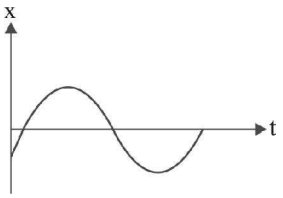
13 Oscillations

Diagram Based Questions :

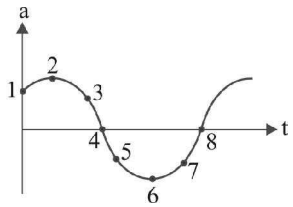
1. The displacement vs time of a particle executing SHM is shown in figure. The initial phase ϕ is



(a) $-\pi < \phi < -\frac{\pi}{2}$ (b) $\pi < \phi < \frac{3\pi}{2}$

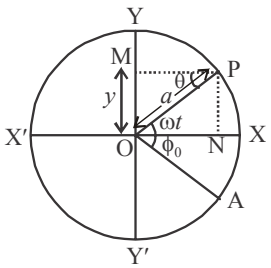
(c) $-\frac{3\pi}{2} < \phi < -\pi$ (d) $\frac{\pi}{2} < \phi < \pi$

2. The acceleration of a particle undergoing SHM is graphed in figure. At point 2 the velocity of the particle is



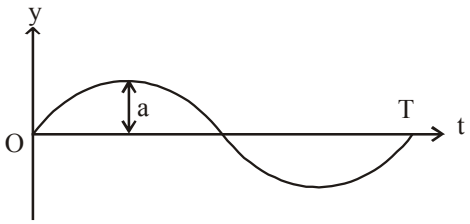
(a) zero (b) negative
(c) positive (d) None of these

3. For the given figure



(a) $y = a \sin \omega t$ (b) $y = a \sin (\omega t - \phi_0)$
(c) $y = a \cos \omega t$ (d) $y = a \cos (\omega t - \phi_0)$

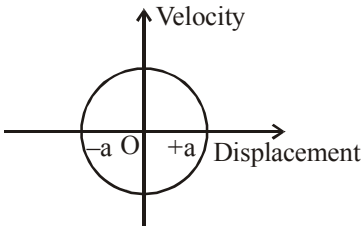
4. In the given displacement time curve for SHM at what value of t is the amplitude negative?



(a) $\frac{T}{2}$ (b) $\frac{T}{4}$

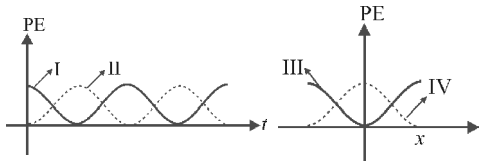
(c) $\frac{3T}{4}$ (d) $\frac{3T}{2}$

5. The graph shown in figure represents



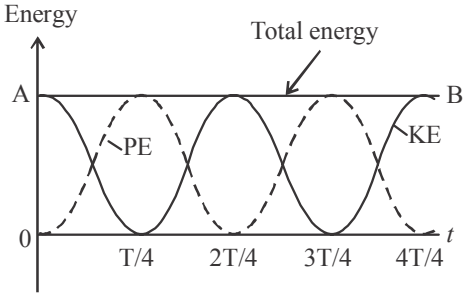
(a) S.H.M.
(b) circular motion
(c) rectillinear motion
(d) uniform circular motion

6. For a particle executing SHM the displacement x is given by $x = A\cos\omega t$. Identify the graph which represents the variation of potential energy (P.E.) as a function of time t and displacement x.



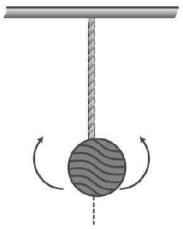
(a) I, III (b) II, IV
(c) II, III (d) I, IV

7. What do you conclude from the graph about the frequency of KE, PE and SHM ?



(a) Frequency of KE and PE is double the frequency of SHM
(b) Frequency of KE and PE is four times the frequency SHM.
(c) Frequency of PE is double the frequency of K.E.
(d) Frequency of KE and PE is equal to the frequency of SHM.

8. A simple pendulum is made of a body which is a hollow sphere containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will



(a) remain unchanged (b) increase
(c) decrease (d) become erratic

Solution

1. **(a)** For $x = (-A)$, we have

$$-A = A\sin(\omega \times 0 + \phi_0)$$

or $\phi_0 = -\frac{\pi}{2}$.

So for $x < (-A)$, $\phi_0 < (-\pi/2)$.

2. **(a)** At point 2, the acceleration of the particle is maximum, which is at the extreme position. At extreme position, the velocity of the particle will be zero.

3. **(b)** $\frac{y}{a} = \sin\theta$

$\therefore \quad y = a\sin\theta$

$\theta = \angle XOP = \omega t - \phi_0$

$\therefore \quad y = a\sin(\omega t - \phi_0)$

4. **(c)**

5. **(a)** t = 0, v maximum. The motion begins from mean position. So it represents S.H.M.

6. **(a)** In $x = A\cos\omega t$, the particle starts oscillating from extreme position. So at $t = 0$, its potential energy is maximum.

7. **(a)** KE and PE completes two vibration in a time during which SHM completes one vibration. Thus frequency of PE or KE is double than that of SHM.

8. **(b)** When some mercury is drained off, the centre of gravity of the bob moves down and so length of the pendulum increases, which result increase in time period.