10.1: Vectors
"I WILL…
…operate vectors and determine the magnitude of the missing side"

I. Definitions

A. Vector is used to indicate a quantity that has both magnitude (length/distance) and direction.

B. Represented by an arrow or a directed line segment

Ex 1: Find the magnitude of vector $\overrightarrow{PQ}$ where *P* (2, 3) and *Q* (5, 9).	Your Turn: Find the magnitude of vector $\overrightarrow{PQ}$ where *P* (–3, 5) and *Q* (7, –11).

II. Vector Operations

A. Geometrically, the product of a vector *v* and a scalar *k* is the <u>vector that is k times as long as *v*</u>

B. If *k* is positive, *k*v has the <u>same</u> direction as *v*, and if *k* is negative, *k*v has the <u>opposite</u> direction.

C. Equivalent Vectors is where every vector is equal to another vector with the initial point at the origin.

Ex 2: Find an equivalent vector whose initial point is the origin where *P* is (1, 5) and *Q* is (7, 11). Solve for $\overrightarrow{OR}$	Your Turn: Find an equivalent vector whose initial point is the origin where *P* is (3, –5) and *Q* is (–6, 9). Solve for $\overrightarrow{OR}$

III. Resultant Force

A. To add two vectors geometrically, position them so the initial point of one coincides with the terminal point of the other

B. This technique is called the parallelogram law for vector addition because the vector $u + v$, often called <u>the resultant of vector</u> addition, is the diagonal of a parallelogram with u and v as sides

C. In other words, it is like adding integers

Ex 3: If $u = \langle 1, 6 \rangle$ and $v = \langle -4, 2 \rangle$, solve for $u + v$ and $3v$.	Your Turn: If $u = \langle -2, 4 \rangle$ and $v = \langle 6, 1 \rangle$, solve for $u + v$ and $3u - 2v$.
Ex 4: If $u = \langle 1, 6 \rangle$ and $v = \langle -4, 2 \rangle$, find the magnitude of $u + v$	Your Turn: If $u = \langle -2, 4 \rangle$ and $v = \langle 6, 1 \rangle$, find the magnitude of $u - v$

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Exercises 10.5

In Exercises 1–4, find the magnitude of the vector $\overrightarrow{PQ}$.

1. $P = (2, 3), Q = (5, 9)$
2. $P = (-3, 5), Q = (7, -11)$
3. $P = (-7, 0), Q = (-4, -5)$
4. $P = (30, 12), Q = (25, 5)$

In Exercises 5–10, find a vector equivalent to the vector $\overrightarrow{PQ}$ with its initial point at the origin.

5. $P = (1, 5), Q = (7, 11)$
6. $P = (2, 7), Q = (-2, 9)$
7. $P = (-4, -8), Q = (-10, 2)$
8. $P = (-5, 6), Q = (-7, -9)$
9. $P = \left(\frac{4}{5}, -2\right), Q = \left(\frac{17}{5}, -\frac{12}{5}\right)$
10. $P = (\sqrt{2}, 4), Q = (\sqrt{3}, -1)$

In Exercises 11–15, find $\mathbf{u} + \mathbf{v}$, $\mathbf{u} - \mathbf{v}$, and $3\mathbf{u} - 2\mathbf{v}$.

11. $\mathbf{u} = \langle -2, 4\rangle, \mathbf{v} = \langle 6, 1\rangle$
12. $\mathbf{u} = \langle 4, 0\rangle, \mathbf{v} = \langle 1, -3\rangle$
13. $\mathbf{u} = \langle 3, 3\sqrt{2}\rangle, \mathbf{v} = \langle 4\sqrt{2}, 1\rangle$
14. $\mathbf{u} = \left\langle \frac{2}{3}, 4\right\rangle, \mathbf{v} = \left\langle -7, \frac{19}{3}\right\rangle$
15. $\mathbf{u} = 2\langle -2, 5\rangle, \mathbf{v} = \frac{1}{4}\langle -7, 12\rangle$

In Exercises 16–23, let $\mathbf{u} = \langle 3, 1\rangle$, $\mathbf{v} = \langle -8, 4\rangle$, and $\mathbf{w} = \langle -6, -2\rangle$. Find the magnitude of each vector.

16. $\mathbf{u} + \mathbf{v}$
17. $\mathbf{u} - \mathbf{v}$
18. $3\mathbf{u} + \mathbf{v}$
19. $\mathbf{v} + \mathbf{w}$
20. $2(\mathbf{v} - \mathbf{w})$
21. $-2(\mathbf{w} + 2\mathbf{u})$
22. $\mathbf{u} + \frac{1}{2}\mathbf{w}$
23. $\frac{7}{6}\mathbf{v} - \frac{2}{3}\mathbf{v}$