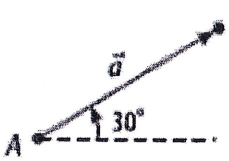
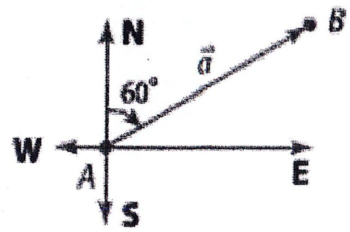
8.7 Vectors

Vectors: Meteorologists use vectors to represent weather pattern. For example, wind vectors are used to indicate wind direction and speed.

Geometric Vector Operations A vector is a directed segment representing a quantity that has both **magnitude,** or length, and **direction.** For example, the speed and direction of an airplane can be represented by a vector. In symbols, a vector is written as $\overrightarrow{AB}$, where A is the initial point and B is the endpoint, or as $\vec{v}$. The sum of two vectors is called the **resultant.** Subtracting a vector is equivalent to adding its opposite. The resultant of two vectors can be found using the **parallelogram method** or the **triangle method.**



The direction of $\vec{a}$ is 30° relative to the horizontal.

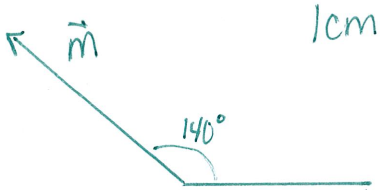


The direction of $\vec{a}$ is 60° east of north.

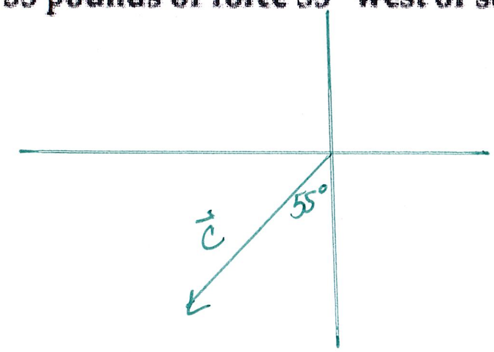
Example 1 Represent Vector Geometrically:

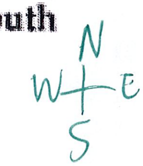
a. $\vec{m}$ = **15 miles per hour at 140° to the horizontal**

1cm = 5mi/hr



b. $\vec{c}$ = **55 pounds of force 55° west of south**

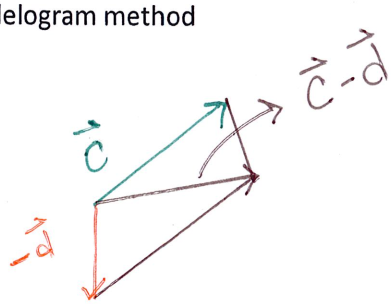




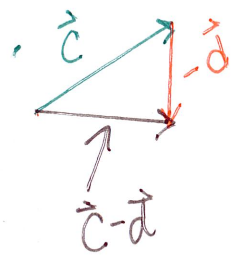
Example 2 Find the resultant of two vectors

Copy the vectors. Then find $\vec{c} - \vec{d}$.

Parallelogram method

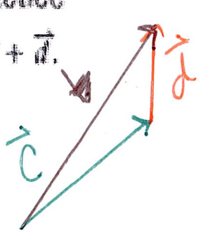


Triangle method



GuidedPractice

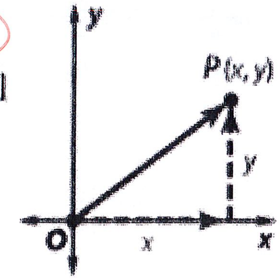
2A. Find $\vec{c} + \vec{d}$.



8.7 Vectors

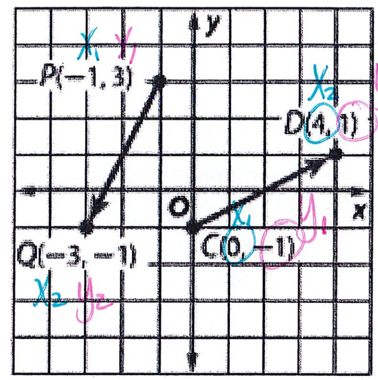
Vectors in a coordinate plane

A vector is in **standard position** if its initial point is at the origin. In this position, a vector can be uniquely described by its terminal point $P(x, y)$.



To describe a vector with any initial point, you can use the **component form** $\langle x, y \rangle$, which describes the vector in terms of its horizontal component x and vertical component y.

