Topic Name : Oscillations (PVCSHM1)
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Instructor: Vikas Sharma Sir

Target: JEE Main & Advanced | NEET
Marking Scheme: +4 & -1
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1. Which of the following expressions does not represent SHM?

(a) $A\cos\omega t$ (b) $A\sin 2\omega t$

(c) $A\sin\omega t + B\cos\omega t$ (d) $A\sin^2\omega t$

2. The differential equation of a particle executing simple harmonic motion along y-axis is

(a) $\frac{d^2y}{dt^2} + \omega^2 y = 0$

(b) $\frac{d^2y}{dt^2} + \omega^2 y^2 = 0$

(c) $\frac{d^2y}{dt^2} - \omega^2 y = 0$

(d) $\frac{dy}{dt} + \omega y = 0$

3. A simple harmonic motion having an amplitude A and time period T is represented by the equation

$y = 5\sin\pi(t+4)$ m

Then the values of A (in m) and T (in sec) are

(a) $A = 5;\ T = 2$ (b) $A = 10;\ T = 1$

(c) $A = 5;\ T = 1$ (d) $A = 10;\ T = 2$

4. If the maximum velocity and acceleration of a particle executing SHM are equal in magnitude, the time period will be

(a) 1.57 seconds (b) 3.14 seconds

(c) 6.28 seconds (d) 12.56 seconds

5. How long after the beginning of motion is the displacement of a harmonically oscillating point equal to one half its amplitude, if the period is 24 seconds and initial phase is zero?

(a) 12 seconds (b) 2 seconds

(c) 4 seconds (d) 6 seconds

6. A particle is executing SHM with amplitude A and has maximum velocity V_o. Its speed at displacement $A/2$ will be

(a) $(\sqrt{3})V_o/2$ (b) $V_o/\sqrt{2}$

(c) V_o (d) $V_o/4$

7. A particle under the action of a SHM has a period of 3 seconds and under the effect of another it has a period 4 seconds. What will be its period under the combined action of both the SHM's in the same direction?

(a) 7 seconds (b) 5 seconds

(c) 2.4 seconds (d) 0.4 seconds

8. The displacement x of a particle in motion is given in terms of time by $x(x-4) = 1 - 5\cos\omega t$.

(a) The particle executes SHM.

(b) The particle executes oscillatory motion which is not SHM.

(c) The motion of the particle is neither oscillatory nor simple harmonic.

(d) The particle is not acted upon by a force when it is at $x = 4$.

9. The equation of SHM is given as

$x = 3\sin 20\pi t + 4\cos 20\pi t$,

where x is in cms and t is in seconds. The amplitude is

(a) 7 cm (b) 4 cm

(c) 5 cm (d) 3 cm

10. What should be the displacement of a simple pendulum whose amplitude is A, at which potential energy is $\frac{1}{4}$th of the total energy?

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

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

11. A particle is executing SHM with amplitude A and has a maximum velocity V_o. The displacement at which its velocity will be $(V_o/2)$ and the velocity at displacement $A/2$ are

(a) $\frac{A}{2}, \frac{V_o}{2}$ (b) $\frac{A}{3}, \frac{V_o}{3}$

(c) $\left(\frac{\sqrt{3}}{2}\right)A, \frac{\sqrt{3}V}{2}$ (d) $\frac{A}{\sqrt{2}}, \frac{V_o}{\sqrt{2}}$

12. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. The time taken for it to go from 0 to $A/2$ is T_1 and to go from $A/2$ to A is T_2. Then

(a) $T_1 < T_2$ (b) $T_1 > T_2$

(c) $T_1 = T_2$ (d) $T_1 = 2T_2$

13. A body executes simple harmonic motion under the action of a force F_1 with a time period (4/5) seconds. If the force is changed to F_2 it executes SHM with time period (3/5) seconds. If both the forces F_1 and F_2 act simultaneously in the same direction on the body, its time period (in seconds) is

(a) 12/25 (b) 24/25

(c) 35/24 (d) 25/12

14. The potential energy of a particle of mass 1 kg in motion along the x-axis is given by $U = 4(1 - \cos 2x)$ J, where x is in metres. The period of small oscillations (in second) is

(a) 2π (b) π

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

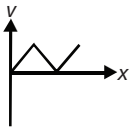
15. A particle executing SHM while moving from one extremity is found at distances x_1, x_2 and x_3 from the centre at the end of three successive seconds. The time period of oscillation is

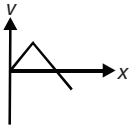
(a) $2\pi/\theta$ (b) π/θ

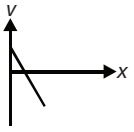
(c) θ (d) $\pi/2\theta$

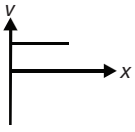
Where $\theta = \cos^{-1}\left(\frac{x_1 + x_3}{2x_2}\right)$

