CHAPTER 7

OSCILLATIONS

MCQs

1. If the spring of spring constant K is cut into two pieces, then spring constant of each spring is:
   (a) k (b) 2k (c) k/2 (d) none of these
2. The angle $\theta = \omega t$ which specifies the displacement as well as direction of motion of the point executing SHM is known as:
   (a) phase (b) critical angle (c) plane angle (d) solid angle
3. The time period of simple pendulum:
   (a) $T = \frac{1}{2\pi}\sqrt{\frac{l}{g}}$ (b) $T = 2\pi\sqrt{\frac{g}{l}}$ (c) $T = 2\pi\sqrt{\frac{l}{g}}$ (d) $T = 2\pi\sqrt{\frac{g}{l}}$
4. The total energy of a particle executing SHM at any displacement x is given by:
   (a) kx (b) $\frac{k}{x}$ (c) $\frac{1}{2}kx^2$ (d) $\frac{1}{2}kx_0^2$
5. The frequency of a second pendulum is:
   (a) 1 Hz (b) 0.5 Hz (c) 1.5 Hz (d) 2Hz
6. Tuning of a radio is the best example of:
   (a) mechanical resonance (b) electrical resonance
   (c) damping (d) phase modulation
7. The oscillation in which amplitude decreases steadily with the time is called:
   (a) natural oscillation (b) damped oscillation
   (c) free oscillation (d) forced oscillation
8. Distance covered during one vibration of an oscillating body in terms of amplitude A is:
   (a) A (b) 4A (c) $\frac{A}{2}$ (d) 2A
9. The product of time period and frequency is:
   (a) zero (b) 1 (c) $\pi 2$ (d) 2
10. The cooking and heating of food by microwave oven is an example of:
    (a) SHM (b) resonance
    (c) damsped oscillation (d) none of these
11. If the time period of simple pendulum is 2 seconds, its frequency will be:
    (a) 0.1 Hz (b) 0.5 Hz (c) 1.5 Hz (d) 2Hz
12. The SI units of spring constant are:
    (a) m^{-1} (b) Nm^{-1} (c) Nm^{-2} (d) Nm^2
13. If F = 0.08N and x = 4 cm then K = :
    (a) $6Nm^{-1}$ (b) $3Nm^{-1}$ (c) $8Nm^{-2}$ (d) $2Nm^{-1}$
14. The process in which energy is dissipated in oscillating system is called:
    (a) resonance (b) forced oscillation (c) damping (d) none
15. Angular frequency is basically a characteristics of:

(a) circular motion (b) linear motion (c) vibratory motion (d) elliptical motion

16. At mean position during SHM:
    (a) PE is maximum and KE is minimum (b) PE is minimum and KE is maximum
    (c) both are maximum (d) both KE and PE are minimum
17. The time period of a spring mass vibratory system is given as:
    (a) $T = 2\pi\sqrt{\frac{m}{k}}$ (b) $T = 2\pi\sqrt{\frac{k}{m}}$ (c) $T = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ (d) none of these
18. The wave form of a body executing SHM is:
    (a) square wave (b) sine wave (c) circular wave pulse (d) pulse
19. In SHM the velocity of the particle is maximum at:
    (a) mean position (b) extreme position
    (c) in between mean and extreme position (d) none
20. The frequency of waves produced in microwave oven is:
    (a) 1435 MHZ (b) 2450 MHZ (c) 1860 MHZ (d) 2850 MHZ
21. Units of spring constant are similar to the units of:
    (a) force (b) momentum (c) pressure (d) surface tension
22. Units used for factor $\sqrt{\frac{l}{g}}$ may be:
    (a) meter (b) second (c) kilogram (d) radian
23. The acceleration of a body performing SHM depends upon its:
    (a) mass (b) time period (c) amplitude (d) displacement
24. If “f” is the frequency of a body executing SHM, its angular frequency "ω" is:
    (a) $4\pi f$ (b) $2\pi f$ (c) $3\pi f$ (d) none of these
25. If mass of the suspended bob of pendulum becomes double, then its time period will be:
    (a) double (b) half (c) four time (d) remains same
26. The relation between time period and angular frequency is:
    (a) $\omega = 2\pi T$ (b) $\omega = \frac{2\pi}{T}$ (c) $\omega = \frac{2T}{\pi}$ (d) $\omega = \frac{\pi}{2T}$
27. The dimensions of spring constant are:
    (a) $[MLT^{-2}]$ (b) $[MLT^{-1}]$ (c) $[MT^{-2}]$ (d) [MLT]
28. The product of angular frequency (ω) and time period will be:
    (a) 1 (b) 2π (c) $\pi/2$ (d) π
29. A simple pendulum is oscillating in a lift. If the lift starts moving upwards with a uniform acceleration, then the time period will:
    (a) Remain unaffected (b) Be longer (c) Be shorter (d) Maybe “B” or “C”
30. A particle is executing SHM then the graph of acceleration as a function of displacement is:
    (a) Straight line (b) Ellipse (c) Circle (d) Hyperbola
31. A particle executing SHM has an acceleration of 65 cm s^{-2} when its displacement is 4cm, its period is second is:
    (a) $\pi/2$ (b) π (c) $\pi/4$ (d) 4π
32. At t = 0 a body performing SHM is at mean position, when t = T/4 it will be at:
    (a) At extreme position (b) Between mean and extreme position
    (c) Beyond extreme position (d) Again at mean position
33. The displacement of particle in SHM in one time period if its amplitude of vibration is “a” will be:

