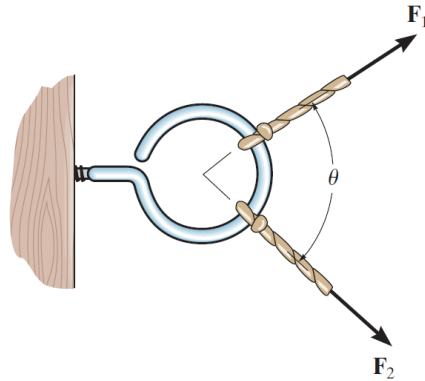


Problem 2-24

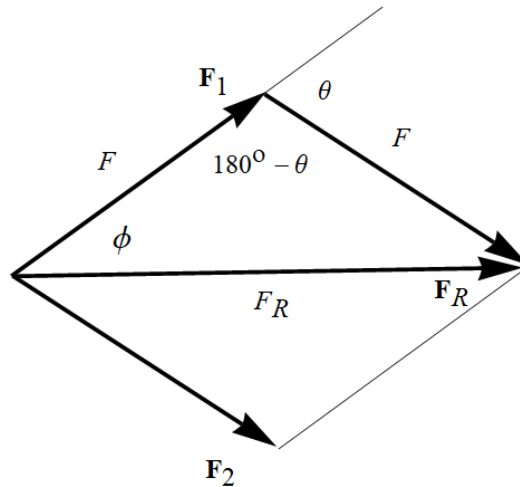
Two forces \mathbf{F}_1 and \mathbf{F}_2 act on the screw eye. If their lines of action are at an angle θ apart and the magnitude of each force is $F_1 = F_2 = F$, determine the magnitude of the resultant force \mathbf{F}_R and the angle between \mathbf{F}_R and \mathbf{F}_1 .



Probs. 2-23/24

Solution

Draw the triangle that \mathbf{F}_1 and \mathbf{F}_2 and their resultant make.



Use the law of cosines to determine F_R .

$$F_R^2 = F^2 + F^2 - 2(F)(F) \cos(180^\circ - \theta)$$

Note that $\cos(180^\circ - \theta) = \cos 180^\circ \cos \theta + \sin 180^\circ \sin \theta = -\cos \theta$.

$$F_R^2 = F^2 + F^2 + 2(F)(F) \cos \theta \quad \rightarrow \quad F_R = F\sqrt{2(1 + \cos \theta)}$$

Use the law of cosines again to determine ϕ , the angle between \mathbf{F}_R and \mathbf{F}_1 .

$$F^2 = F^2 + F_R^2 - 2(F)(F_R) \cos \phi \quad \rightarrow \quad \cos \phi = \frac{F_R}{2F} = \sqrt{\frac{1 + \cos \theta}{2}} = \cos \frac{\theta}{2} \quad \Rightarrow \quad \phi = \frac{\theta}{2}$$