A particle moves in the x-y plane under the influence of a force such that its linear momentum is $\mathbf{p}(t) = A[\hat{\mathbf{i}}\cos(kt) - \hat{\mathbf{j}}\sin(kt)]$, where, A and k are constants. The angle between the force and the momentum is **(2007, 3M)**

(a) $0°$ (b) $30°$ (c) $45°$ (d) $90°$

Solution

$$P(t) = A(\hat{i}\cos(Kt) - \hat{j}\sin(Kt))$$

$$F(t) = \frac{d\,P(t)}{dt}$$

$$F(t) = AK(-\hat{i}\sin(Kt) - \hat{j}\cos(Kt))$$

$$\cos\theta = \frac{P(t) \cdot F(t)}{|P(t)|\,|F(t)|} = \frac{A^2K(0)}{(A)(AK)} = 0$$

A, option