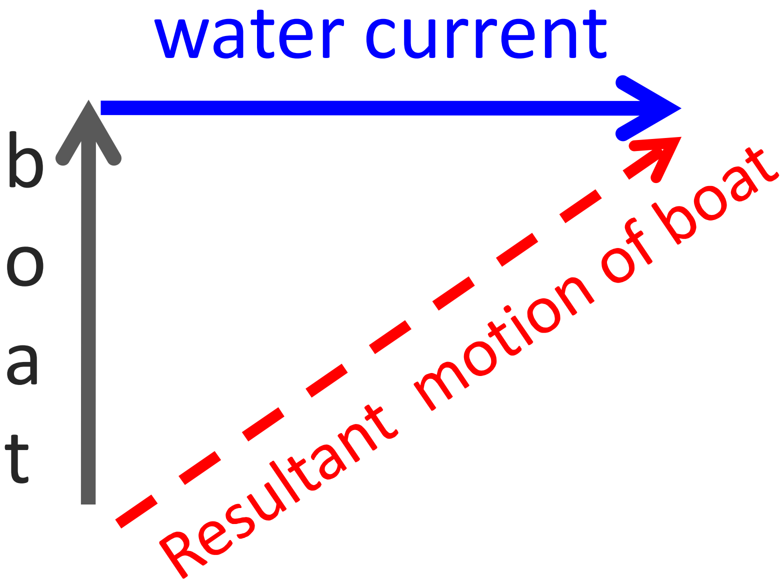
Notes: 9.1 Vectors

vector: A quantity that has both magnitude and direction. A vector is be represented by a directed line segment.



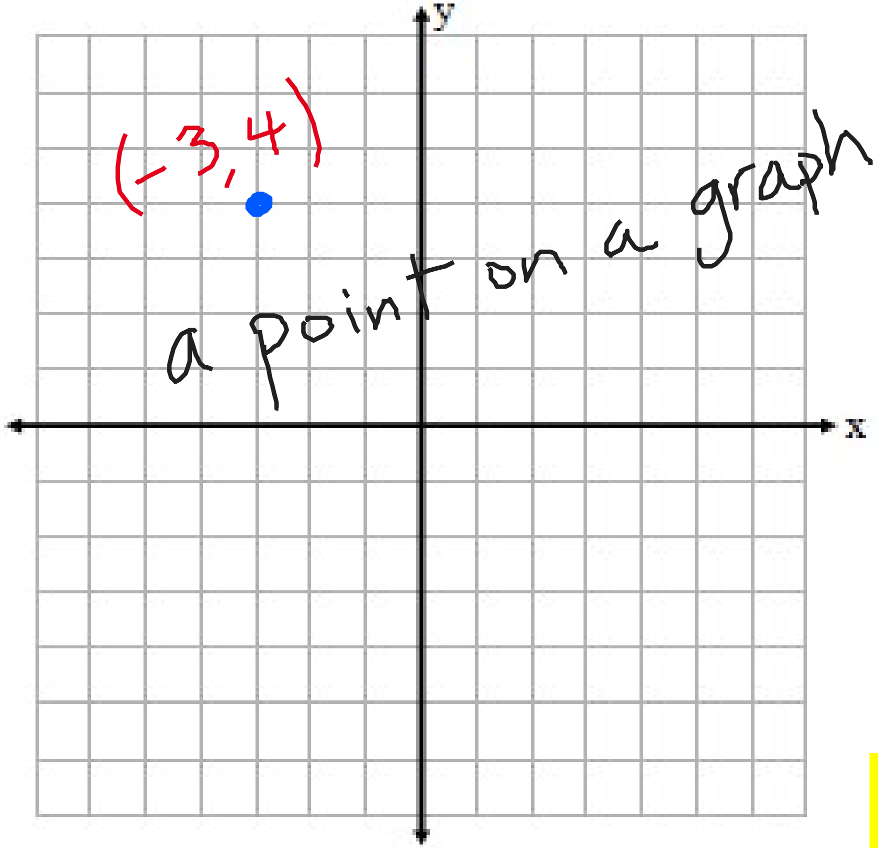
magnitude: How fast an object is moving or how much **force** is being applied to the object. Represented by the ***length*** of the given line segment.

direction: Represented by the ***angle*** between the positive x-axis and the vector.

notation:

