Answer on Question #84278 Physics / Other

If a force acting on a is given as $\mathbf{F} = 2\hat{\mathbf{i}} - \hat{\mathbf{j}}$ and position vector of particle with respect to origin is given as $\mathbf{r} = \hat{\mathbf{i}} + \hat{\mathbf{j}}$, calculate torque of this force about origin.

Solution:

The torque of the force by definition

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$$

$$= (\hat{\mathbf{i}} + \hat{\mathbf{j}}) \times (2\hat{\mathbf{i}} - \hat{\mathbf{j}})$$

$$= 2\underbrace{\hat{\mathbf{i}} \times \hat{\mathbf{i}}}_{\mathbf{0}} + 2\underbrace{\hat{\mathbf{j}} \times \hat{\mathbf{i}}}_{-\hat{\mathbf{k}}} - \underbrace{\hat{\mathbf{i}} \times \hat{\mathbf{j}}}_{\hat{\mathbf{k}}} - \underbrace{\hat{\mathbf{j}} \times \hat{\mathbf{j}}}_{\mathbf{0}}$$

$$= -3\hat{\mathbf{k}}$$

Answer: $\boldsymbol{\tau} = -3\hat{\mathbf{k}}$