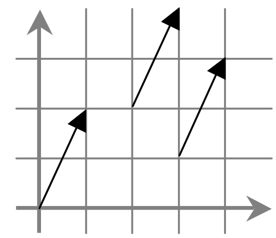
Precalculus **Name ______________________**

6.3 Vectors in the Plane – *Day 1*

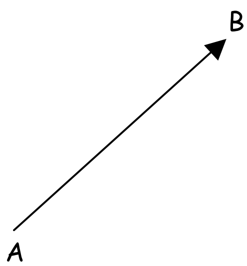
A **vector** is a directed distance or quantity that has both **magnitude** (length) and direction. It is geometrically represented by a directed line segment.

Vectors can be represented algebraically using ordered pairs. For example, the ordered pair $\langle 1,2 \rangle$ represents the vector from the **origin** to the point at (1,2).

The initial point of a vector can be any point in the plane, not just the origin. For example, **ALL** of the vectors in the coordinate plane at the right can be represented by $\langle 1,2 \rangle$.



Notation: Vectors are denoted with one-tailed arrows above the letter. ie: $\vec{w}$



Point A is the ______________ point, which is the starting point of the vector.

Point B is the ______________ point, which is the endpoint point of the vector.

Draw the **horizontal** & **vertical** components of this vector $\overrightarrow{AB}$.

Notice you have now formed a right triangle! We can find the **magnitude** (length) of the resultant vector by using the Pythagorean Theorem.

Suppose $P(x_1, y_1)$ and $Q(x_2, y_2)$ are the **initial** (starting) and **terminal** (ending) points of a vector:

- The **component form** that represents $\overrightarrow{PQ}$ is $\langle x_2 - x_1, y_2 - y_1 \rangle$.
- The **magnitude** of $\overrightarrow{PQ}$ is given by $\left\| \overrightarrow{PQ} \right\| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

Example 1: Find the component form that represents the vector from $C(7,-3)$ to $D(-2,-1)$, then find the magnitude of the vector.

Resultant Vector:	The sum or difference of two vectors	
Vector Operations:	Addition:	$\vec{a} + \vec{b} = \langle a_1, a_2 \rangle + \langle b_1, b_2 \rangle = \langle a_1 + b_1, a_2 + b_2 \rangle$
	Subtraction:	$\vec{a} - \vec{b} = \langle a_1, a_2 \rangle - \langle b_1, b_2 \rangle = \langle a_1 - b_1, a_2 - b_2 \rangle$
	Scalar Multiplication:	$k\vec{a} = \langle ka_1, ka_2 \rangle$

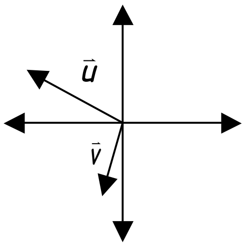
Example 2: *If* $\vec{u} = \langle 1,-4 \rangle$ *and* $\vec{v} = \langle 0,8 \rangle$, *find:*

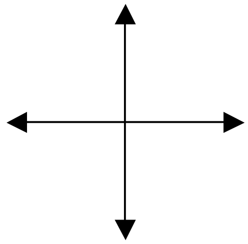
a. $\vec{u} + \vec{v}$ **b.** $\vec{u} - \vec{v}$ **c.** $\frac{1}{2}\vec{v}$

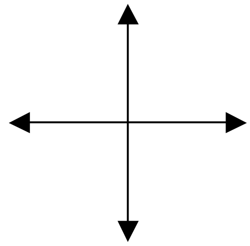
Geometric Vectors: Illustrate vector operations by drawing the vectors and their resultant on the coordinate plane. There are two methods: the tip-to-tail method and the parallelogram method.

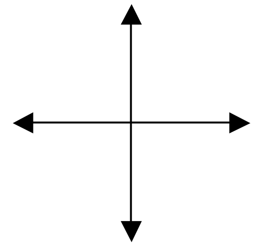
Use the figure to sketch a graph of the specified vector.

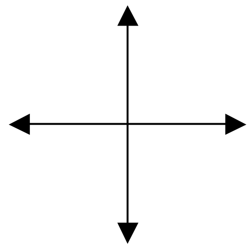
Example 3: **a.** $2\vec{v}$ **b.** $2\vec{v}+\vec{u}$ **c.** $\vec{u}-\vec{v}$

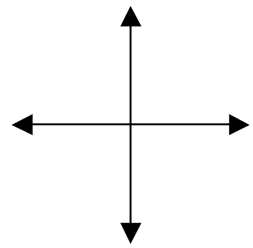






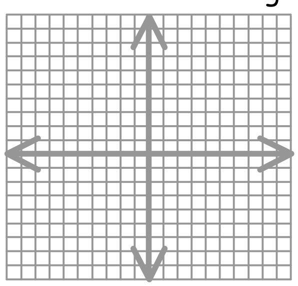




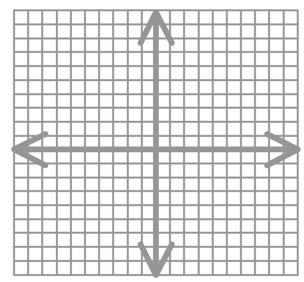


Example 4: $\vec{v}=\langle -2,2\rangle$ and $\vec{w}=\langle 3,4\rangle$. Algebraically find the resultant vector and magnitude, then draw the vectors and illustrate the resultant geometrically.

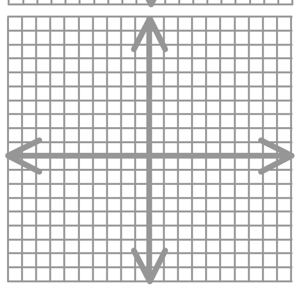
a. $2\vec{v}$



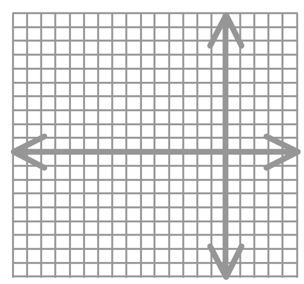
b. $\vec{w}-\vec{v}$



c. $\vec{v}+2\vec{w}$



d. $2\vec{v}-3\vec{w}$



Linear Combination of Unit Vectors

Any vector $\vec{v}=\langle v_1,v_2\rangle$ can be expressed as $v_1\vec{i}+v_2\vec{j}$. That is, any vector that is represented by an ordered pair can also be written as the <u>Linear Combination of Unit Vectors</u>. The <u>scalars</u> v_1 and v_2 are the ___________________ and __________________ components of $\vec{v}$.

Example 5: Write $\overrightarrow{AB}$ as a linear combination of unit vectors given that the initial point for this vector is A (2,-1) and the terminal point is B (-1,5).

Example 6: Use vector operations to find the following. Let $\vec{u}=\vec{i}+\vec{j}$ and $\vec{v}=5\vec{i}-3\vec{j}$.

a. $2\vec{u}-3\vec{v}$ **b.** $4\vec{u}+\frac{1}{2}\vec{v}$