

24. We note that the component of \vec{v} perpendicular to \vec{r} has magnitude $v \sin \phi$ where $\phi = 30^\circ$. A similar observation applies to \vec{F} .

(a) Eq. 12-20 leads to

$$\ell = rmv_{\perp} = (3.0)(2.0)(4.0) \sin 30^\circ = 12 \text{ kg} \cdot \text{m}^2/\text{s} .$$

Using the right-hand rule for vector products, we find $\vec{r} \times \vec{p}$ points out of the page, perpendicular to the plane of Fig. 12-36.

(b) Eq. 11-31 (which is the same as Eq. 12-15) leads to

$$\tau = rF \sin \phi = (3.0)(2.0) \sin 30^\circ = 3.0 \text{ N} \cdot \text{m} .$$

Using the right-hand rule for vector products, we find $\vec{r} \times \vec{F}$ is also out of the page.