

Mathematics Questions by Topic

Motion and Force

Answer 4

Source: K21SM2Q15

Question 4

A particle of mass 2 kg, is moving so that its velocity vector at a time t , given by

$$\dot{\mathbf{r}}(t) = 4\sin^2(t)\mathbf{i} + 4\cos^2(t)\mathbf{j}, \text{ for } t \geq 0, \text{ given that } \mathbf{r}\left(\frac{\pi}{4}\right) = \frac{\pi}{2}(\mathbf{i} + \mathbf{j})$$

The change in momentum over $\frac{\pi}{6} \leq t \leq \frac{\pi}{4}$, is given by

A. $-2\mathbf{i} + 2\mathbf{j}$.

B. $2\mathbf{i} - 2\mathbf{j}$.

C. $\mathbf{i} - \mathbf{j}$

D. $-\mathbf{i} + \mathbf{j}$

E. $2\sqrt{2}$

ANSWER B

$$\dot{\mathbf{r}}\left(\frac{\pi}{6}\right) = 4\sin^2\left(\frac{\pi}{6}\right)\mathbf{i} + 4\cos^2\left(\frac{\pi}{6}\right)\mathbf{j} = \mathbf{i} + 3\mathbf{j}$$

$$\dot{\mathbf{r}}\left(\frac{\pi}{4}\right) = 4\sin^2\left(\frac{\pi}{4}\right)\mathbf{i} + 4\cos^2\left(\frac{\pi}{4}\right)\mathbf{j} = 2\mathbf{i} + 2\mathbf{j}$$

$$\mathbf{p} = m\left(\dot{\mathbf{r}}\left(\frac{\pi}{4}\right) - \dot{\mathbf{r}}\left(\frac{\pi}{6}\right)\right) = 2\left((2\mathbf{i} + 2\mathbf{j}) - (\mathbf{i} + 3\mathbf{j})\right)$$

$$\mathbf{p} = 2\mathbf{i} - 2\mathbf{j}$$