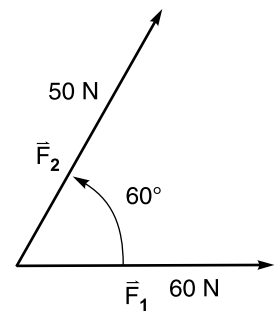
8-5

Study Guide

Applications with Vectors

Vectors can be used to represent any quantity that has direction and magnitude, such as force, velocity, and weight.

Example **Suppose Jamal and Mike pull on the ends of a rope tied to a dinghy. Jamal pulls with a force of 60 newtons and Mike pulls with a force of 50 newtons. The angle formed when Jamal and Mike pull on the rope is 60°.**



a. Draw a labeled diagram that represents the forces.

Let $\vec{\mathbf{F}}_1$ and $\vec{\mathbf{F}}_2$ represent the two forces.

b. Determine the magnitude of the resultant force.

First find the horizontal (x) and vertical (y) components of each force.

Given that we place $\vec{\mathbf{F}}_1$ on the x-axis, the unit vector is $1\vec{\mathbf{i}} + 0\vec{\mathbf{j}}$.

Therefore, the x- and y-components of $\vec{\mathbf{F}}_1$ are $60\vec{\mathbf{i}} + 0\vec{\mathbf{j}}$.

$\vec{\mathbf{F}}_2 = x\vec{\mathbf{i}} + y\vec{\mathbf{j}}$

$\cos 60° = \frac{x}{50}$ $\qquad$ $\sin 60° = \frac{y}{50}$

$x = 50 \cos 60°$ $\qquad$ $y = 50 \sin 60°$

$= 25$ $\qquad$ ≈ 43.3

Thus, $\vec{\mathbf{F}}_2 = 25\vec{\mathbf{i}} + 43.3\vec{\mathbf{j}}$.

Then add the unit components.

$(60\vec{\mathbf{i}} + 0\vec{\mathbf{j}}) + (25\vec{\mathbf{i}} + 43.3\vec{\mathbf{j}}) = 85\vec{\mathbf{i}} + 43.3\vec{\mathbf{j}}$

$\vec{\mathbf{F}} \approx \sqrt{85^2 + 43.3^2}$

$\approx \sqrt{9099.89}$

≈ 95.39

The magnitude of the resultant force is 95.39 newtons.

c. Determine the direction of the resultant force.

$\tan \theta = \frac{43.3}{85}$ $\qquad$ *Use the tangent ratio.*

$\theta = \tan^{-1} \frac{43.3}{85}$

$\theta \approx 27°$

The direction of the resultant force is 27° with respect to the vector on the x-axis.