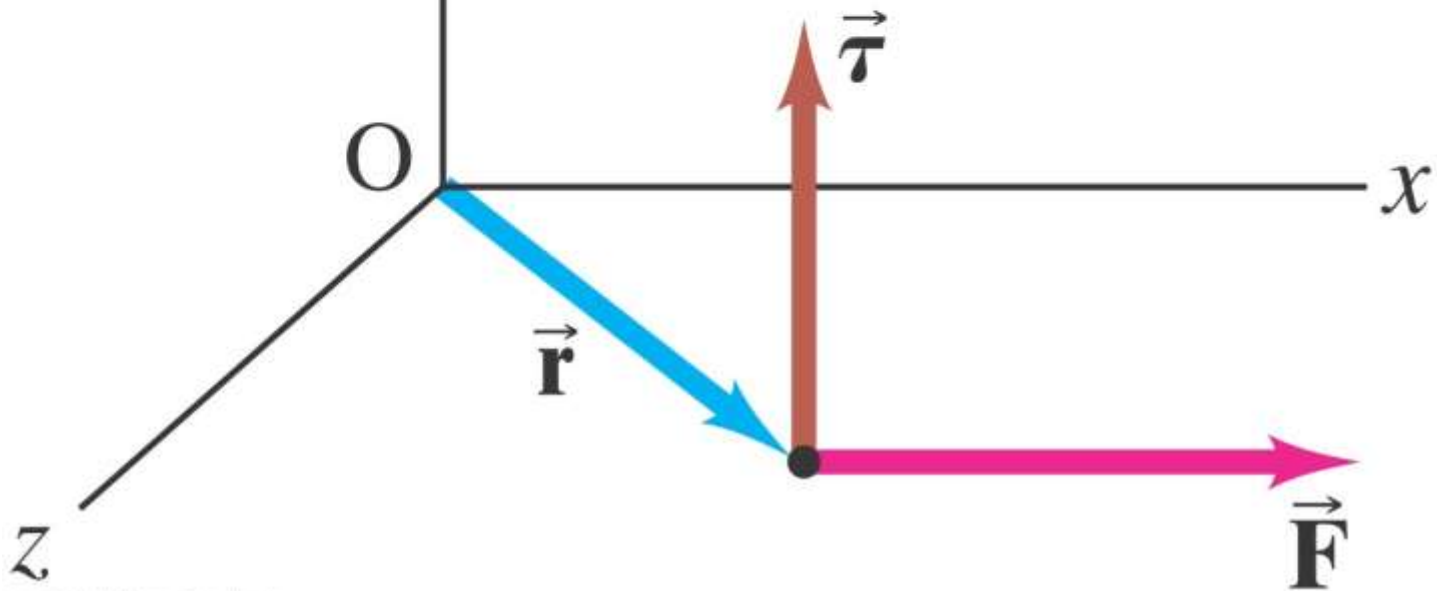


$$\vec{\tau} = \vec{r} \times \vec{F}$$

