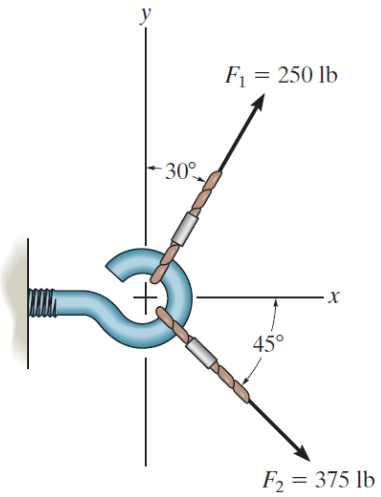
Problem 2-3

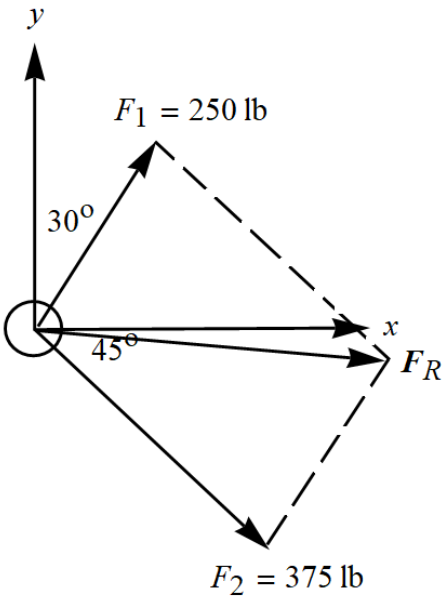
Determine the magnitude of the resultant force $\mathbf{F}_R = \mathbf{F}_1 + \mathbf{F}_2$ and its direction, measured counterclockwise from the positive x axis.



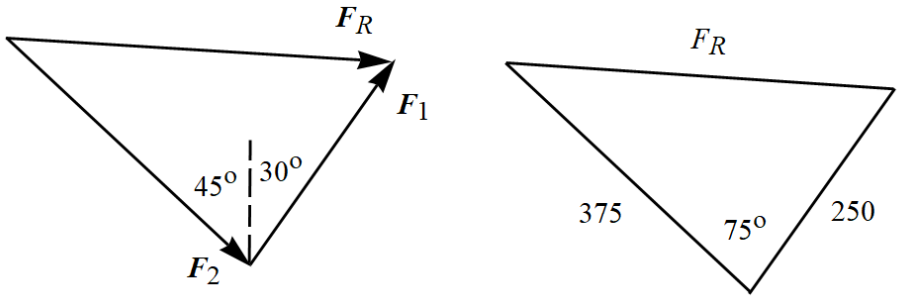
Prob. 2–3

Solution

The resultant force is obtained by drawing the parallelogram that these two force vectors make.



Draw the triangle consisting of the force vectors, one after the other, with the resultant being their vector sum.



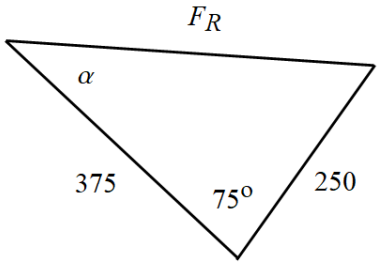
To the right is the triangle corresponding to the vector magnitudes. Apply the law of cosines to it to determine the magnitude of the resultant force.

$$F_R^2 = 250^2 + 375^2 - 2(250)(375)\cos 75^\circ$$

Take the square root of both sides.

$$F_R = \sqrt{250^2 + 375^2 - 2(250)(375)\cos 75^\circ} \approx 393 \text{ lb}$$

Now that F_R is known, the angle α can be determined in the figure below.



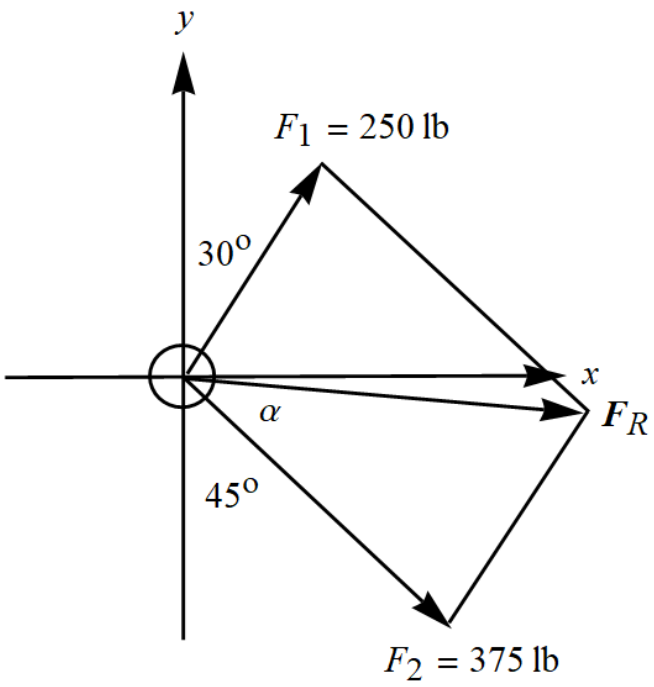
Use the law of cosines again to find it.

$$250^2 = 375^2 + F_R^2 - 2(375)(F_R)\cos\alpha \quad \rightarrow \quad \alpha \approx 37.9^\circ$$

The counterclockwise angle from the positive x-axis is then

$$270^\circ + 45^\circ + \alpha \approx 353^\circ$$

as illustrated below.


y
$F_1 = 250$ lb
30°
x
α
F_R
45°
$F_2 = 375$ lb