16. If velocity of SHM is plotted with displacement, which of the following figure should be the nearest graph

(a) 

(b) 

(c) 

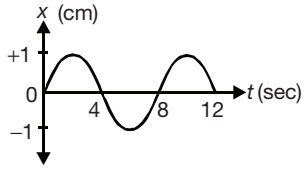
(d) 

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

(a) $\frac{1}{4}$ second (b) $\frac{1}{2}$ second

(c) 1 second (d) 2 seconds

18. The x-t graph of a particle undergoing simple x (cm) harmonic motion is shown below. The acceleration of the particle at $t = \frac{4}{3}$ s is



(a) $\frac{\sqrt{3}}{32}\pi^2$ cm/s^2 (b) $\frac{-\pi^2}{32}$ cm/s^2

(c) $\frac{\pi^2}{32}$ cm/s^2 (d) $-\frac{\sqrt{3}}{32}\pi^2$ cm/s^2

19. If $< T >$ and $< U >$ denote the average kinetic and the average potential energies respectively of a mass executing a simple harmonic motion, over one period, then the corresponding relation is

(a) $< T > = -2 < U >$

(b) $< T > = +2 < U >$

(c) $< T > = < U >$

(d) $< U > = 2 < T >$

20. The maximum displacement of the particle executing SHM is 1 cm and the maximum acceleration is 1.57 cm/s^2. Its time period is

(a) 0.25 s (b) 4.0 s

(c) 1.57 s (d) 3.14 s

21. Time period of a simple pendulum is T. If its length increases by 2%, the new time period becomes

(a) 0.98 T (b) 1.02 T

(c) 0.99 T (d) 1.01 T

22. 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) $a^2T^2 + 4\pi^2v^2$ (b) $\frac{aT}{x}$

(c) $aT = 2\pi v$ (d) $\frac{aT}{v}$

23. The total energy of a particle executing simple harmonic motion is proportional to

(a) displacement from equilibrium position

(b) frequency of oscillation

(c) velocity of equilibrium position

(d) square of amplitude of motion

24. For a particle executing simple harmonic motion, the kinetic energy K is given by $K = K_o \cos^2 \omega t$. The maximum value of potential energy is

(a) K_o (b) zero

(c) $K_o/2$ (d) not obtainable

25. Two SHM's are respectively represented by $y = a\sin(\omega t - kx)$ and $y = b\cos(\omega t - kx)$. The phase difference between the two is

(a) $\pi/2$ (b) $\pi/4$

(c) $\pi/6$ (d) $3\pi/4$

26. Two particles P and Q describe SHM of same amplitude a and frequency ν along the same straight line. The maximum distance between two particle is $\sqrt{2}a$. The initial phase difference between the particles is

(a) zero (b) $\pi/2$

(c) $\pi/6$ (d) $\pi/3$

27. A particle is subjected to two mutually perpendicular simple harmonic motions such that its x and y coordinates are given by

$x = 2\sin\omega t$

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

The path of the particle will be

(a) an ellipse (b) a straight line

(c) a parabola (d) a circle

28. Two simple harmonic motions with same frequency act on a particle at right angles, i.e., along x and y-axis. If the two amplitudes are equal and the phase difference is $\pi/2$ the resultant motion will be

(a) a straight line inclined at 45° to the x-axis.

(b) an ellipse with the major axis along the x-axis.

(c) an ellipse with the major axis along the y-axis.

(d) a circle.

29. If two SHMs are represented by equations

$$y_1 = 10\sin\left(3\pi t + \frac{\pi}{4}\right)$$

and $y_2 = 5[\sin(3\pi t) + \sqrt{3}\cos(3\pi t)]$, the ratio of their amplitudes is

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

(c) 1 : 1 (d) $1:\sqrt{2}$

30. Which of the following combinations of Lissajous' figure will be like infinite (∞)?

(a) $x = a\sin\omega t, y = b\sin\omega t$

(b) $x = a\sin 2\omega t, y = b\sin\omega t$

(c) $x = a\sin\omega t, y = b\sin 2\omega t$

(d) $x = a\sin 2\omega t, y = b\sin 2\omega t$

31. A particle is subjected simultaneously to two SHM's, one along the x-axis and the other along the y-axis. The two vibrations are in phase and have unequal amplitudes. The particle will execute

(a) straight line motion

(b) circular motion

(c) elliptic motion

(d) parabolic motion

32. The equations of two waves acting in perpendicular direction are given as

$x = a\cos(\omega t + \delta)$ and $y = a\cos(\omega t + \alpha)$, where $\delta = \alpha + \frac{\pi}{2}$, the resultant wave represents

(a) a parabola (b) a circle

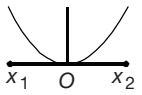
(c) an ellipse (d) a straight line

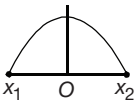
33. The total energy of particle performing SHM depend on

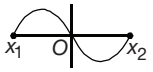
(a) k, a, m (b) k, a

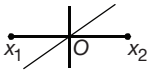
(c) k, a, x (d) k, x

34. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2, the equilibrium position being O. Its potential energy is plotted. It will be as given below in the graph

(a) 

(b) 

(c) 

(d) 

35. Which one of the following statements is true for the speed v and the acceleration a of a particle executing simple harmonic motion?

