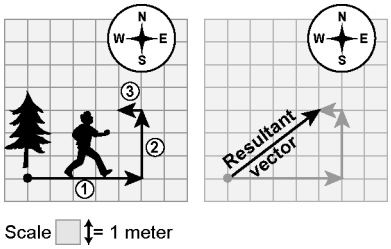
Name: _____

Skill Sheet 7.1A Adding Displacement Vectors

A displacement vector is a quantity that contains two separate pieces of information: (1) magnitude or size, and (2) direction. When you add displacement vectors, you end up at a certain position. This new position is the total displacement from the original position. A vector that connects the starting position with the final position is called the resultant vector ($\vec{x}$).

1. Example vector problem

Andreas walked 5 meters east away from a tree. Then, he walked 3 meters north. Finally, he walked 1 meter west. Each of these three pathways is a displacement vector. Use these displacement vectors to find Andreas's total displacement from the tree.

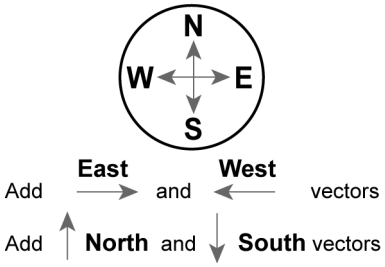


Displacement vector	Direction	Magnitude (meters)	Total magnitude (total meters walked)
1	east	5	5
2	north	3	5 + 3 = 8
3	west	1	8 + 1 = 9

Andreas's motion can be represented on a graph. To determine his total displacement from the tree, do the following:

1. Add the east and west displacement vectors. These are in the *x*-axis direction on a graph.
   Andreas's walk = 5 m east + (– 1)m west = 4 m east
2. Add the north and south displacement vectors. These are in the *y*-axis direction on a graph.
   Andreas's walk = 3 m north

How to add displacement vectors:



Solution: Andreas walked a total of 9 meters. The total displacement is 4 meters east and 3 meters north. The resultant vector ($\vec{x}$) goes from the starting position to the final position of total displacement.

2. Adding displacement vectors

1. What is the total displacement of a bee that flies 2 meters east, 5 meters north, and 3 meters east?

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2. What is the total displacement of an ant that walks 2 meters west, 3 meters south, 4 meters east, and 1 meter north?

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3. A ball is kicked 10 meters north, 5 meters west, 15 meters south, 5 meters east, and 5 meters north. Find the total displacement and the total distance it traveled.

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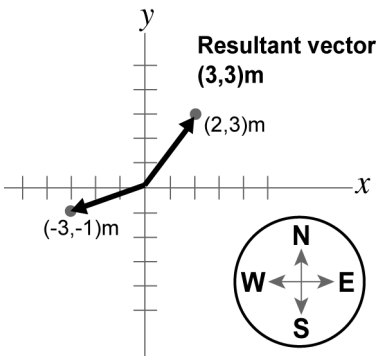
3. Adding displacement vectors using *x-y* coordinates

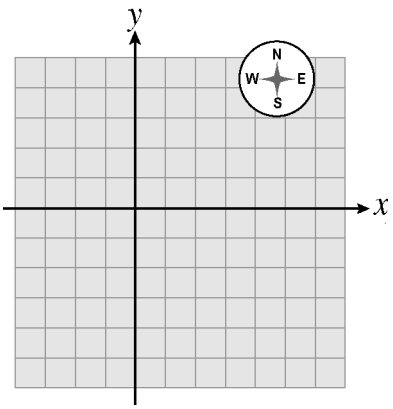
A resultant vector can be written using *x-y* coordinates on a graph. The original position is the origin of a graph where the axes represent east-west and north-south positions. For example, (2,3)m is a resultant vector with the following components: 2 meters east and 3 meters north. A resultant vector, (-3,-1)m, has components 3 meters west and 1 meter south. Use this information to solve the following problems. Write your answers using *x-y* coordinates. The first one is done for you.



1. Add the following four vectors to find the resultant vector, $\vec{x}_R$:
   $x_1 = (5,0)$m, $x_2 = (0,–5)$m, $x_3 = (3,0)$m, $x_4 = (–7,0)$ m
   Add the east-west components: 5 m east + 0 m + 3 m east + (– 7) m west = 1 m east
   Add the north-south components: 0 m + (–5) m south + 0 m + 0 m = (–5) m south $\vec{x}_R = (1,–5)$m.

2. Add the following three vectors to find the resultant vector, $\vec{x}_R$:
   $\vec{x}_1 = (–2,0)$m, $\vec{x}_2 = (0,–5,)$m, $\vec{x}_3 = (3,0)$m

3. Add the following vectors to find the resultant vector. Plot the resultant vector ($\vec{x}_R$) on the grid to the left:
   $\vec{x}_1 = (4,0)$m, $\vec{x}_2 = (–1,2)$m, $\vec{x}_3 = (0,1)$m



4. Add the following three vectors to find the resultant vector, $\vec{x}_R$.
   $\vec{x}_1 = (5,3)$m, $\vec{x}_2 = (–5,0)$m, $\vec{x}_3 = (5,2)$m