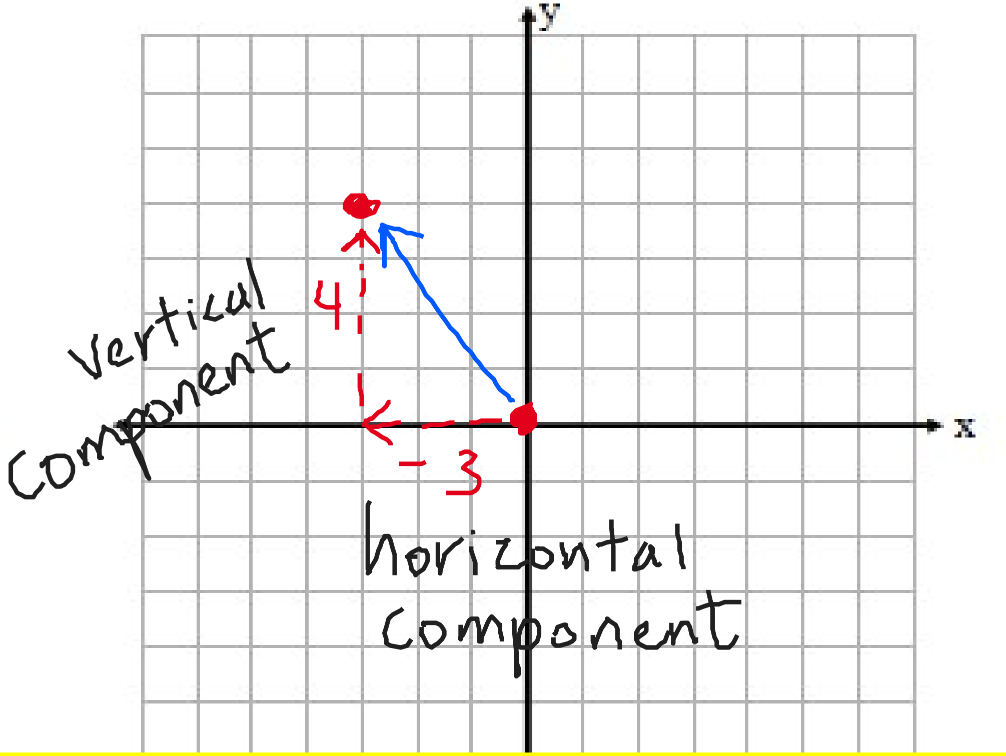
ordered pair

$(-3, 4)$



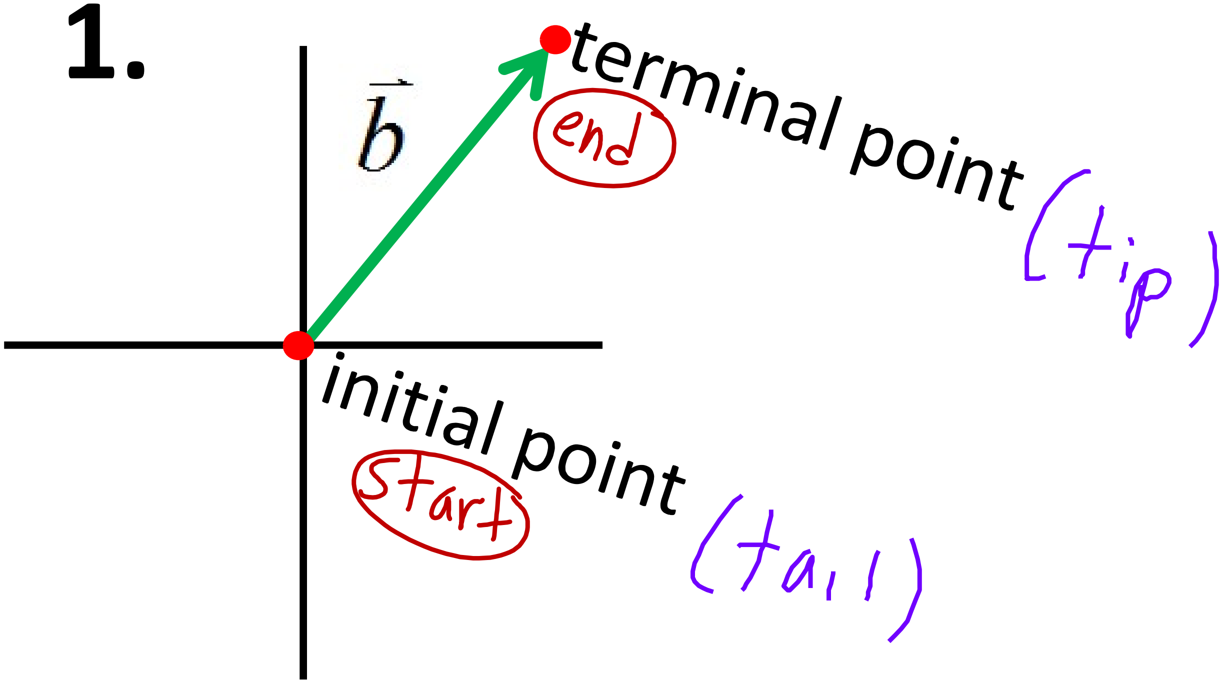
vector component form

$\langle -3, 4 \rangle$



This information can be used to find the magnitude and direction of vector ***v*.**

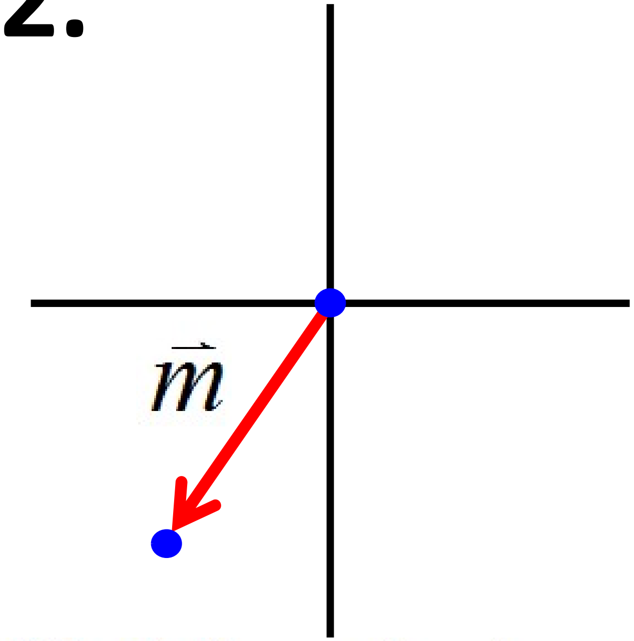
1.



$\vec{b}=45^\circ$ (*direction*)

$\vec{b}=12\,inches$ (*magnitude*)

2.



$\vec{m}=230^\circ$ (*direction*)

$\vec{m}=9\,inches$ (*magnitude*)

3. Vector Component Form

given points: $(x_1,\ y_1)$ *and* $(x_2,\ y_2)$

$$v = \langle x_2 - x_1,\ y_2 - y_1 \rangle$$

horizontal ↖ *and* ↗ *vertical components*

4. Magnitude

