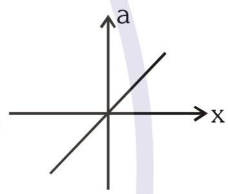
(1) 2 (2) 4 (3) 10 (4) 14

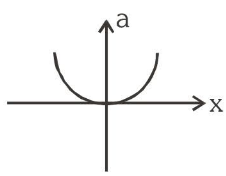
18. If the displacement, velocity and acceleration of a particle in SHM are 1 cm, 1cm/sec, 1cm/sec^2 respectively its time period will be (in seconds) :

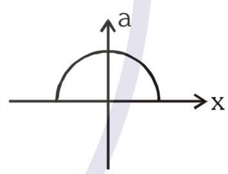
(1) π (2) 0.5π (3) 2π (4) 1.5π

19. The variation of acceleration (a) and displacement (x) of the particle executing SHM is indicated by the following curve :

(1) 

(2) 

(3) 

(4) 

20. A body oscillates with SHM according to the equation $x = 5.0 \cos(2\pi t + \pi)$. At time t = 1.5 s, its displacement, speed and acceleration respectively is :

(1) 0, -10π, + $20\pi^2$ (2) 5, 0, $-20\pi^2$

(3) 2.5, $+20\pi$, 0 (4) –5.0, $+5\pi$, $-10\pi^2$

21. Two simple Harmonic Motions of angular frequency 500 and 5000 rads^{-1} have the same displacement amplitude. The ratio of their maximum accelerations is:-

(1) 1 : 10^3 (2) 1 : 10^4 (3) 1 : 10 (4) 1: 10^2

22. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then its time period of vibration will be :-

(1) $\frac{2\pi\beta}{\alpha}$ (2) $\frac{\beta^2}{\alpha^2}$ (3) $\frac{\alpha}{\beta}$ (4) $\frac{\beta^2}{\alpha}$

23. A particle executes linear simple harmonic motion with an amplitude of 5 cm. When the particle is at 3 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is :-

(1) $\frac{2}{3\pi}$ (2) $\frac{3\pi}{2}$ (3) $\frac{2\pi}{3}$ (4) $\frac{3}{2\pi}$

24. A body executes S.H.M. with an amplitude A. At what displacement from the mean position, is the potential energy of the body one-fourth of its total energy?

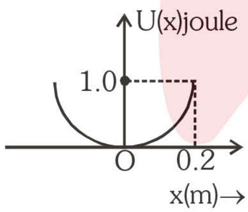
(1) $\frac{A}{4}$

(2) $\frac{A}{2}$

(3) $\frac{3A}{4}$

(4) Some other fraction of A

25. A particle of mass 4 kg moves simple harmonically such that its PE (U) varies with position x, as shown. The period of oscillations is :-



(1) $\frac{2\pi}{25}$s (2) $\frac{\pi\sqrt{2}}{5}$s

(3) $\frac{4\pi}{5}$s (4) $\frac{2\pi\sqrt{2}}{5}$s

26. The force acting on a 4gm mass in the energy region $U = 8x^2$ at $x = -2$cm is :

(1) 8 dyne (2) 4 dyne

(3) 16 dyne (4) 32 dyne

27. A particle describes SHM in a straight line about O.

If the time period of the motion is T then its kinetic energy at P be half of its peak value at O, if the time taken by the particle to travel from O to P is

(1) $\frac{1}{2}$T (2) $\frac{1}{4}$T (3) $\frac{1}{2\sqrt{2}}$T (4) $\frac{1}{8}$T

28. The total energy of a harmonic oscillator of mass 2kg is 9 joules. If its potential energy at mean position is 5 joules, its K.E. at the mean position will be :

(1) 9J (2) 14J (3) 4J (4) 11J

29. The 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 :-

(1) K_o and K_o (2) 0 and $2K_o$

(3) $\frac{K_o}{2}$ and K_o (4) K_o and $2K_o$

30. If <E> and <V> denotes the average kinetic and average potential energies respectively of mass describing a simple harmonic motion over one period then the correct relation is:

(1) <E> = <V> (2) <E> = 2<V>

(3) <E> = –2<V> (4) <E> = – <V>

31. The potential energy of a simple harmonic oscillator at mean position is 3 joules. If its mean K.E. is 4 joules, its total energy will be :

(1) 7J (2) 8J (3) 10J (4) 11J

32. Simple pendulum of large length is made equal to the radius of the earth. Its period of oscillation will be :

(1) 84.6 min. (2) 59.8 min.

(3) 42.3 min. (4) 21.15 min.

33. A lift is ascending with acceleration g/3. What will be the time period of a simple pendulum suspended from its ceiling if its time period in stationary lift is T ?

(1) $\frac{T}{2}$ (2) $\frac{\sqrt{3}\,T}{2}$ (3) $\frac{\sqrt{3}\,T}{4}$ (4) $\frac{T}{4}$

34. A simple pendulum performs simple harmonic motion about x = 0 with an amplitude a and time period T. The speed of the pendulum at x = a/2 will be :-

(1) $\frac{\pi a\sqrt{3}}{T}$ (2) $\frac{\pi a\sqrt{3}}{2T}$ (3) $\frac{\pi a}{T}$ (4) $\frac{3\pi^2 a}{T}$

35. The period of oscillation of simple pendulum of length L suspended from the roof of the vehicle which moves without friction, down on an inclined plane of inclination α, is given by :-

(1) $2\pi\sqrt{\frac{L}{g\cos\alpha}}$ (2) $2\pi\sqrt{\frac{L}{g\sin\alpha}}$

(3) $2\pi\sqrt{\frac{L}{g}}$ (4) $2\pi\sqrt{\frac{L}{g\tan\alpha}}$

36. The time period of oscillations of a simple pendulum is 1 minute. If its length is increased by 44%, then its new time period of oscillation will be :-

