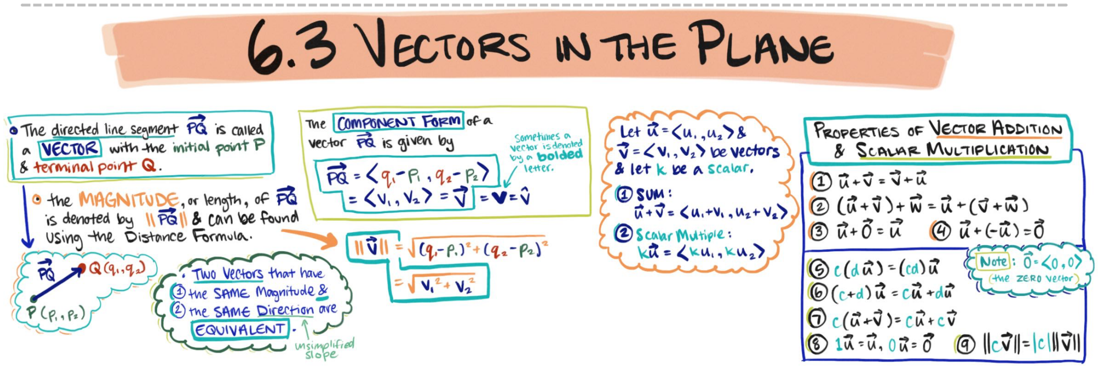
6.3 Vectors in the Plane

Objective: Today we will find the magnitude of vectors, write vectors in their component form, and perform operations on vectors.

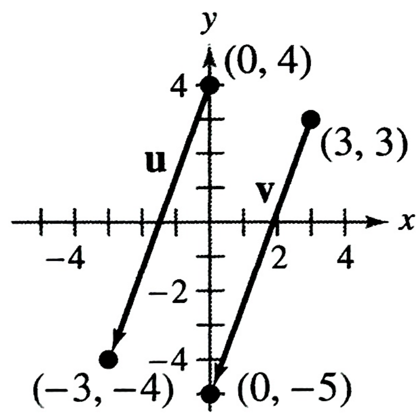
Warm-up: Solve the triangle for its missing parts.

$A = 60°$ $b = 3$ $c = 6$



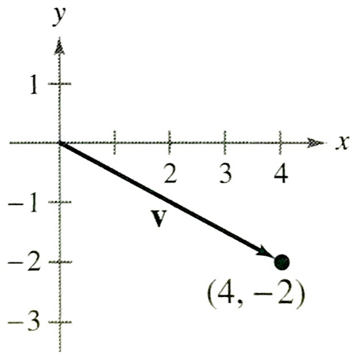
Equivalent Directed Line Segments In Exercises 11 and 12, show that $\mathbf{u} = \mathbf{v}$.

12.

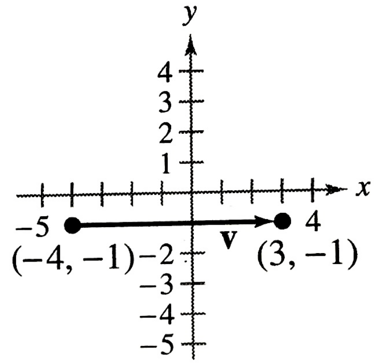


Finding the Component Form of a Vector In Exercises 13–24, find the component form and the magnitude of the vector **v**.

14.



18.

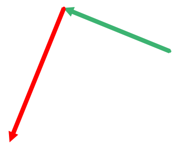


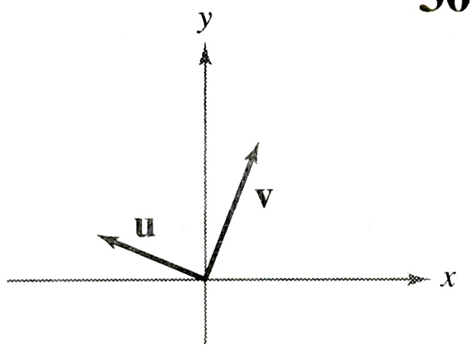
Finding the Component Form of a Vector In Exercises 13–24, find the component form and the magnitude of the vector **v**.

	Initial Point	*Terminal Point*
20.	$(-3, 11)$	$(9, 40)$

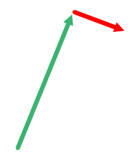
Sketching the Graph of a Vector In Exercises 25–30, use the figure to sketch a graph of the specified vector. To print an enlarged copy of the graph, go to the website

28. $\mathbf{u} - \mathbf{v}$



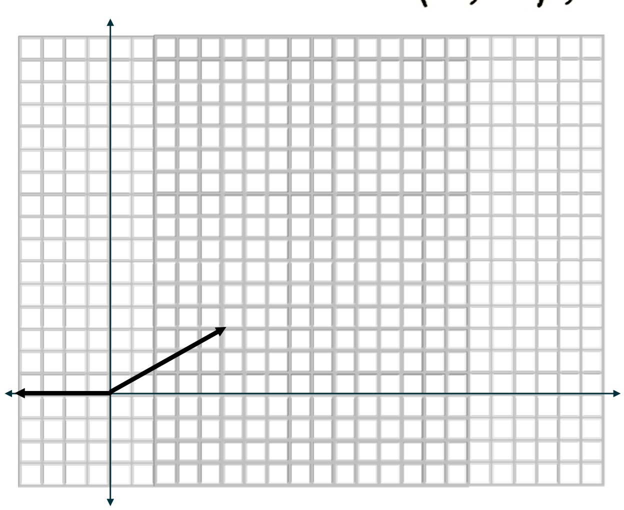


30. $\mathbf{v} - \frac{1}{2}\mathbf{u}$



Vector Operations In Exercises 37–42, find (a) $\mathbf{u} + \mathbf{v}$, (b) $\mathbf{u} - \mathbf{v}$, (c) $2\mathbf{u} - 3\mathbf{v}$, and (d) $\mathbf{v} + 4\mathbf{u}$. Then sketch each resultant vector.

