

A plane is flying due north at a speed of 300 mph. A wind is blowing from the southeast at a speed of 15 mph. Find the ground speed and direction of the plane.

$$\vec{p} = \langle 300 \cos 90^\circ, 300 \sin 90^\circ \rangle$$

$$\vec{w} = \langle 15 \cos 135^\circ, 15 \sin 135^\circ \rangle$$

$$\vec{p} + \vec{w} = \langle -10.61, 310.61 \rangle$$

$$\begin{aligned} \text{Speed} &= \sqrt{(-10.61)^2 + (310.61)^2} \\ &= 310.79 \text{ mph} \end{aligned}$$

$$\begin{aligned} \tan^{-1} \left( \frac{310.61}{-10.61} \right) &= -88.04^\circ \\ &= 91.96^\circ \end{aligned}$$

Three forces with magnitudes of 50 pounds, 75 pounds, 110 pounds act on an object at angles of  $30^\circ$ ,  $45^\circ$ , and  $150^\circ$  respectively with the positive x-axis. Find the direction and magnitude of the resultant of these forces.

$$\vec{F}_1 = \langle 50 \cos 30^\circ, 50 \sin 30^\circ \rangle$$

$$\vec{F}_2 = \langle 75 \cos 45^\circ, 75 \sin 45^\circ \rangle$$

$$\vec{F}_3 = \langle 110 \cos 150^\circ, 110 \sin 150^\circ \rangle$$

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \langle 1.07, 133.03 \rangle$$

$$\sqrt{(1.07)^2 + (133.03)^2} = 133.03$$

$$\tan^{-1} \left( \frac{133.03}{1.07} \right)$$

$$89.54^\circ$$