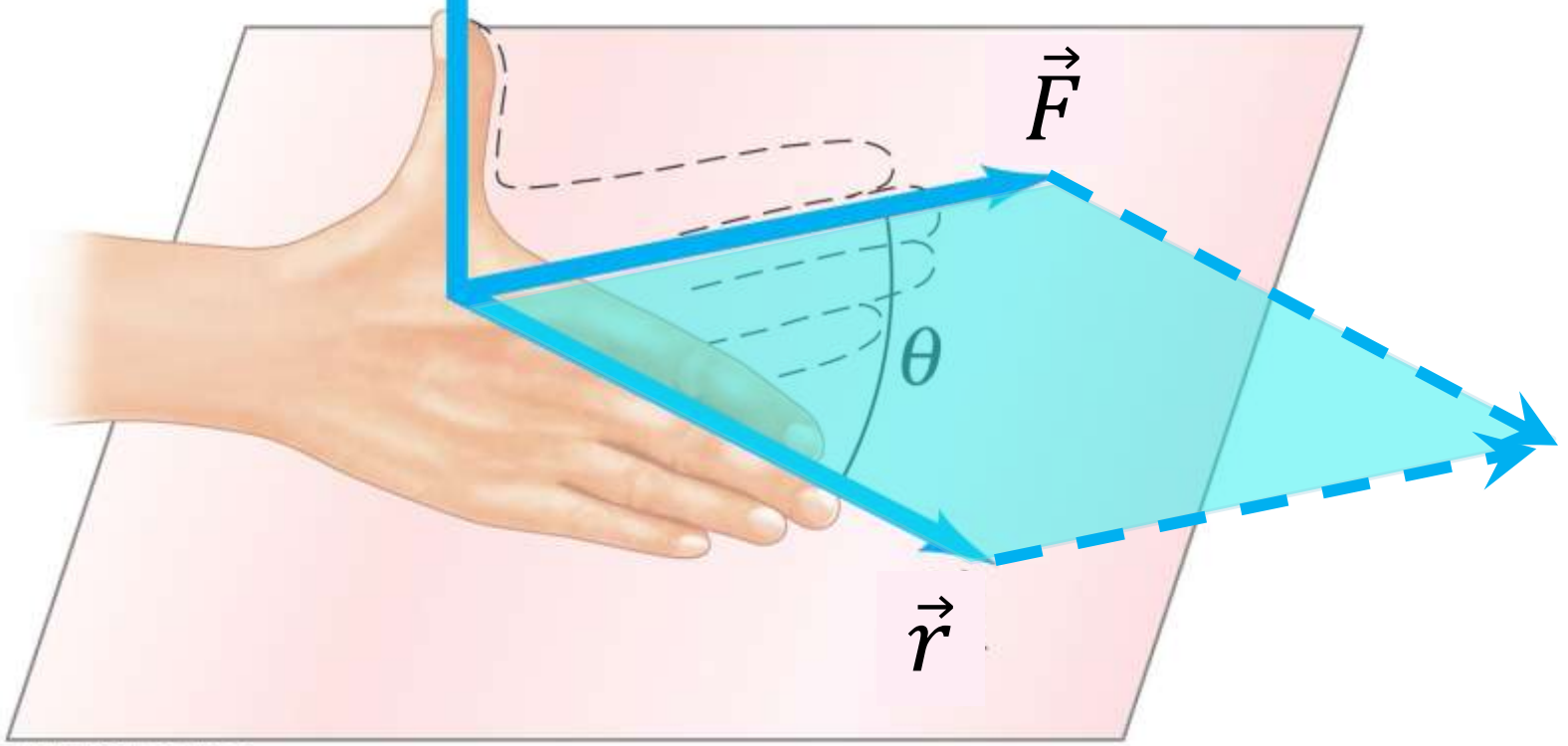
$$\vec{\tau} \perp \vec{r} \quad \& \quad \vec{\tau} \perp \vec{F}$$