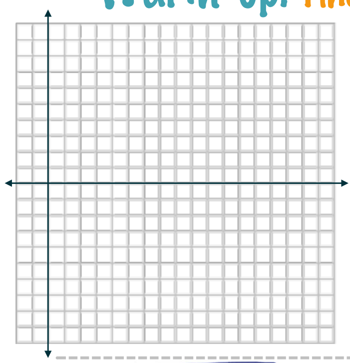
38. $\mathbf{u} = \langle 5, 3 \rangle$, $\mathbf{v} = \langle -4, 0 \rangle$



6.3 Vectors in the Plane

Objective: Today we will find the magnitude of vectors, write vectors in their component form, and perform operations on vectors.

Warm-up: Find and graph the resultant vectors.



$\mathbf{u} = \langle 6, 0 \rangle \quad \mathbf{v} = \langle 8, -2 \rangle$

1. $3\mathbf{u} - 2\mathbf{v}$

2. $-\mathbf{u} + 3\mathbf{v}$

UNIT VECTORS

- A UNIT VECTOR, $\vec{u}$, is a vector that has a magnitude of 1, ($\|\vec{u}\| = 1$).
  - UNIT VECTOR in the direction of $\vec{v}$:

$$\vec{u} = \frac{\vec{v}}{\|\vec{v}\|} = \left(\frac{1}{\|\vec{v}\|}\right)\vec{v}$$

* To FIND ANY vector $\vec{v}$ in the SAME Direction as $\vec{w}$:

$$\vec{v} = \frac{\|\vec{v}\|}{\|\vec{w}\|}\vec{w}$$

NOTE:

$\vec{v} = \langle v_1, v_2 \rangle$ ← Component Form

$\vec{v} = v_1\langle 1, 0 \rangle + v_2\langle 0, 1 \rangle$

$\vec{v} = v_1\hat{i} + v_2\hat{j}$ ← Linear Combination Form

DIRECTION ANGLES

- Let θ be the direction angle of $\vec{u}$.

$$\vec{u} = \langle x, y \rangle = \langle \cos\theta, \sin\theta \rangle = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$$

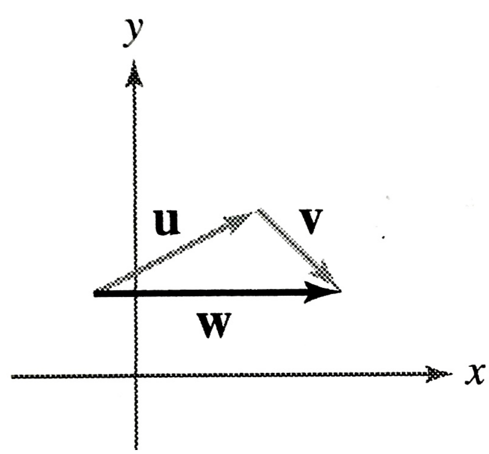
- If $\vec{v} = a\hat{i} + b\hat{j}$ is ANY vector in the SAME direction as $\vec{u}$, then

$$\vec{v} = \|\vec{v}\|\langle \cos\theta, \sin\theta \rangle = \|\vec{v}\|\cos\theta\,\hat{i} + \|\vec{v}\|\sin\theta\,\hat{j}$$

Writing a Vector In Exercises 43–46, use the figure and write the vector in terms of the other two vectors.

44. $\mathbf{v}$

46. $2\mathbf{v}$



Finding a Unit Vector In Exercises 47–56, find a unit vector in the direction of the given vector. Verify that the result has a magnitude of 1.

50. $\mathbf{v} = \langle 3, -4 \rangle$

52. $\mathbf{v} = \langle 8, -20 \rangle$

Finding a Vector In Exercises 57–62, find the vector v with the given magnitude and the same direction as u.

	Magnitude	*Direction*
58.	$\|\mathbf{v}\| = 3$	$\mathbf{u} = \langle 4, -4 \rangle$

	Magnitude	*Direction*
60.	$\|\mathbf{v}\| = 10$	$\mathbf{u} = 2\mathbf{i} - 3\mathbf{j}$

Writing a Linear Combination of Unit Vectors In Exercises 63–66, the initial and terminal points of a vector are given. Write the vector as a linear combination of the standard unit vectors **i** and **j**.

	Initial Point	*Terminal Point*
65.	$(-1, -5)$	$(2, 3)$

Finding Direction Angles of Vectors In Exercises 73–78, find the magnitude and direction angle of the vector **v**.

74. $\mathbf{v} = 8(\cos 135°\mathbf{i} + \sin 135°\mathbf{j})$

78. $\mathbf{v} = 12\mathbf{i} + 15\mathbf{j}$