(1) 96 s (2) 58 s (3) 82 s (4) 72 s

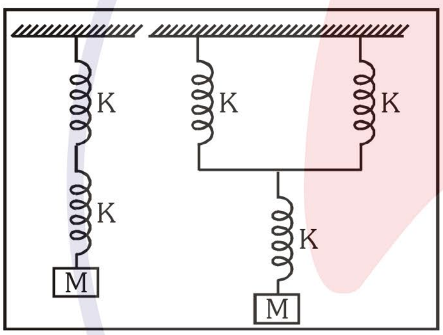
37. Two pendulums of length 1.21 m and 1.0 m start vibrating. At some instant, the two are in the mean position in same phase. After how many vibrations of the longer pendulum, the two will be in phase?

(1) 10 (2) 11 (3) 20 (4) 21

38. 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 16 m/s^2 at a distance of 4 m from the mean position. The time period of oscillation is :-

(1) 2π s (2) π s (3) 2 s (4) 1 s

39. Some springs are combined in series and parallel arrangement as shown in the figure and a mass M is suspended from them. The ratio of their frequencies will be :



(1) 1 : 1 (2) 2 : 1 (3) $\sqrt{3}$: 2 (4) 4 : 1

40. 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 oscillations are equal, the ratio of amplitudes of A and B is-

(1) $\sqrt{k_1/k_2}$ (2) k_1/k_2

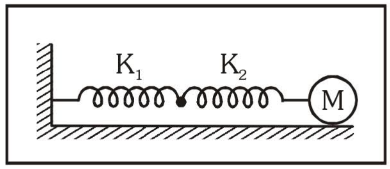
(3) $\sqrt{k_2/k_1}$ (4) k_2/k_1

41. A block of mass m is suspended separately by two different springs have time period t_1 and t_2. If same mass is connected to parallel combination of both springs, then its time period is given by :-

(1) $\dfrac{t_1 t_2}{t_1 + t_2}$ (2) $\dfrac{t_1 t_2}{\sqrt{t_1^2 + t_2^2}}$

(3) $\sqrt{\dfrac{t_1 t_2}{t_1 + t_2}}$ (4) $t_1 + t_2$

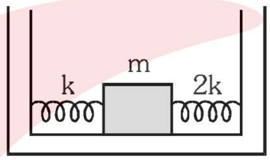
42. As shown in the figure, two light springs of force constant K_1 and K_2 oscillate a block of mass M. Its effective force constant will be :



(1) K_1K_2 (2) $K_1 + K_2$

(3) $\dfrac{1}{K_1} + \dfrac{1}{K_2}$ (4) $\dfrac{K_1K_2}{K_1 + K_2}$

43. Two springs of force constant k and 2k are connected to a mass as shown below. The frequency of oscillation of the mass is :



(1) $\dfrac{1}{2\pi}\sqrt{\dfrac{k}{m}}$ (2) $\dfrac{1}{2\pi}\sqrt{\dfrac{2k}{m}}$

(3) $\dfrac{1}{2\pi}\sqrt{\dfrac{3k}{m}}$ (4) $\dfrac{1}{2\pi}\sqrt{\dfrac{m}{k}}$

44. In an artificial satellite, the use of a pendulum watch is discarded, because :

(1) The satellite is in a constant state of motion
(2) The effective value of g becomes zero in the artificial satellite
(3) The periodic time of the pendulum watch is reduced
(4) None of these

45. A body of mass m is attached to the 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 2 kg, the time period of oscillations becomes 5 s. The value of m in kg is :-

(1) $\dfrac{8}{9}$ (2) $\dfrac{9}{8}$ (3) $\dfrac{9}{16}$ (4) $\dfrac{16}{9}$

46. The amplitude of a SHM reduces to 1/3 in first 20 second then in first 40 second its amplitude becomes:

(1) $\frac{1}{3}$ (2) $\frac{1}{9}$ (3) $\frac{1}{27}$ (4) $\frac{1}{\sqrt{3}}$

47. Amplitude of vibrations remains constant in case of

(i) free vibrations

(ii) damped vibrations

(iii) maintained vibrations

(iv) forced vibrations

(1) i, iii, iv (2) ii, iii

(3) i, ii, iii (4) ii, iv

48. In the following four :

(i) Time period of revolution of a satellite just above the earth's surface (T_{st})

(ii) Time period of oscillation of ball inside the tunnel bored along the diameter of the earth (T_{ma})

(iii) Time period of simple pendulum having a length equal to the earth's radius in a uniform field of 9.8 newton/kg (T_{sp})

(iv) Time period of an infinite simple pendulum in the earth's gravitational field (T_{is})

Which of the following is true

(1) $T_{st} > T_{ma}$ (2) $T_{ma} > T_{st}$

(3) $T_{sp} > T_{is}$ (4) $T_{st} = T_{ma} = T_{sp} = T_{is}$

49. A block is resting on a piston which executes simple harmonic motion with a period 2.0 s. The maximum velocity of the piston, at an amplitude just sufficient for the block to separate from the piston is :- (g = 10 m/s^2)

(1) 1.57 ms^{-1} (2) 3.14 ms^{-1}

(3) 1 ms^{-1} (4) 6.42 ms^{-1}

50. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = Kt^2$, (K = 1 m/s^2) where y is the vertical displacement. The time period now becomes T_2. The ratio of $\frac{T_1^2}{T_2^2}$ is : (g = 10 m/s^2)

(1) $\frac{6}{5}$ (2) $\frac{5}{6}$ (3) 1 (4) $\frac{4}{5}$

ANSWER KEY

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