

Name: _____

Skill Sheet 7.1B

Vector Components

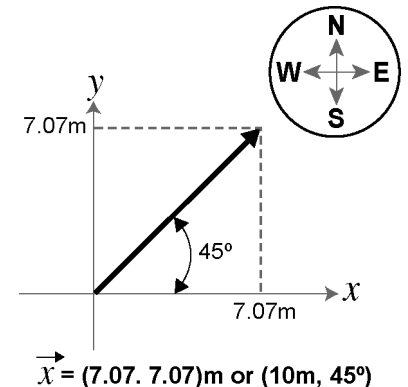
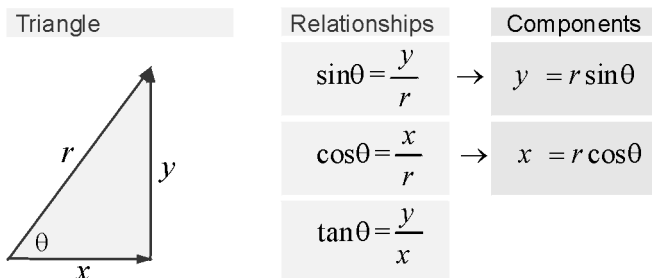
There are two ways to represent displacement vectors. One way uses x - y coordinates. In this skill sheet, you will practice representing vectors that use polar coordinates. Polar coordinates indicate the magnitude of the vector and its angle from the x -axis on a graph. For example, a displacement vector $(2\text{ m}, 10^\circ)$ is 2 meters in magnitude and at a 10° angle from the x -axis on a graph. Using trigonometry, you can convert polar coordinates into x - y coordinates.

1. Two ways to write displacement vectors

A displacement vector, \vec{x} , of magnitude 10 meters that has a component in the x -direction equal to 7.07 meters and a component in the y -direction equal to 7.07 meters can be represented as $\vec{x} = (7.07, 7.07)\text{m}$.

This same vector can be represented in polar coordinates as $\vec{x} = (10.0, 45^\circ)\text{m}$. Why is this way of representing the vector like $\vec{x} = (7.07, 7.07)\text{m}$?

Finding the components of a vector



If the displacement vector is the hypotenuse of a right triangle, then:

x -component: $x = 10\cos(45^\circ)\text{m} = 10(0.707)\text{m} = 7.07\text{ m}$

y -component: $y = 10\sin(45^\circ)\text{m} = 10(0.707)\text{m} = 7.07\text{ m}$

Note that the angle is measured counterclockwise from the x -axis.

2. Problems

Answer the following problems and show your work. The first problem is done for you.

- Find the x - y components of the displacement vector $\vec{x} = (7.0, 30^\circ)\text{m}$.
 x -component = $(7.0\text{ meters})\cos 30^\circ = 6.1\text{ meters}$
 y -component = $(7.0\text{ meters})\sin 30^\circ = 3.5\text{ meters}$
 $\vec{x} = (6.1, 3.5)\text{m}$
- What are the x - y coordinates for the displacement vector $\vec{x} = (10, 60^\circ)\text{m}$? Graph this displacement vector.
- Find the x - y components of the velocity vector $\vec{v} = (17, 90^\circ)\text{m/sec}$.

4. What are the x - y components of the displacement vector $\vec{x} = (100, 360^\circ)\text{cm}$.

5. Graph the vector $\vec{v} = (-7.07, 7.07)\text{m}$.

6. Graph the vector $\vec{x} = (-2, -4)\text{cm}$.

7. Find the components of the velocity vector $\vec{v} = (80, 180^\circ)\text{km/h}$.

8. Find the x - y components of the acceleration vector $\vec{x} = (5, 225^\circ)\text{m/sec}^2$.

9. Find the x - y components of the velocity vector $\vec{v} = (80, 300^\circ)\text{km/h}$.

10. Find the x - y components of the force vector $\vec{F} = (80, 135^\circ)\text{N}$.

11. Challenge problem: A robot starts from a certain point and moves west for a distance of 5 meters; it then goes north for 5 meters, and then east for 10 meters. Assume that the positive x direction is east and the positive y direction is north. The negative x direction is west and the negative y direction is south.

a. Find the x - y components of the final displacement vector for the robot.

b. Express the final displacement vector in polar coordinates. Use the formula below to find the angle of the resultant vector. Use the Pythagorean theorem to find r , the length of the resultant vector.

$$\frac{y}{r} = \sin \theta$$