(a) Zero (b) 2a (c) a (d) 4a

34. The maximum velocity of harmonic oscillator is $10 cms^{-1}$. If its amplitude is 10 cm. What is its maximum acceleration?

(a) $100 cm\ s^{-2}$ (b) $10 cm\ s^{-2}$ (c) $1 cm\ s^{-2}$ (d) $0.1 cm\ s^{-2}$

35. The relation of restoring force in a simple pendulum if it makes an angle "θ" with horizontal is:

(a) $mg \sin\theta$ (b) $mg \cos\theta$ (c) $mg \tan\theta$ (d) $mg \cot\theta$

36. If the displacement in SHM is written by equation $x = x_o \cos\omega t$ the value of initial phase in this case is:

(a) $0°$ (b) $90°$ (c) $45°$ (d) $180°$

37. Spring constant of a spring and its length are related as:

(a) $k \alpha 1$ (b) $k \alpha \sqrt{1}$ (c) $k \alpha 1^{-1}$ (d) $k \alpha 1^{-1/2}$

38. A simple pendulum has frequency of 2 Hz. How long does it take to move from mean to extreme to extreme position:

(a) 0.12s (b) 0.5s (c) 0.2s (d) 0.05s

39. The relation for instantaneous velocity for a simple harmonic oscillator is:

(a) $v = \omega\sqrt{x_0^2 - x^2}$ (b) $v = \sqrt{\frac{k}{m}(x_0^2 - x^2)}$ (c) $v = \sqrt{\frac{g}{l}(x_0^2 - x^2)}$ (d) All of these

40. When of the following can be true for "ω"?

(a) $\sqrt{\frac{k}{m}}$ (b) $\sqrt{\frac{g}{l}}$ (c) $\frac{2\pi}{T}$ (d) All of these

41. For a simple harmonic oscillator which of the following is true for maximum acceleration?

(a) $A = \omega x_o$ (b) $a = k/m\, x_o$ (c) $a = -g/\ell x_o$ (d) All of these

42. The displacement covered by a simple harmonic oscillator in a time of $\frac{3}{4}T$ while starting from extreme position with amplitude "a":

(a) Zero (b) 4a (c) 2a (d) 6a

43. A uniform circular motion is:

(a) A periodic motion only (b) A simple harmonic motion only

(c) Both periodic and harmonic motion (d) Neither periodic not harmonic motion

44. In SHM when displacement is equal to $\frac{x_o}{2}$, then the ratio of P.E to K.E is:

(a) 2:3 (b) 3:3 (c) 1:3 (d) 3:1

45. When K.E and P.E in SHM become equal to the displacement is?

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

46. The time period of a simple pendulum is independent of:

(a) Length of pendulum (b) Value of gravity (c) Centre of mass (d) None of these

47. Wavelength of microwaves used in oven is:

(a) 12 m (b) 12 cm (c) 12mm (d) 12nm

48. What is the phase difference between velocity and displacement in SHM:

(a) 0 (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) π

49. The time period of a simple pendulum measured inside a stationary lift is T. If the lift stands moving its time period?

