Practice Set 2 (Oscilations)

Q1. Two simple harmonic motions of angular frequency 100 and 1000rads^{-1} have the same displacement amplitude. The ratio of their maximum acceleration is

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

Q2. Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05 s and the velocity of the wave is 300 m/s. What is the phase difference between the oscillations of two points?

(a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$ (c) π (d) $\frac{\pi}{6}$

Q3. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = c\sin(\omega t + \pi/6)$, After the elapse of what fraction of the time period the velocity of the point will be equal to half of its maximum velocity?

(a) $\frac{T}{8}$ (b) $\frac{T}{6}$ (c) $\frac{T}{3}$ (d) $\frac{T}{12}$

Q4. A simple pendulum performs simple harmonic motion about $x = 0$ with an amplitude a and time period T. The speed of the pendulum at $x = \frac{a}{2}$ will be

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

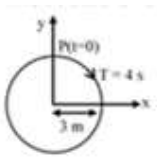
Q5. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be

(a) $\frac{\beta^2}{\alpha^2}$ (b) $\frac{\alpha}{\beta}$ (c) $\frac{\beta^2}{\alpha}$ (d) $\frac{2\pi\beta}{\alpha}$

Q6. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is:

(a) $\frac{3\pi}{2}$ rad (b) $\frac{\pi}{2}$ rad (c) zero (d) πrad

Q7. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the fig.



Y-projection of the radius vector of rotating particle P is:

(a) $(y)t = 3\cos\left(\frac{3\pi t}{2}\right)$, where y in m (b) $(y)t = 3\cos\left(\frac{\pi t}{2}\right)$, where y in m

(c) $(y)t = -3\cos 2\pi t$, where y in m (d) $(y)t = 4\sin\left(\frac{\pi t}{2}\right)$, where y in m

Q8. Average velocity of a particle executing SHM in one complete vibration is:

(a) $\frac{A\omega^2}{2}$ (b) Zero (c) $\frac{A\omega}{2}$ (d) $A\omega$

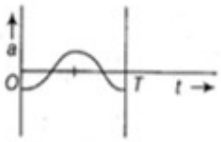
Q9. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and for like a simple harmonic oscillator. The acceleration of the bob of the pendulum is $20\ \mathrm{m/s^2}$ at a distance of $5\ \mathrm{m}$ from the mean position. The time period of oscillation is

(a) $2s$ (b) πs (c) $2\pi s$ (d) $1\ \mathrm{s}$

Q10. The oscillation of a body on a smooth horizontal surface is represented by the equation, $X = A\cos(\omega t)$ where $X =$ displacement at time $t\omega =$ frequency of oscillation Which one of the following graphs shows correctly the variation a with t?

(a) 

(b) 

(c) 

(d) 

Here, $a =$ acceleration at time $t =$ time period

Q11. A particle is executing simple harmonic motion with time period T. Let x, v and a denote the displacement, velocity and acceleration of the particle, respectively, at time t. Then

(a) $\frac{aT}{x}$ does not change with time

(b) $(ar + 2\pi v)$ does not change with time

(c) x and v are related by an equation of a straight line

(d) v and a are related by an equation of an ellipse

Q12. A lightly damped harmonic oscillator with natural frequency ω_0 is driven by a periodic force of frequency ω. The amplitude of oscillation is maximum when

(a) ω is slightly lower than ω_0

(b) $\omega = \omega_0$

(c) ω is slightly higher than ω_0

(d) The force is in phase with the displacement

Q13. The displacement of a particle executing simple harmonic motion is given by $y = A_0 + A\sin\omega t + B\cos\omega t$. Then the amplitude of its oscillation is given by:

(a) $\sqrt{A_0^2 + (A+B)^2}$ (b) $\mathrm{A + B}$ (c) $A_0 = \sqrt{A^2 + B^2}$ (d) $\sqrt{A^2 + B^2}$

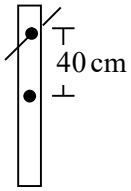
Q14. Three sinusoidal waves have the same frequency with amplitude $A, A/2$ and $A/3$ while their phase angles are $0, \pi/2$ and π respectively. The amplitude of the resultant wave is

(a) $\frac{11}{6}$ (b) $\frac{2A}{3}$ (c) $\frac{5A}{6}$ (d) $\frac{7A}{6}$

Q15. Six simple harmonic oscillations each of same frequency and equal amplitude are superposed. The phase difference between any two consecutive oscillations i.e., $\phi_n - \phi_{\alpha-1} = \Delta\phi$ is constant, where ϕ_n is the phase of the n^4 oscillation. If the resultant amplitude of the superposition is zero, what is the phase difference $\Delta\phi$?

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{2}$ (d) 2π

Q16. A uniform meter stick is suspended through a small pin hole at the 10 cm mark. Find the time period of small oscillation about the point of suspension.



(a) 1.45 s (b) 1.55 s (c) 1.65 s (d) 1.75 s

Practice Set (Solution)

Ans. 1: (b) Ans. 2: (b) Ans. 3: (d) Ans. 4: (a) Ans. 5: (d) Ans. 6: (d) Ans. 7: (b)

Ans. 8: (b) Ans. 9: (b) Ans. 10: (a) Ans. 11: (a) and (d) Ans. 12: (a) Ans. 13: (d)

Ans. 14: (c) Ans. 15: (d) Ans. 16: (b)