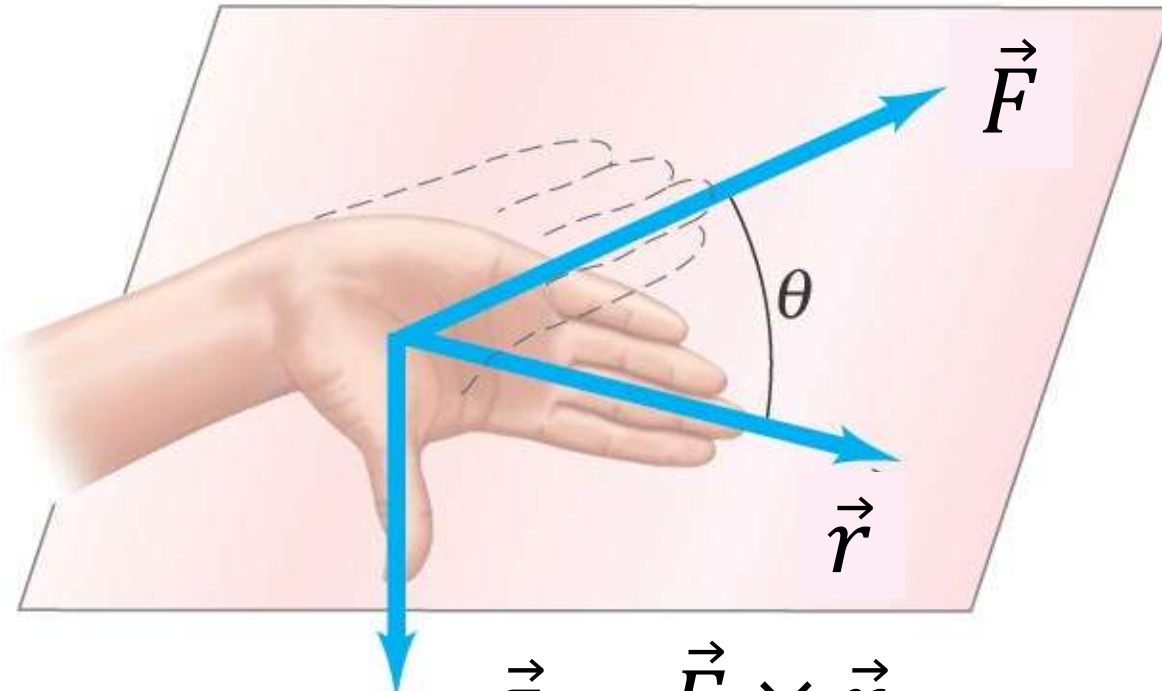


$$\vec{\tau} = \vec{r} \times \vec{F}$$

Magnitude = Area

Max. Area when  
 $\theta = 90^\circ$

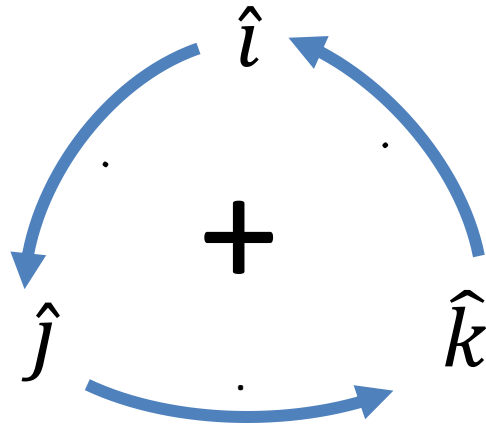




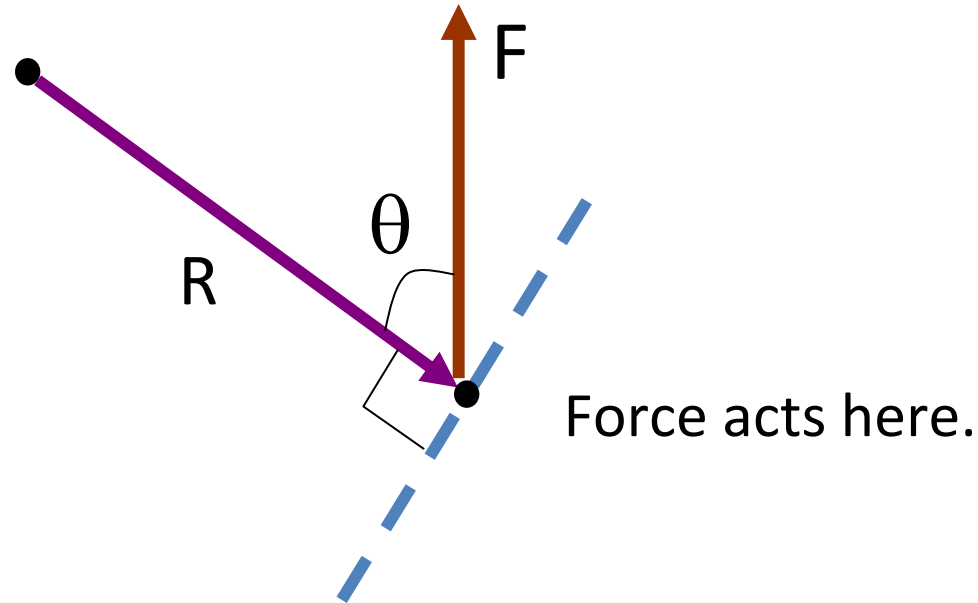
Copyright © 2008 Pearson Education, Inc.

