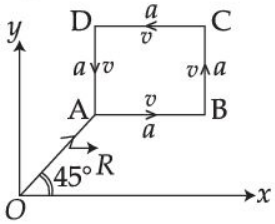
A particle of mass $m$ is moving along the side of a square of side '$a$', with a uniform speed $v$ in the $x$-$y$ plane as shown in the figure :




Which of the following statements is **false** for the angular momentum $\vec{L}$ about the origin ?

(1) $\vec{L} = -\frac{mv}{\sqrt{2}} R \hat{k}$ when the particle is moving from $A$ to $B$.

(2) $\vec{L} = mv\left[\frac{R}{\sqrt{2}} - a\right]\hat{k}$ when the particle is moving from $C$ to $D$.

(3) $\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from $B$ to $C$.

(4) $\vec{L} = \frac{mv}{\sqrt{2}} R \hat{k}$ when the particle is moving from $D$ to $A$.

Based on JEE Main 2016

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**A to B**

$$\vec{L} = \overrightarrow{OA} \times m\vec{v}$$

$$\vec{L} = \frac{R}{\sqrt{2}}(\hat{i} + \hat{j}) \times mv\hat{i}$$

$$\vec{L} = -\frac{mvR}{\sqrt{2}}\hat{k}$$

**B to C**

$$\vec{L} = \overrightarrow{OC} \times m\vec{v}$$

$$\vec{L} = \frac{R + a\sqrt{2}}{\sqrt{2}}(\hat{i} + \hat{j}) \times mv\hat{j}$$

$$\vec{L} = \frac{mv(R + a\sqrt{2})}{\sqrt{2}}\hat{k}$$

**C to D**

$$\vec{L} = \overrightarrow{OC} \times m\vec{v}$$

$$\vec{L} = \frac{R + a\sqrt{2}}{\sqrt{2}}(\hat{i} + \hat{j}) \times mv(-\hat{i})$$

$$\vec{L} = \frac{mv(R + a\sqrt{2})}{\sqrt{2}}\hat{k}$$

**D to A**

$$\vec{L} = \overrightarrow{OA} \times m\vec{v}$$

$$\vec{L} = \frac{R}{\sqrt{2}}(\hat{i} + \hat{j}) \times mv(-\hat{j})$$

$$\vec{L} = -\frac{mvR}{\sqrt{2}}\hat{k}$$

Hence, Options (2) & (4).