If given points: $(x_1,\ y_1)$ *and* $(x_2,\ y_2)$ **then**

$$|v| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

↖ *This is the distance formula... a form of the Pythagorean Theorem.*

OR

if $\mathrm{v} = \langle a_1, a_2 \rangle$

then $|v| = \sqrt{(a_1)^2 + (a_2)^2}$

horizontal vertical
components

5. The sum of unit vectors in 2 dimensions:

Example 1: $\left\langle -2, 3 \right\rangle = -2\vec{i} + 3\vec{j}$

Example 2: $\left\langle -8, -13 \right\rangle = -8i - 13j$

Note: *i and j each have a length of one*

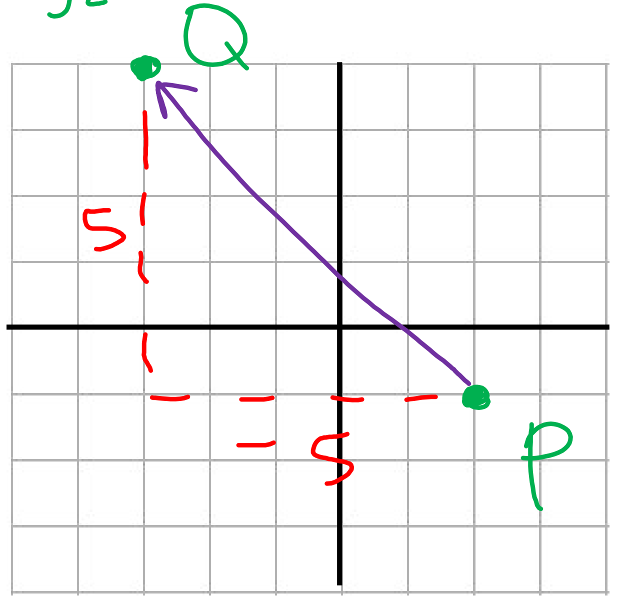
Example: Sketch a graph, then express vector PQ in component form and find the magnitude.

