Question 15

The position vector of a 2 kg moving particle is given by $\underset{\sim}{r}(t) = 4\sin(t)\underset{\sim}{i} + \cos(2t)\underset{\sim}{j}$ where the position in measured in metres and $t \geq 0$ is the time in seconds. The maximum momentum in kg-m/s of the particle is

A. 8

B. 4

C. 2

D. 1

E. $2\sqrt{5}$

ANSWER A

$$\underset{\sim}{r}(t) = 4\sin(t)\underset{\sim}{i} + \cos(2t)\underset{\sim}{j}$$

$$\underset{\sim}{\dot{r}}(t) = 4\cos(t)\underset{\sim}{i} - 2\sin(2t)\underset{\sim}{j}$$

$$\left|\underset{\sim}{\dot{r}}(t)\right| = \sqrt{\left(4\cos(t)\right)^2 + \left(-2\sin(2t)\right)^2} = \sqrt{16\cos^2(t) + 4\sin^2(2t)}$$

$$= \sqrt{16\cos^2(t) + 4\left(2\sin(t)\cos(t)\right)^2} = \sqrt{16\cos^2(t) + 16\sin^2(t)\cos^2(t)}$$

$$= \sqrt{16\cos^2(t)\left(1 + \sin^2(t)\right)} = \sqrt{16\cos^2(t)\left(2 - \cos^2(t)\right)}$$

when $\cos(t) = 1$ $\left|\underset{\sim}{\dot{r}}(t)\right|_{max} = 4$, $m = 2$ $p_{max} = mv = 8$ kg m/s

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