CBSE

OSCILLATIONS WS 8

Class 11 - Physics

Section A

1. A body is executing S.H.M When its displacement from the mean position is 4 cm and 5 cm, the corresponding velocities of the body are 10 cm per sec and 8 cm per sec. Then the time period of the body is: **[1]**

   a) 4π sec
   b) $\frac{3\pi}{2}$ sec
   c) $2\ \pi$ sec
   d) π sec

2. A particle executing SHM has an amplitude of 6 cm. Its acceleration at a distance of 2 cm from the mean position is 8 cm/s^2. The maximum speed of the particle in cm/s is **[1]**

   a) 16
   b) 4
   c) 24
   d) 12

3. A particle executes S.H.M with a period of 6 seconds and amplitude 3 cm. Its maximum speed in cm/sec is: **[1]**

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

4. Two simple harmonic motions of angular frequency 100 rads^{-1} and 1000 rads^{-1} have the same displacement amplitude. The ratio of their maximum acceleration is **[1]**

   a) $1 : 10^3$
   b) 1 : 10
   c) $1 : 10^4$
   d) $1 : 10^2$

5. For a particle executing S.H.M having amplitude A, the speed of the particle is one-half of its maximum speed when its displacement from the mean position is: **[1]**

   a) x = $\frac{\sqrt{3}}{2}A$
   b) x = 2A
   c) x = $\sqrt{3}A$
   d) x = $\frac{A}{2}$

6. A particle executes SHM of amplitude A. If T_1 and T_2 are the times taken by the particle to traverse from 0 to $\frac{A}{2}$ and from $\frac{A}{2}$ to A respectively, then $\frac{T_1}{T_2}$ will be equal to **[1]**

   a) 1
   b) $\frac{1}{4}$
   c) 2
   d) $\frac{1}{2}$

7. The maximum velocity and maximum acceleration of a body moving in a simple harmonic oscillation are 2 m/s and 4 m/s^2. The angular velocity is: **[1]**

   a) 1 rad/sec
   b) 4 rad/sec
   c) 5 rad/sec
   d) 2 rad/sec

8. Velocity of a body moving in simple harmonic motion is **[1]**

a) $\omega\sqrt{a^2+y^2}$ b) $\omega^2\sqrt{a^2+y^2}$

c) $\omega^2\sqrt{a^2-y^2}$ d) $\omega\sqrt{a^2-y^2}$

9. The angular velocities of three bodies in simple harmonic motion are ω_1, ω_2, ω_3 with the respective amplitudes as A_1 A_2 A_3 . If all the three bodies have the same mass and velocity, then **[1]**

a) $A^2{}_1\omega_1 = A^2{}_2\omega_2 = A^2{}_3\omega_3$ b) $A_1\omega^2{}_1 = A^2{}_2\omega^2{}_2 = A^2{}_3\omega^2{}_3$

c) $A_1\omega_1 = A_2\omega_2 = A_3\omega_3$ d) $A^2{}_1\omega^2{}_1 = A^2{}_2\omega^2{}_2 = A^2{}_3\omega^2{}_3$

10. A particle executing simple harmonic motion with an amplitude A and angular frequency ω. The ratio of maximum acceleration to the maximum velocity of the particle is **[1]**

a) ωA b) $\frac{\omega^2}{A}$

c) ω^2 A d) ω

11. A particle executing SHM has amplitude 0.01 m and frequency 60 Hz. The maximum acceleration of the particle is **[1]**

a) 60 π^2 m/s^2 b) 80 π^2 m/s^2

c) 120 π^2 m/s^2 d) 144 π^2 m/s^2

12. If a simple harmonic oscillator has got a displacement of 0.02 m and acceleration equal to 2.0 m/s^2 at any time, the angular frequency of the oscillator is equal to: **[1]**

a) 100 rad/s b) 0.1 rad/s

c) 10 rad/s d) 1 rad/s

13. **Assertion:** In S.H.M., the motion is to and fro and periodic. **[1]**
Reason: Velocity of the particle, $v = \omega\sqrt{a^2-x^2}$ where x is displacement.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

14. **Assertion:** In simple harmonic motion, the velocity is maximum, when the acceleration is minimum. **[1]**
Reason: Displacement and velocity in simple harmonic motion differ in phase by $\frac{\pi}{2}$.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

15. If the distance y of a point moving on a straight line measured from a fixed origin on it and velocity v are connected by the relation 4v^2 = 25 - y^2, then show that the motion is simple harmonic and find its time period. **[1]**

16. A sphere is hung with a wire. 30° rotation of the sphere about the wire generates a restoring torque of 4.6 Nm. If the moment of inertia of the sphere is 0.082 kg m^2, deduce the frequency of angular oscillations. **[1]**

17. How much is KE for displacement equal to half the amplitude? **[1]**

18. Does the direction of acceleration at various points during the oscillation of a simple pendulum remain towards mean position? **[1]**

19. What is the phase difference between the displacement and acceleration of a particle executing S.H.M.? **[1]**

20. What is the maximum acceleration of a particle in simple harmonic motion? **[1]**

21. Write the relation between time period T, displacement x and acceleration a of a particle in S.H.M. **[1]**

22. A block is resting on a piston which is moving vertically with simple harmonic motion of period 1.0 second. At what amplitude of motion will he block and piston separate? What is the maximum velocity of the piston at this amplitude? **[1]**