start $\quad$ end

P(2, -1) $\quad$ Q(-3, 4)

$x_1 \quad y_1 \quad x_2 \quad y_2$

initial point (start) $\quad$ terminal point (end)



$$PQ = \left\langle x_2 - x_1 , y_2 - y_1 \right\rangle$$

$$PQ = \left\langle -3 - 2 , 4 - -1 \right\rangle$$

$$= \boxed{\left\langle \underbrace{-5}_{\text{horiz}} , \underbrace{5}_{\text{vertical}} \right\rangle}$$

Component form

$$|PQ| = \sqrt{(-5)^2 + (5)^2}$$

$$= \sqrt{25 + 25}$$

$$= \sqrt{50} \qquad \sqrt{25}\sqrt{2}$$

$$\boxed{|PQ| = 5\sqrt{2}}$$

magnitude (length)

9.1 #31

Operations with Vectors Find $2\mathbf{u}$, $-3\mathbf{v}$, $\mathbf{u}+\mathbf{v}$, and $3\mathbf{u}-4\mathbf{v}$ for the given vectors **u** and **v**.

31. $\mathbf{u} = \langle 2, 7\rangle$, $\mathbf{v} = \langle 3, 1\rangle$

$2u = 2\langle 2,7\rangle$

$= \boxed{\langle 4,14\rangle}$

$-3v = -3\langle 3,1\rangle$

$= \boxed{\langle -9,-3\rangle}$

$u+v = \langle 2,7\rangle + \langle 3,1\rangle$

$= \boxed{\langle 5,8\rangle}$

$3u-4v =$

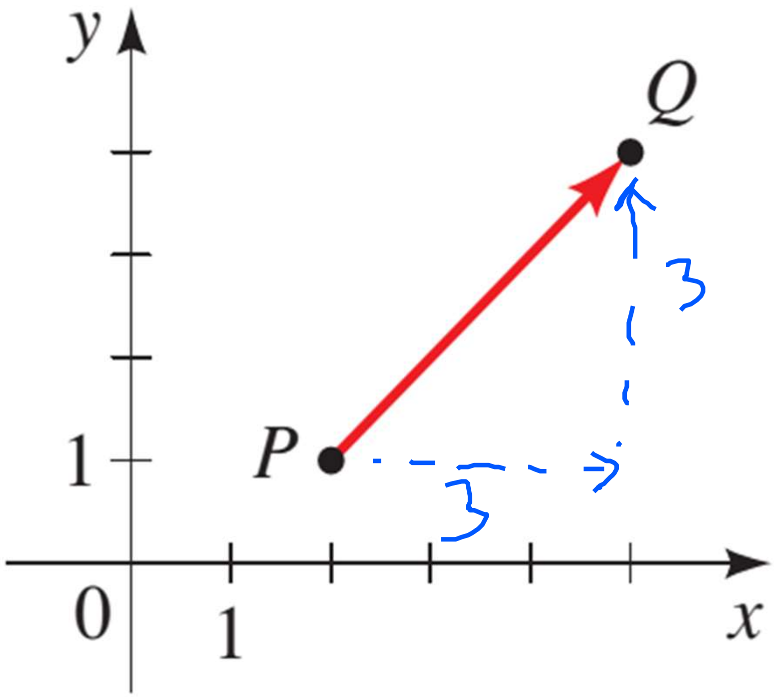
$3\langle 2,7\rangle - 4\langle 3,1\rangle$

$\langle 6,21\rangle \quad \langle 12,4\rangle$

$= \boxed{\langle {}^{-}6,17\rangle}$

Component Form of Vectors Express the vector with initial point P and terminal point Q in component form.

9.

