

Answer on Question #69220 Physics / Other

A particle of mass 'm' moves along a space curve defined by $\mathbf{r} = 5t^4\mathbf{i} - 3t^2\mathbf{j} + 4t\mathbf{k}$ obtain the torque about the origin. Draw diagram.

Solution:

The momentum of the particle

$$\mathbf{p} = m\mathbf{v} = m \frac{d\mathbf{r}}{dt} = m(20t^3\mathbf{i} - 6t\mathbf{j} + 4\mathbf{k}).$$

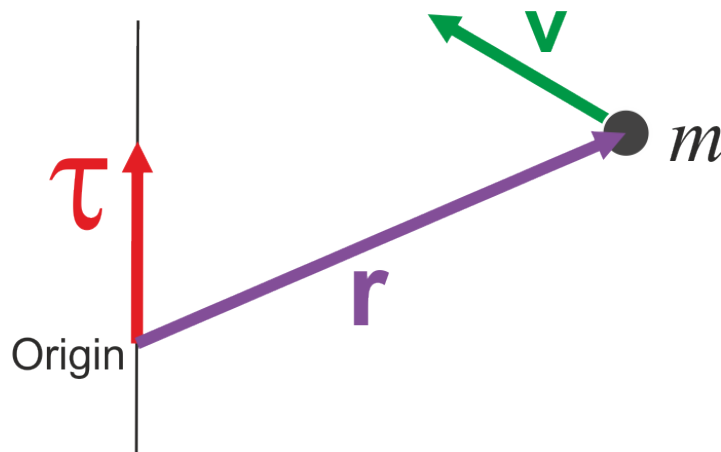
The angular momentum vector by definition

$$\mathbf{L} = [\mathbf{r} \times \mathbf{p}] = m \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 5t^4 & -3t^2 & 4t \\ 20t^3 & -6t & 4 \end{vmatrix} = 12t^2m\mathbf{i} + 60t^4m\mathbf{j} + 30t^5m\mathbf{k}.$$

Therefore, the torque

$$\boldsymbol{\tau} = \frac{d\mathbf{L}}{dt} = 24tm\mathbf{i} + 240t^3m\mathbf{j} + 150t^4m\mathbf{k}.$$

The diagram is as follows



Answers: $\boldsymbol{\tau} = 24tm\mathbf{i} + 240t^3m\mathbf{j} + 150t^4m\mathbf{k}.$

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