Vector Components

Vector addition is the process of combining two vectors into one. **Resolving vectors** is the process of taking one vector and "separating it" into two. These two vectors are called the **components** of the original vector.

The main use of vector components is to take vectors that do not point in convenient directions (north, south, east, west), and replace them with a pair of vectors (the components) that do.

Properties of Vector Components

1. Each vector has two components: one component along the x-axis, the other along the y-axis. Therefore, the components of a vector are always perpendicular to each other.

2. If we add the two components of a given vector, the sum will be the given vector.

3. The two components of a vector are independent of each other. In other words, what happens to one component of a vector has no effect on what happens to the other component of the vector.

Resolving a Vector

To resolve a vector, simply consider the vector to be the hypotenuse of a right triangle, which has one leg that is horizontal (the x-component) and one leg that is vertical (the y-component). By knowing the magnitude and direction of the original vector, the magnitudes of the components can be found using trigonometry.

Example 1
Resolve the vector $A = 10\ m\ [30°\ W\ of\ N]$.

Vectors with Zero Components

It is possible for one or both components of a vector to be zero. In the case of a vector that is vertical, the *x*-component is zero.

Example 2
Resolve the vector $A = 1.0\ N\ [North]$.

For a vector that is horizontal, the *y*-component is zero.

Example 3
Resolve the vector $A = 1.0\ N\ [West]$.

If the magnitude of a vector is zero, then both of its components are also zero.

Example 4
Resolve the vector $A = 0$.

Vectors that are Equal

Two vectors are equal if they have the same magnitude and direction. Two vectors are equal only if the components of the vectors are also equal.

Homework
Vector Components Worksheet

Vector Components Worksheet

1. What are the components of a vector of magnitude $1.5\ m$ at an angle of $35°$ from the positive x-axis? ($1.2\ m$; $0.86\ m$)

2. A hiker walks $14.7\ km$ at an angle $35°$ south of east. Find the east and north components of this walk. ($12\ km$; $-8.4\ km$)

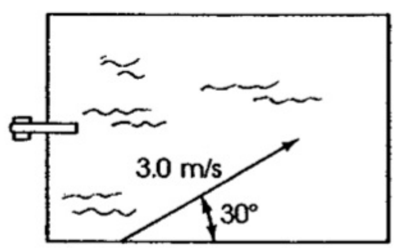
3. An airplane flies at $65\ m/s$ in the direction $149°$ counterclockwise from east. What are the east and north components of the plane's velocity? ($-56\ m/s$; $33\ m/s$)

4. A golf ball, hit from the tee, travels $325\ m$ in a direction $25°$ south of the east axis. What are the east and north components of its displacement? ($295\ m$; $-137\ m$)

5. A boat sails in a straight line $20\ km\left[30°\ E\ of\ N\right]$. What are the components of its displacement to the north and east? ($17\ km$; $10\ km$)

6. A cannon fires a cannonball with a speed of $100\ m/s$ at an angle of $20°$ above the horizontal. What are the horizontal and vertical components of the initial velocity of the cannonball? ($94\ m/s$; $34\ m/s$)

7. A girl swims at $3.0\ m/s$ across a swimming pool, as shown. What are the components of her swimming velocity in each of the following directions?
   a. across the pool ($1.5\ m/s$)
   b. along the pool's edge ($2.6\ m/s$)



8. An airplane is climbing at an angle of $15°$ to the horizon, with the sun directly overhead. Its shadow is observed to be moving across the ground at $200\ km/h$.
   a. What is the actual airspeed of the plane? ($207\ km/h$)
   b. How long does it take to increase the airplane's altitude by $1000\ m$? ($0.019\ h$)

9. A football player is running at a constant speed in a straight line up the field at an angle of $15°$ to the sidelines. The coach notices that it takes the player $4.0\ s$ to get from the $25\ m$ line to the goal line. How fast is the player running? ($6.5\ m/s$)