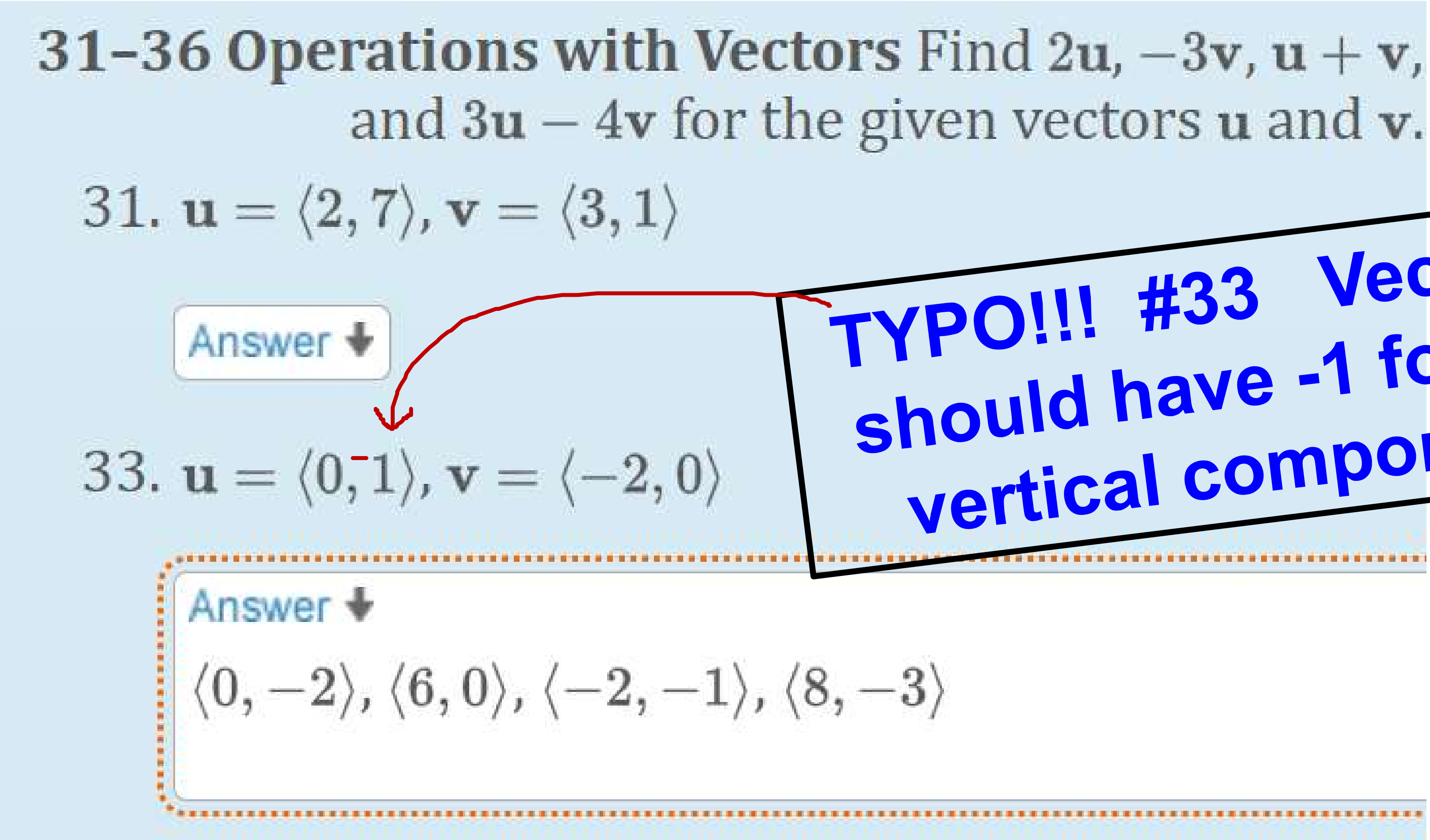


$P(2,1)$ $Q(5,4)$

x_1 y_1 x_2 y_2

$\vec{v} = \langle 5-2, 4-1 \rangle$

$= \boxed{\langle 3, 3 \rangle}$



31–36 Operations with Vectors Find $2\mathbf{u}$, $-3\mathbf{v}$, $\mathbf{u}+\mathbf{v}$, and $3\mathbf{u}-4\mathbf{v}$ for the given vectors $\mathbf{u}$ and $\mathbf{v}$.

31. $\mathbf{u} = \langle 2, 7\rangle$, $\mathbf{v} = \langle 3, 1\rangle$

33. $\mathbf{u} = \langle 0, -1\rangle$, $\mathbf{v} = \langle -2, 0\rangle$

$\langle 0, -2\rangle$, $\langle 6, 0\rangle$, $\langle -2, -1\rangle$, $\langle 8, -3\rangle$

TYPO!!! #33 Vector u should have -1 for the vertical component