Example Write 3 a Vector in Component Form



Write the component form of $\overrightarrow{CD}$.

$\overrightarrow{CD} = \langle x_2 - x_1, y_2 - y_1 \rangle$ $\langle 4-0, 1--1 \rangle$

$\langle 4, 2 \rangle$

Write the component form of $\overrightarrow{PQ}$.

$\langle -3--1, -1-3 \rangle$ $\langle -2, -4 \rangle$

Example 4 Find the magnitude and direction of a Vector

Find the magnitude and direction of $\vec{r} = \langle -4, -5 \rangle$.

Step 1 Use the Distance Formula to find the magnitude.

$|\vec{r}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Distance Formula

$|\vec{r}| = \sqrt{(-4-0)^2 + (-5-0)^2}$

$|\vec{r}| = \sqrt{16 + 25}$

$|\vec{r}| = \sqrt{41}$ or about 6.4

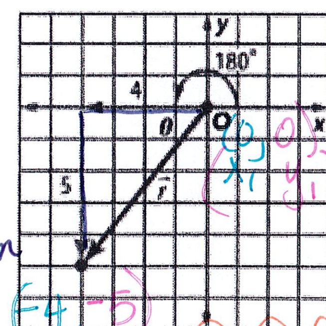
Step 2 Use trigonometry to find the direction.

TOA

Trig Method Direction

$\tan\theta = \frac{5}{4}$

$\theta = 51.34°$



The magnitude of $\vec{r}$ is 6.4 units and the direction is at an angle of 231.3° to the horizontal

The direction of $\vec{r}$ is the angle that makes w/ the positive x-axis

$180 + 51.3 = 231.3°$

Example: Find the magnitude and direction of $\vec{a} = \langle 3, 5 \rangle$.

Find the magnitude.

$|\vec{a}| = \sqrt{(0-3)^2 + (0-5)^2}$

$|\vec{a}| = \sqrt{9 + 25}$

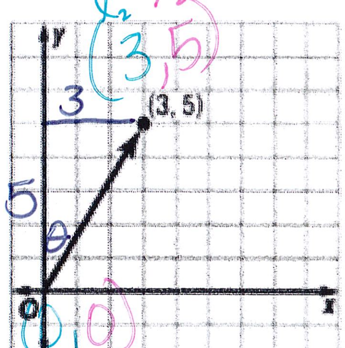
$|\vec{a}| = \sqrt{34} \approx 5.8$

Direction

$\tan\theta = \frac{5}{3}$

$\theta = 59.03°$

Direction 59°
magnitude 5.8



8.7 Vectors

KeyConcept Vector Operations

If $\langle a, b\rangle$ and $\langle c, d\rangle$ are vectors and k is a scalar, then the following are true.

Vector Addition	$\langle a, b\rangle + \langle c, d\rangle = \langle a + c, b + d\rangle$
Vector Subtraction	$\langle a, b\rangle - \langle c, d\rangle = \langle a - c, b - d\rangle$
Scalar Multiplication	$k\langle a, b\rangle = \langle ka, kb\rangle$

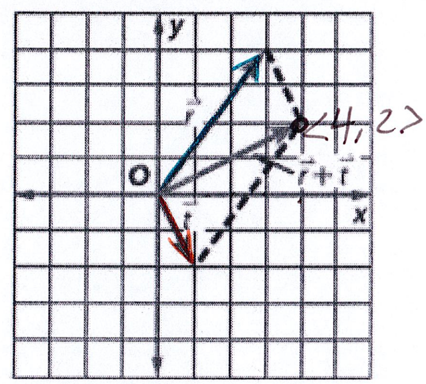
Find each of the following for $\vec{r} = \langle 3, 4\rangle$, $\vec{s} = \langle 5, -1\rangle$, and $\vec{t} = \langle 1, -2\rangle$. Check your answers graphically.