(a) When v is maximum, a is maximum.

(b) Value of a is zero, whatever may be the value of v.

(c) When v is zero, a is zero.

(d) When v is maximum, a is zero.

36. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is

(a) π (b) 0.707π

(c) zero (d) 0.5π

37. The displacement of a particle is represented by the equation $y = \sin^3\omega t$. The motion is

(a) non-periodic.

(b) periodic but not simple harmonic

(c) simple harmonic with period $2\pi/\omega$.

(d) simple harmonic with period $2\pi/\omega$.

38. The relation between acceleration and displacement of four particles are given below:

(a) $a_x = +2x$.

(b) $a_x = +2x^2$.

(c) $a_x = -2x^2$.

(d) $a_x = -2x$.

Which one of the particles is executing simple harmonic motion?

39. Motion of an oscillating liquid column in a U-tube is

(a) periodic but not simple harmonic.

(b) non-periodic.

(c) simple harmonic and time period is independent of the density of the liquid.

(d) simple harmonic and time-period is directly proportional to the density of the liquid.

40. A particle is acted simultaneously by mutually perpendicular simple hormonic motions $x = a \cos \omega t$ and $y = a \sin \omega t$. The trajectory of motion of the particle will be

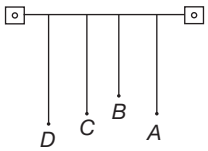
(a) an ellipse.

(b) a parabola.

(c) a circle.

(d) a straight line.

41. Four pendulums A, B, C and D are suspended from the same elastic support as shown in Fig. A and C are of the same length, while B is smaller than A and D is larger than A. If A is given a transverse displacement,



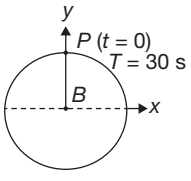
(a) D will vibrate with maximum amplitude.

(b) C will vibrate with maximum amplitude.

(c) B will vibrate with maximum amplitude.

(d) All the four will oscillate with equal amplitude.

42. As shown in Fig. shows the circular motion of a particle. The radius of the circle, the period, sense of revolution and the initial position are indicated on the figure. The simple harmonic motion of the x-projection of the radius vector of the rotating particle P is



(a) $x(t) = B \sin\left(\frac{2\pi t}{30}\right)$

(a) $x(t) = B \cos\left(\frac{\pi t}{15}\right)$

(a) $x(t) = B \sin\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$

(a) $x(t) = B \cos\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$

43. The equation of motion of a particle is $x = a \cos (\alpha t)^2$. The motion is

(a) periodic but not oscillatory.

(b) periodic and oscillatory.

(c) oscillatory but not periodic.

(d) neither periodic nor oscillatory.

Assertion & Reason :

In the following questions, a statement of assertion is followed by a statement of reason. You are required to choose the correct one out of the given five responses and mark it as

(a) *If both assertion and reason are true and reason is the correct explanation of the assertion.*

(b) *If both assertion and reason are true but reason is not correct explanation of the assertion.*

(c) *If assertion is true, but reason is false.*

(d) *If both assertion and reason are false.*

(e) *If reason is true but assertion is false.*

44. Assertion: All oscillatory motions are necessarily periodic motion but all periodic motion are not oscillatory.

Reason: Simple pendulum is an example of oscillatory motion.

45. Assertion: Acceleration is proportional to the displacement. This condition is not sufficient for motion in simple harmonic.

Reason: In simple harmonic motion direction of displacement is also considered.

46. Assertion: Sine and cosine functions are periodic functions.

Reason: Sinusoidal functions repeat its values after a definite interval of time.

47. **Assertion:** When a simple pendulum is made to oscillate on the surface of moon, its time period increases.
Reason: Moon is much smaller as compared to earth.

48. **Assertion:** The graph of total energy of a particle in SHM. wrt, position is a straight line with zero slope.
Reason : Total energy of particle in SHM remains constant throughout its motion.

49. **Assertion:** In SHM, kinetic and potential energies become equal when the displacement is $\frac{1}{\sqrt{2}}$ times the amplitude.
Reason: In SHM, kinetic energy is zero when potential energy is maximum.

50. **Assertion:** If the amplitude of a simple harmonic oscillator is doubled, its total energy becomes four times.
Reason: The total energy is directly proportional to the square of amplitude of vibration of the harmonic oscillator.

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