Question

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

A 0°

B 30°

C 45°

D 90°

Solution

Correct option is D)

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

$F = \frac{dP(t)}{dt}$

$F = \frac{d}{dt}A(-\hat{i}\cos kt - j\sin kt)$

$= A(-\hat{i}\sin kt(k) - j\cos kt(k))$

$F = Ak(-\hat{i}\sin kt - j\cos kt)$

Angle between two vectors is θ

$\cos\theta = \frac{F.P}{|F||P|}$

$= A\frac{(\hat{j}\cos kt - \hat{j}\sin kt).Ak(-\hat{i}\sin kt - \hat{j}\sin kt)}{|F||P|}$

$\frac{A^2k(-\sin kt\cos kt + \sin kt\cos kt)}{|F||P|}$

$= A^2k(0) = 0$

$\theta = \cos^{-1}(0) = 90^0$