$$-\vec{\tau} = \vec{F} \times \vec{r}$$

# RHR and unit vectors



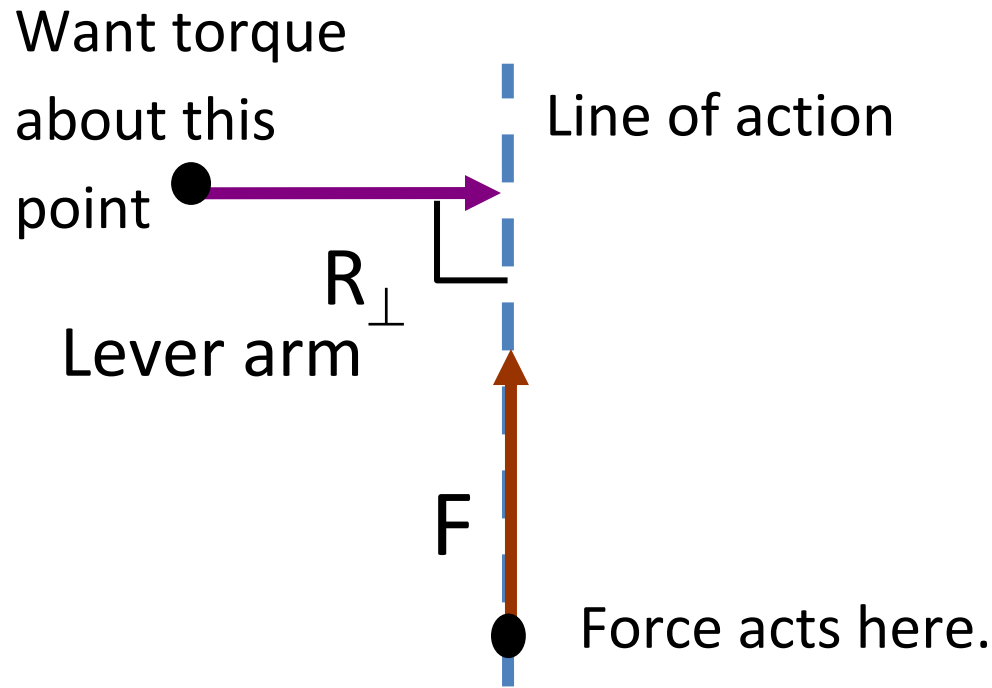
Want torque  
about this  
point



$$\tau = rF_{\perp} = rF\sin\theta$$

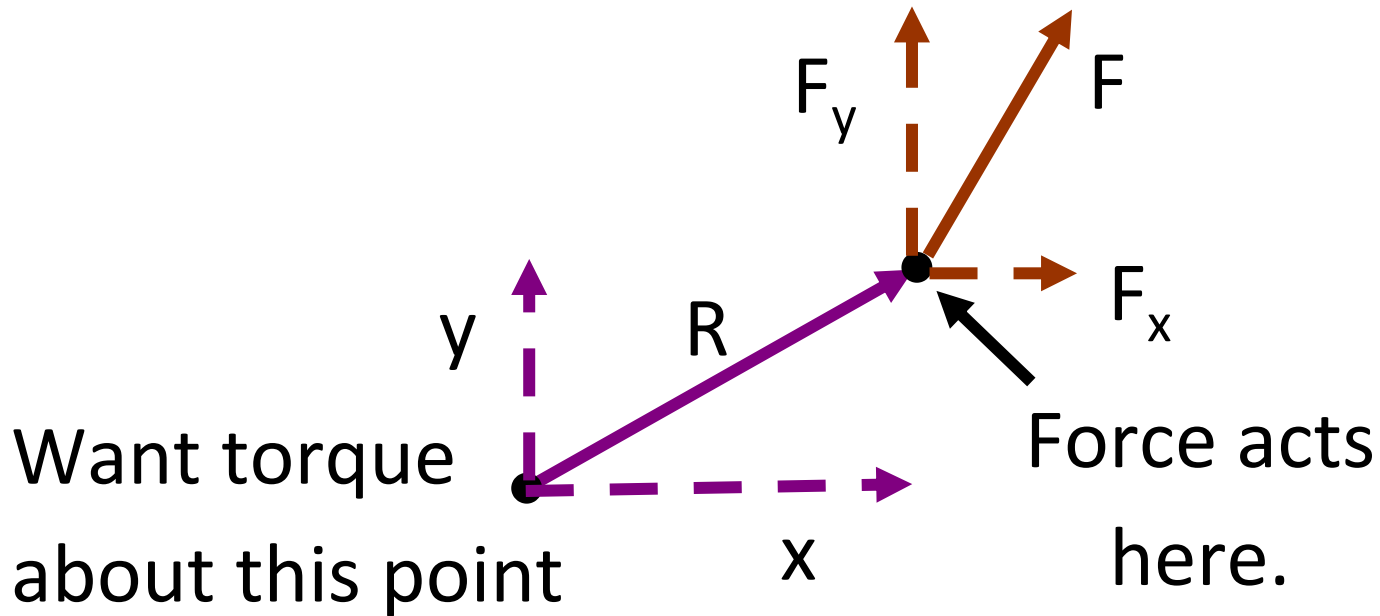
Note:  $F_{\perp}$  means the component of  $F$  perpendicular to  $R$  – not the vertical component of  $F$ .

