Boas 6-4.9 Given $\mathbf{L} = m\mathbf{r} \otimes \dot{\mathbf{r}}$

Then $\frac{d\mathbf{L}}{dt} = \dot{\mathbf{L}} = \frac{d}{dt}(m\mathbf{r} \otimes \dot{\mathbf{r}})$

$$= \frac{d}{dt}(m\mathbf{r}) \otimes \dot{\mathbf{r}} + m\mathbf{r} \otimes \frac{d}{dt}\dot{\mathbf{r}}$$

$$= m\dot{\mathbf{r}} \otimes \dot{\mathbf{r}} + m\mathbf{r} \otimes \ddot{\mathbf{r}}$$

Now $\dot{\mathbf{r}} \otimes \dot{\mathbf{r}} = 0$ since $\sin\theta = \sin 0^\circ = 0$ in $\dot{r}\dot{r}\sin\theta = |\dot{\mathbf{r}} \otimes \dot{\mathbf{r}}|$

Hence, $\dot{\mathbf{L}} = m\mathbf{r} \otimes \ddot{\mathbf{r}}$

$$\boxed{\dot{\mathbf{L}} = m\mathbf{r} \times \frac{d^2}{dt}\mathbf{r}}$$