8-2

Study Guide

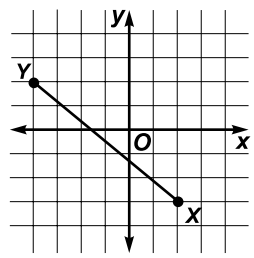
Algebraic Vectors

Vectors can be represented algebraically using ordered pairs of real numbers.

Example 1 **Write the ordered pair that represents the vector from $X(2, -3)$ to $Y(-4, 2)$. Then find the magnitude of $\overrightarrow{XY}$.**

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

$\overrightarrow{XY} = \langle x_2 - x_1, y_2 - y_1 \rangle$
$= \langle -4 - 2, 2 - (-3) \rangle$
$= \langle -6, 5 \rangle$



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

$|\overrightarrow{XY}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(-4 - 2)^2 + [2 - (-3)]^2}$
$= \sqrt{(-6)^2 + 5^2}$
$= \sqrt{61}$

$\overrightarrow{XY}$ is represented by the ordered pair $\langle -6, 5 \rangle$ and has a magnitude of $\sqrt{61}$ units.

Example 2 **Let $\vec{s} = \langle 4, 2 \rangle$ and $\vec{t} = \langle -1, 3 \rangle$. Find each of the following.**

a. $\vec{s} + \vec{t}$

$\vec{s} + \vec{t} = \langle 4, 2 \rangle + \langle -1, 3 \rangle$
$= \langle 4 + (-1), 2 + 3 \rangle$
$= \langle 3, 5 \rangle$

b. $\vec{s} - \vec{t}$

$\vec{s} - \vec{t} = \langle 4, 2 \rangle - \langle -1, 3 \rangle$
$= \langle 4 - (-1), 2 - 3 \rangle$
$= \langle 5, -1 \rangle$

c. $4\vec{s}$

$4\vec{s} = 4\langle 4, 2 \rangle$
$= \langle 4 \cdot 4, 4 \cdot 2 \rangle$
$= \langle 16, 8 \rangle$

d. $3\vec{s} + \vec{t}$

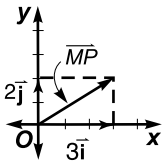
$3\vec{s} + \vec{t} = 3\langle 4, 2 \rangle + \langle -1, 3 \rangle$
$= \langle 12, 6 \rangle + \langle -1, 3 \rangle$
$= \langle 11, 9 \rangle$

A unit vector in the direction of the positive x-axis is represented by $\vec{\mathbf{i}}$, and a unit vector in the direction of the positive y-axis is represented by $\vec{\mathbf{j}}$. Vectors represented as ordered pairs can be written as the sum of unit vectors.

Example 3 **Write $\overrightarrow{MP}$ as the sum of unit vectors for $M(2, 2)$ and $P(5, 4)$.**

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

$\overrightarrow{MP} = \langle 5 - 2, 4 - 2 \rangle$
$= \langle 3, 2 \rangle$



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

$\overrightarrow{MP} = 3\vec{\mathbf{i}} + 2\vec{\mathbf{j}}$