Use this method if both  $R$  and  $\theta$  are easy to find.



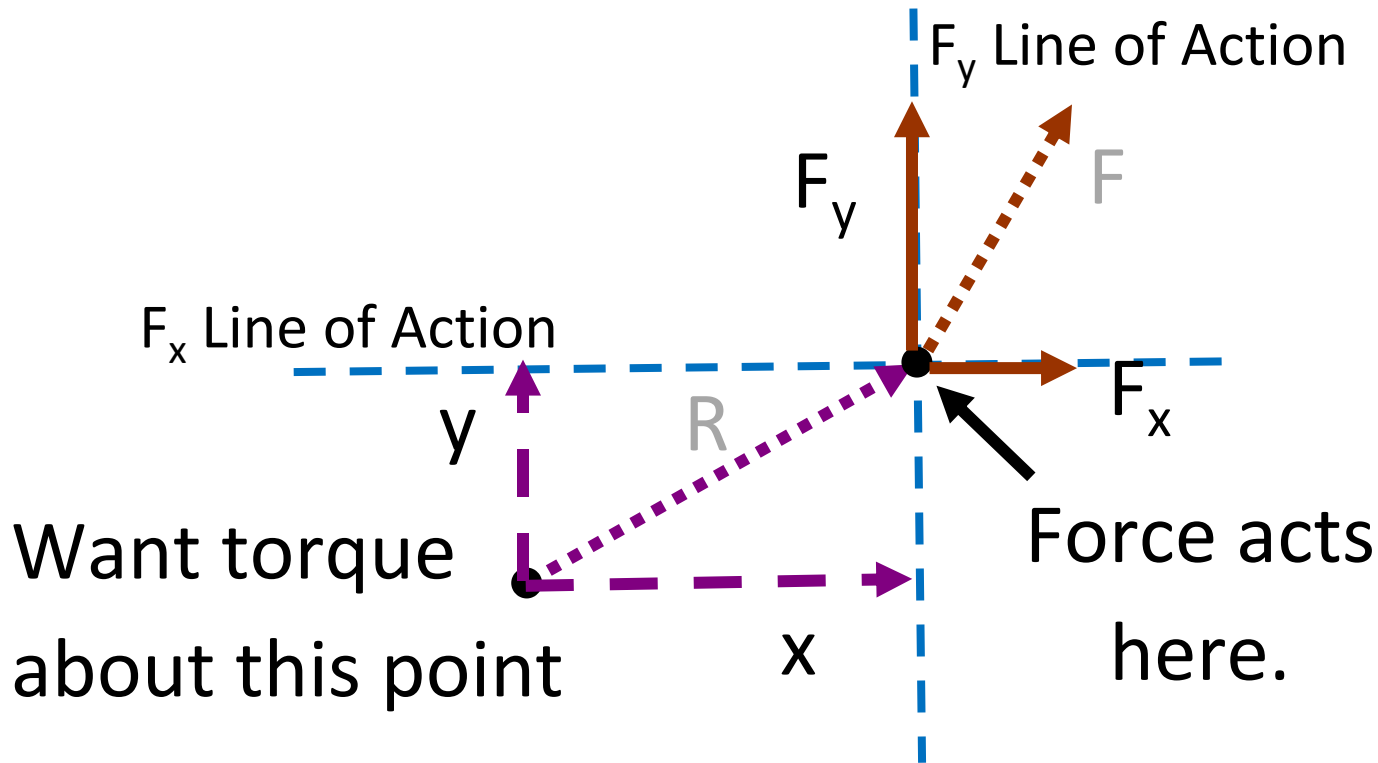
$$\tau = R_{\perp} F$$

Use this method if the lever arm is easy to find.  
Often used for vertical or horizontal forces.



$$\begin{aligned}\vec{\tau} &= \vec{R} \times \vec{F} \\ &= (\hat{i}x + \hat{j}y) \times (\hat{i}F_x + \hat{j}F_y) \\ &= \hat{k}(xF_y - yF_x)\end{aligned}$$

# Easier to Treat as Lever Arm Twice



$$\tau_z = +xF_y - yF_x$$