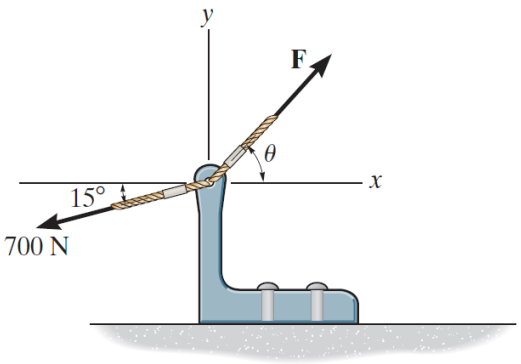
Problem 2-2

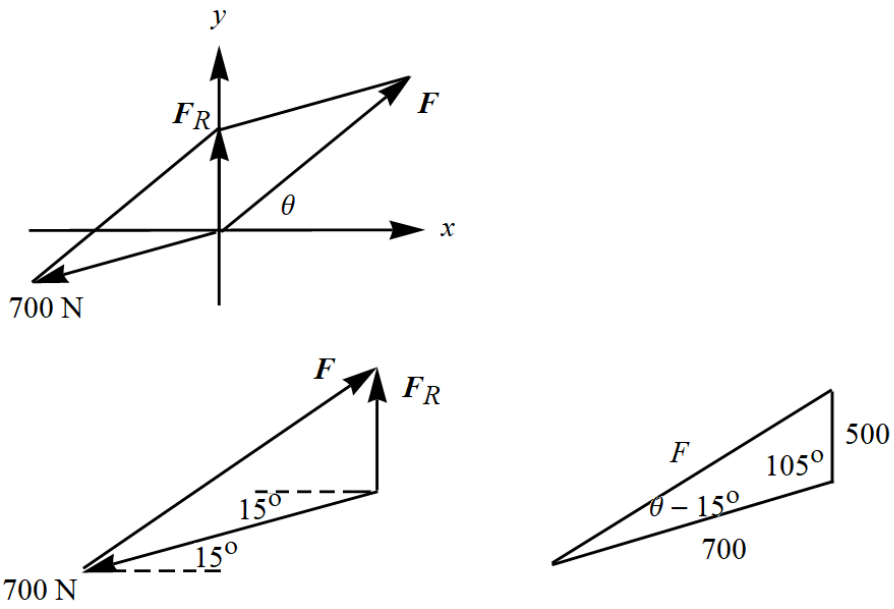
If the magnitude of the resultant force is to be 500 N, directed along the positive y axis, determine the magnitude of force **F** and its direction θ.



Probs. 2–1/2

Solution

Draw the parallelogram formed by the two force vectors so that the resultant lines up with the y-axis. Draw the triangle consisting of the force vectors, one after the other, with the resultant being their vector sum.



To the right is the triangle corresponding to the vector magnitudes. Apply the law of cosines to it to determine the magnitude of the unknown force.

$$F^2 = 500^2 + 700^2 - 2(500)(700)\cos 105°$$

Take the square root of both sides.

$$F = \sqrt{500^2 + 700^2 - 2(500)(700)\cos 105°} \approx 960.\ \text{N}$$

Now that F is known, use the law of cosines again to determine $\theta - 15°$.

$$500^2 = F^2 + 700^2 - 2F(700)\cos(\theta - 15°)$$

Solve for θ.

$$\cos(\theta - 15°) = \frac{500^2 - F^2 - 700^2}{-1400F}$$

$$\theta - 15° = \cos^{-1}\left(\frac{500^2 - F^2 - 700^2}{-1400F}\right)$$

Therefore,

$$\theta = 15° + \cos^{-1}\left(\frac{500^2 - F^2 - 700^2}{-1400F}\right) \approx 45.2°.$$