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

50. A student made a simple pendulum of time period 1 s. The string used is length of 1 m, in order to make a simple pendulum of time period 2 s, he should use a string of length:
    (a) 2 m (b) 3 m (c) 4 cm (d) 4 m
51. A girl is swinging on a swing in the sitting position. How will the time period of swing be affected if she stands up?
    (a) the time period will now be shorter (b) the time period will now be longer
    (c) the time period will now be unchanged (d) None of these
52. If a simple pendulum is shifted from Lahore to mount Everest, then its time period:
    (a) does not change (b) decreases (c) increases (d) none of these
53. At what place motion of simple pendulum will be slowest:
    (a) poles (b) equator
    (c) on the surface of earth (d) at the center of earth
54. A particle executes SHM with frequency f. The frequency with which its K.E. oscillate:
    (a) f (b) 2f (c) 3f (d) 4f
55. A simple harmonic oscillator has time period T. The time taken by it to travel from extreme position to half of the amplitude is:
    (a) T/6 (b) T/4 (c) T/8 (d) T/2
56. Two springs have force constants in the ratio of 4:9. Their time periods are in the ratio of:
    (a) 3:2 (b) 2:3 (c) 1:3 (d) 3:1
57. A pendulum clock that keeps correct time on earth is taken to moon. It will run:
    (a) slower (b) faster (c) no change (d) none of these

SHORT QUESTIONS

1. Define amplitude of a vibrating body.
2. Show that waveform of SHM (experimentally) is sine wave.
3. Define vibration.
4. Define phase.
5. Define a formula for speed of mass attached to a spring, and vibrating, at mean position.
6. Define second pendulum.
7. Calculate length of second pendulum.
8. At what displacement K.E = P.E of a vibrating mass spring system.
9. Define damped oscillations.
10. Does frequency depend on amplitude for harmonic oscillators?
11. Can we realize an ideal simple pendulum?
12. What is the total distance travelled by an object moving with SHM in a time equal to its time period, if its amplitude is A?
13. What happens to the period of simple pendulum if its length is doubled? What happens if the suspended mass is doubled?
14. Does the acceleration of a simple harmonic oscillator remain constant during its motion? Is the acceleration ever zero? Explain.
15. Describe some common phenomena in which resonance plays an important role.
16. If a mass system is hung vertically and set into oscillations, why does the motion eventually stop?
17. Show that in simple harmonic motion the accelerate is zero when velocity is greatest and velocity is zero when acceleration is greatest.

LONG QUESTIONS

1. Show that the acceleration at any instant of a body executing SHM is proportional to displacement and is always directed towards its mean position.
2. Calculate instantaneous velocity of projection N of a point P moving in circle.
3. Define simple pendulum. Derive formula for its time period.
4. Explain energy conservation in SHM.

PROBLEMS

1. A 100.0 g body is hung on a spring, which elongates the spring by 4.0 cm. when a certain object is hung on the spring and set vibrating, its period is 0.568 s. What is the mass of the object pulling the spring?
2. An 8.0 kg body executes SHM with amplitude 30 cm. The restoring force is 60 N when the displacement is 30 cm. Find:
   (i) Period
   (ii) Acceleration, Speed, K.E. and P.E. when the displacement is 12 cm.
3. A block of mass 4.0 kg is dropped from a height of 0.80 m on to a spring of spring constant K = 1960 Nm^{-1}. Find the maximum distance through which the spring will be compressed.
4. A simple pendulum is 50.0 cm long. What will be its frequency of vibration at a place where g = 9.8 ms^{-2}.
5. Find the amplitude, frequency and period of an object vibrating at the end of a spring, if the equation for its position, as a function of time t is $x = 0.25\cos\left(\frac{\pi}{8}\right)t$ What is the displacement of the object after 2.0 s?