Problem 2.1

Two forces are applied as shown to a hook. Determine graphically the magnitude and direction of their resultant using (a) the parallelogram law, (b) the triangle rule.

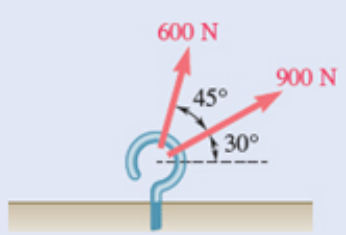
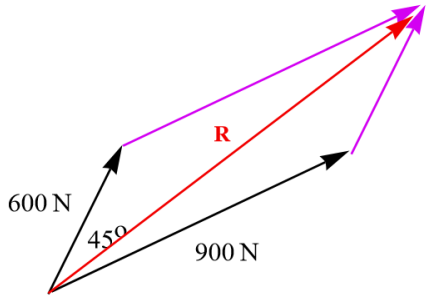


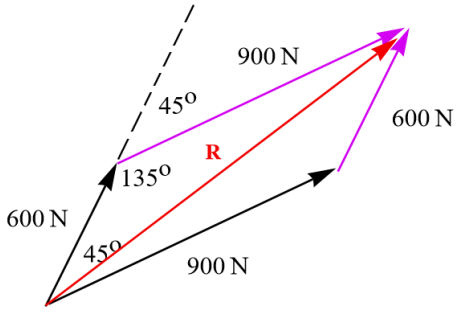
Fig. P2.1

Solution

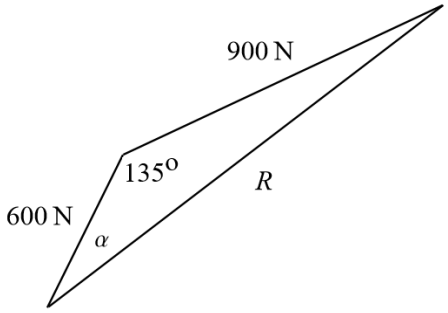
Start by drawing the parallelogram formed by the two vectors.



Use geometry to determine the angle opposite to the resultant vector.



The triangle consisting of the vector magnitudes is shown below.



Use the law of cosines to determine the magnitude of the resultant.

$$R^2 = (600\text{ N})^2 + (900\text{ N})^2 - 2(600\text{ N})(900\text{ N})\cos 135^\circ$$

$$R = \sqrt{600^2 + 900^2 - 2(600)(900)\cos 135^\circ}\text{ N}$$

$$\boxed{R \approx 1391\text{ N}}$$

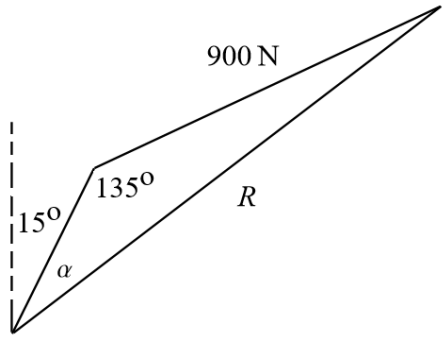
Use the law of cosines again to determine the interior angle α.

$$(900\text{ N})^2 = (600\text{ N})^2 + R^2 - 2(600\text{ N})R\cos\alpha$$

$$\cos\alpha = \frac{(900\text{ N})^2 - (600\text{ N})^2 - R^2}{-2(600\text{ N})R} \approx 0.889$$

$$\alpha \approx 27.2^\circ.$$

From Fig. P2.1 the angle of the 600 N force from the vertical is $90^\circ - (30^\circ + 45^\circ) = 15^\circ$.



The angle of the resultant from the horizontal is

$$\boxed{\theta = 90^\circ - (15^\circ + \alpha) \approx 47.8^\circ.}$$