23. The relation between the acceleration a and displacement x of a particle executing S.H.M. is a = - ($\frac{p}{q}$) y, where p and q are constants. What will be the time period T of the particle? **[1]**

24. When are the velocity and acceleration in the same direction in S.H.M.? **[1]**

Section B

25. An 8kg body performs S.H.M. of amplitude 30 cm. The restoring force is 60N when the displacement is 30cm. Find - a) Time period b) the acceleration c) potential and kinetic energy when the displacement is 12cm? **[2]**

26. A particle executes S.H.M. of time period 10 seconds. The displacement of particle at any instant is given by: x = 10 sin ωt(in cm). Find **[2]**

    i. the velocity of body 2s after it passes through mean position

    ii. the acceleration 2s after it passes the mean position.

27. A particle executes SHM on a straight line path. The amplitude of oscillation is 2 cm. When the displacement of the particle from the mean position is 1 cm, the magnitude of its acceleration is equal to its velocity. Find the time period, maximum velocity and maximum acceleration of SHM. **[2]**

28. i. In SHM of a particle, draw graphs showing variation in **[2]**

    a. displacement,

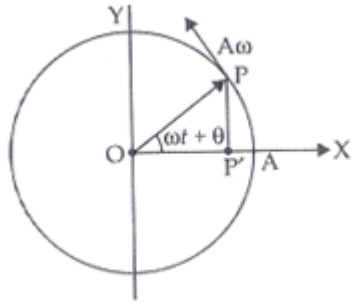
    b. velocity and

    c. acceleration with time. Hence discuss the phase relationship between them using proper equations.

    ii. If the following function represents SHM of a particle, find the amplitude of oscillation,

    $F(t) = (\sin\omega t - \cos\omega t)$ units

29. In Figure what will be the sign of the velocity of the point P′ which is the projection of the velocity of the reference particle P. P is moving in a circle of radius R in anticlockwise direction. **[2]**



30. Show that if a particle is moving in SHM, its velocity at a distance $\frac{\sqrt{3}}{2}$ of its amplitude from the central position is half its velocity in central position. **[2]**

31. Show that in simple harmonic motion (S.H.M.), the acceleration is directly proportional to its displacement at the given instant. **[2]**

32. What is the ratio of maximum acceleration to the maximum velocity of a simple harmonic motion? **[2]**

33. A body is executing SHM according to the equation: y = 14 sin(100πt + $\frac{\pi}{6}$) cm. Find its maximum speed and **[2]**

maximum acceleration.

34. Two linear simple harmonic motions of equal amplitudes and angular frequency w and 2 w are impressed on a particle along axis X and Y respectively. If the initial phase difference between them is $\frac{\pi}{2}$, find the resultant path followed by the particle? **[2]**

35. The amplitude of a simple harmonic oscillator is doubled. How does this affect **[2]**

i. periodic time,

ii. maximum velocity,

iii. maximum acceleration and

iv. maximum energy?

36. In case of an oscillating simple pendulum what will be the direction of acceleration of the bob at (a) the mean position, (b) the end points? **[2]**

Section C

37. **State True or False:** **[3]**

(a) The acceleration of particle performing SHM is always towards the mean position. **[1]**

(b) The acceleration of a particle in SHM lags behind its velocity in phase by $\frac{\pi}{2}$ rad. **[1]**

(c) The ratio of maximum acceleration to the maximum displacement of a particle performing simple harmonic motion is equal to angular velocity. **[1]**

38. A body oscillates with SHM according to the equation (in SI units), **[3]**

$x = 5 \cos [2\pi t + \frac{\pi}{4}]$.

At t = 1.5 s, calculate the

a. displacement,

b. speed and

c. acceleration of the body

39. A uniform cord have a mass 0.2 kg and length 6 m. If tension is maintained in the cord by suspending a mass of 3 kg from one end, then find out the speed of a pulse on this cord. Also find the time, it takes the pulse to travel from the wall to the pulley. **[3]**

Section D

40. Explain the relation in phase between displacement, velocity and acceleration in SHM, graphically as well as theoretically. **[5]**

Section E

41. **Fill in the blanks:** **[8]**

(a) The acceleration of a particle in SHM acts in the _____ direction of its displacement. **[1]**

(b) A particle executes SHM with a period of $\frac{11}{7}$s and an amplitude of 0.025 m. The maximum value of acceleration is _____ ms^{-2}. **[1]**

(c) The direction of acceleration of the bob at its mean position is _____ i.e., towards the point of suspension. **[1]**

(d) The _____ of a particle executing SHM at any instant is defined as the time rate of change of its displacement at that instant. **[1]**

(e) _____ of a body executing periodic motion is equal to the product of frequency of the particle with factor 2π. **[1]**

(f) The acceleration of a particle in SHM is _____ at the mean position and _____ at the extreme position. **[1]**

(g) If the displacement of a particle executing SHM is $y = 0.24 \sin (400t + 0.5)$, then the maximum velocity of the particle is _____ ms^{-1} and its initial phase is _____ rad. **[1]**

(h) The _____ of the particle executing SHM at any instant is defined as the time rate of change of its velocity at that instant. **[1]**