Check Graphically

a. $\vec{r} + \vec{t}$ use the parallelogram

$\langle 3, 4\rangle + \langle 1, -2\rangle$

$\langle 4, 2\rangle$

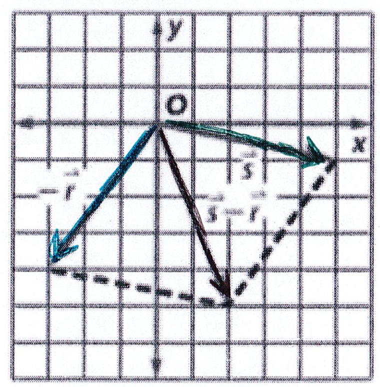


b. $\vec{s} - \vec{r}$

$\langle 5, -1\rangle - \langle 3, 4\rangle$

$\langle 5-3, -1-4\rangle$

$\langle 2, -5\rangle$



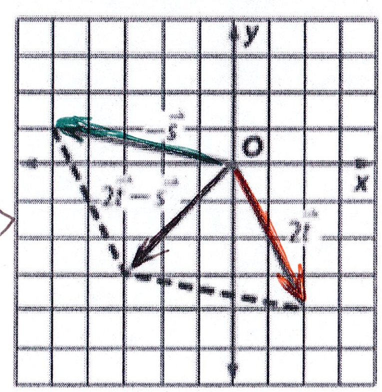
c. $2\vec{t} - \vec{s}$

$2\langle 1, -2\rangle - \langle 5, -1\rangle$

$\langle 2, -4\rangle - \langle 5, -1\rangle$ $\langle -3, -3\rangle$

$\langle 2-5, -4-1\rangle$

$\langle -3, -3\rangle$



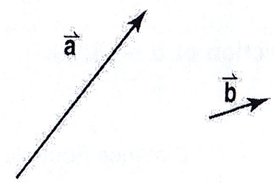
NAME ______________________ DATE ______________ PERIOD ________

8-7 Study Guide and Intervention

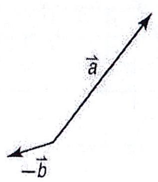
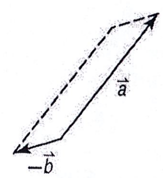
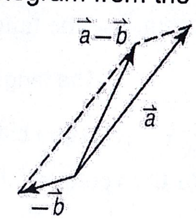
Vectors

Geometric Vector Operations A vector is a directed segment representing a quantity that has both **magnitude,** or length, and **direction.** For example, the speed and direction of an airplane can be represented by a vector. In symbols, a vector is written as $\overrightarrow{AB}$, where A is the initial point and B is the endpoint, or as $\vec{v}$. The sum of two vectors is called the **resultant.** Subtracting a vector is equivalent to adding its opposite. The resultant of two vectors can be found using the **parallelogram method** or the **triangle method.**

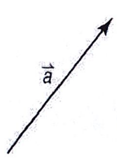
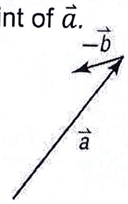
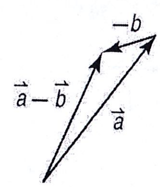
Example: Copy the vectors to find $\vec{a} - \vec{b}$.



Method 1: Use the parallelogram method.

Copy $\vec{a}$ and $-\vec{b}$ with the same initial point.	Complete the parallelogram.	Draw the diagonal of the parallelogram from the initial point.
		

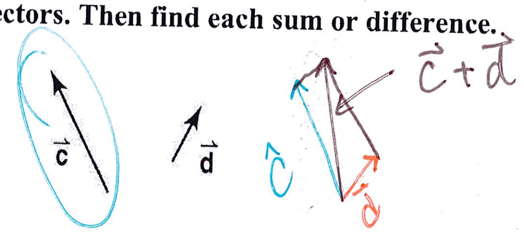
Method 2: Use the triangle method.

Copy $\vec{a}$.	Place the initial point of $-\vec{b}$ at the terminal point of $\vec{a}$.	Draw the vector from the initial point of $\vec{a}$ to the terminal point of $-\vec{b}$.
		

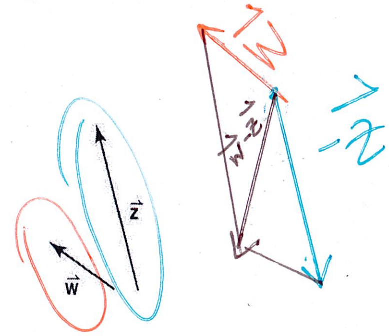
Exercises

Copy the vectors. Then find each sum or difference.

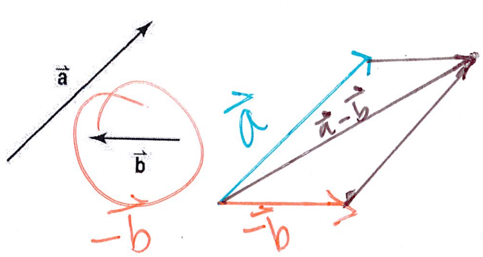
1. $\vec{c} + \vec{d}$



2. $\vec{w} - \vec{z}$



3. $\vec{a} - \vec{b}$



4. $\vec{r} + \vec{t}$