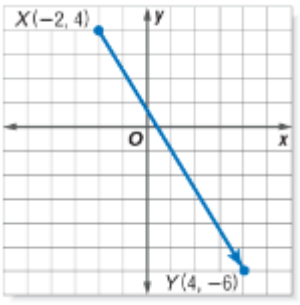
Lesson 8-2 Algebraic Vectors

Example 1

Write the ordered pair that represents the vector from *X*(-2, 4) to *Y*(4, -6). Then find the magnitude of $\overrightarrow{XY}$.

First, represent $\overrightarrow{XY}$ as an ordered pair.



$\overrightarrow{XY} = \langle 4 - (-2), -6 - 4\rangle$ or $\langle 6, -10\rangle$

Then, determine the magnitude of $\overrightarrow{XY}$.

$$|\overrightarrow{XY}| = \sqrt{(4 - (-2))^2 + (-6 - 4)^2}$$
$$= \sqrt{136} \text{ or } 2\sqrt{34}$$

$\overrightarrow{XY}$ is represented by the ordered pair $\langle 6, -10\rangle$ and has a magnitude of $2\sqrt{34}$ units.

Example 2

Let $\vec{m} = \langle 2, -3\rangle$, $\vec{n} = \langle 1, 5\rangle$, and $\vec{p} = \langle -2, 4\rangle$. Find each of the following.

a. $\vec{n} + \vec{p}$

$\vec{n} + \vec{p} = \langle 1, 5\rangle + \langle -2, 4\rangle$
$= \langle 1 + (-2), 5 + 4\rangle$
$= \langle -1, 9\rangle$

b. $\vec{m} - \vec{p}$

$\vec{m} - \vec{p} = \langle 2, -3\rangle - \langle -2, 4\rangle$
$= \langle 2 - (-2), -3 - 4\rangle$
$= \langle 4, -7\rangle$

c. $3\vec{n}$

$3\vec{n} = 3\langle 1, 5\rangle$
$= \langle 3 \cdot 1, 3 \cdot 5\rangle$
$= \langle 3, 15\rangle$

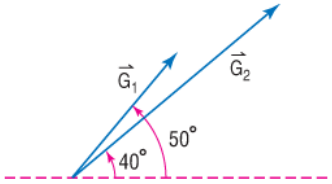
d. $2\vec{m} + 3\vec{p}$

$2\vec{m} + 3\vec{p} = 2\langle 2, -3\rangle + 3\langle -2, 4\rangle$
$= \langle 4, -6\rangle + \langle -6, 12\rangle$
$= \langle -2, 6\rangle$

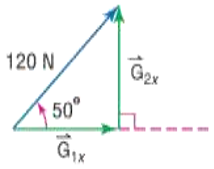
Example 3

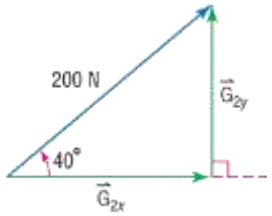
EMERGENCY MEDICINE **Two paramedics are moving a person on a stretcher. Bob is pushing the stretcher with a force of 120 Newtons at 50° with the horizontal, while Ed is pulling the stretcher with a force of 200 Newtons at 40° with the horizontal. What is the magnitude of the force exerted on the stretcher?**

Draw a diagram of the situation. Let $\overrightarrow{\mathbf{G}_1}$ represent the force Bob exerts and let $\overrightarrow{\mathbf{G}_2}$ represent the force Ed exerts.



Write each vector as an ordered pair by finding its horizontal and vertical components. Let $\overrightarrow{\mathbf{G}_{1x}}$ and $\overrightarrow{\mathbf{G}_{1y}}$ represent the *x* and *y* components of $\overrightarrow{\mathbf{G}_1}$ and let $\overrightarrow{\mathbf{G}_{2x}}$ and $\overrightarrow{\mathbf{G}_{2y}}$ represent the *x* and *y* components of $\overrightarrow{\mathbf{G}_2}$.





$$\cos 50° = \frac{|\overrightarrow{\mathbf{G}_{1x}}|}{120}$$
$$|\overrightarrow{\mathbf{G}_{1x}}| = 120 \cos 50°$$
$$\approx 77.1$$

$$\cos 40° = \frac{|\overrightarrow{\mathbf{G}_{2x}}|}{200}$$
$$|\overrightarrow{\mathbf{G}_{2x}}| = 200 \cos 40°$$
$$\approx 153.2$$

$$\sin 50° = \frac{|\overrightarrow{\mathbf{G}_{1y}}|}{120}$$
$$|\overrightarrow{\mathbf{G}_{1y}}| = 120 \sin 50°$$
$$\approx 91.9$$

$$\sin 40° = \frac{|\overrightarrow{\mathbf{G}_{2y}}|}{200}$$
$$|\overrightarrow{\mathbf{G}_{2y}}| = 200 \sin 40°$$
$$\approx 128.6$$

Find the sum of the vectors.

$$\overrightarrow{\mathbf{G}_1} + \overrightarrow{\mathbf{G}_2} \approx \langle 77.1, 91.9\rangle + \langle 153.2, 128.6\rangle$$
$$\approx \langle 230.3, 220.5\rangle$$

The net force on the stretcher is the magnitude of the sum.

$$|\overrightarrow{\mathbf{G}_1} + \overrightarrow{\mathbf{G}_2}| \approx \sqrt{(230.3)^2 + (220.5)^2} \text{ or about } 319$$

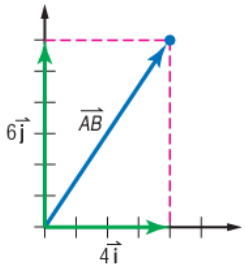
The net force on the stretcher is about 319 Newtons.

Example 4

Write $\overrightarrow{AB}$ as the sum of unit vectors for $A(3, -2)$ and $B(7, 4)$.

First, write $\overrightarrow{AB}$ as an ordered pair.

$\overrightarrow{AB} = \langle 7 - 3, 4 - (-2) \rangle$
$= \langle 4, 6 \rangle$



Then write $\overrightarrow{AB}$ as the sum of unit vectors.

$\overrightarrow{AB} = 4\vec{\mathbf{i}} + 6\vec{\mathbf{j}}$