

5.10 The motion of a particle of mass m is given by $x = 0$ for $t < 0$ s, $x(t) = A \sin 4\pi t$ for $0 < t < (1/4)$ s ($A > 0$), and $x = 0$ for $t > (1/4)$ s. Which of the following statements is true?

- (a) The force at $t = (1/8)$ s on the particle is $-16\pi^2 A m$.
- (b) The particle is acted upon by an impulse of magnitude $4\pi^2 A m$ at $t = 0$ s and $t = (1/4)$ s.
- (c) The particle is not acted upon by any force.
- (d) The particle is not acted upon by a constant force.
- (e) There is no impulse acting on the particle.

$$(10) \quad x(t) = A \sin 4\pi t \quad 0 < t < \frac{1}{4}$$

$$\frac{dx}{dt} = 4A\pi \cos 4\pi t \quad ; \quad \frac{d^2x}{dt^2} = -16A\pi^2 \sin 4\pi t = a$$

$$F = ma = m(-16A\pi^2 \sin 4\pi t) \quad (p = \pi)$$

$$\begin{aligned} \text{At } t = \frac{1}{8}, \quad F &= -16Am\pi^2 \sin\left(\frac{\pi}{2}\right) \\ &= -16Am\pi^2 \Rightarrow (a) \end{aligned}$$

$$\begin{aligned} \text{Impulse} &\Rightarrow \int_{t_1}^{t_2} F \cdot dt = \int_0^{\frac{1}{4}} -16\pi^2 Am \sin 4\pi t \\ &= 4\pi^2 Am \Rightarrow (b) \end{aligned}$$

From (a) it is clear that (c) is incorrect.
Since the force is sinusoidal it is not constant \Rightarrow (d)

Ans. \Rightarrow a, b, d