

Answer on Question #72634-Physics-Other

The amplitude of an oscillator is 8 cm and it completes 100 oscillations in 80s.

- i) Calculate its time period and angular frequency.
- ii) If the initial phase is $\pi/4$, write expressions for its displacement and velocity.
- iii) Calculate the values of maximum velocity and acceleration.

Solution

i)

$$T = \frac{80}{100} = 0.8 \text{ s.}$$
$$\omega = \frac{2\pi}{T} = \frac{2\pi}{0.8} = 7.85 \frac{\text{rad}}{\text{s}}.$$

ii)

$$x(m) = 0.08 \sin\left(\frac{5\pi}{2}t + \frac{\pi}{4}\right)$$
$$v\left(\frac{m}{s}\right) = 0.08 \left(\frac{2\pi}{0.8}\right) \cos\left(\frac{5\pi}{2}t + \frac{\pi}{4}\right) = \frac{\pi}{5} \cos\left(\frac{5\pi}{2}t + \frac{\pi}{4}\right)$$

iii)

$$V = \frac{\pi}{5} \approx 0.63 \frac{m}{s}.$$
$$a = \frac{\pi}{5} \left(\frac{2\pi}{0.8}\right) = 4.9 \frac{m}{s^2}.$$

Body of mass 0.15 kg executes SHM described by the equation

$$x(t) = 2\sin(\pi t + \pi/4)$$

where x is in meters and t is in seconds.

- i) Determine the amplitude and time period of the oscillation.
- ii) Calculate the initial values of displacement and velocity.
- iii) Calculate the values of time when the energy of the oscillator is purely kinetic

Solution

i)

$$A = 2 \text{ m.}$$

$$T = \frac{2\pi}{\pi} = 2 \text{ s.}$$

ii)

$$x(0) = 2 \sin\left(\frac{\pi}{4}\right) = 2\left(\frac{\sqrt{2}}{2}\right) = \sqrt{2} \approx 1.41 \text{ m.}$$

$$v(0) = 2(\pi)\cos\left(\frac{\pi}{4}\right) = 2(\pi)\left(\frac{\sqrt{2}}{2}\right) = \pi\sqrt{2} \approx 4.44 \frac{\text{m}}{\text{s}}.$$

iii)

$$x(t) = 2\sin\left(\pi t + \frac{\pi}{4}\right) = 0$$

$$\pi t + \frac{\pi}{4} = \pi n$$

$$t = n - \frac{1}{4}, n = 1, 2, 3, \dots$$

$$t = \frac{3}{4} \text{ s}, 1\frac{3}{4} \text{ s}, 2\frac{3}{4} \text{ s} \dots$$

$$t = 0.75 \text{ s}, 1.75 \text{ s}, 2.75 \text{ s} \dots$$

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