

Vector Operations

3.2

Objectives

- **Identify** appropriate coordinate systems for solving problems with vectors.
- **Apply** the Pythagorean theorem and tangent function to calculate the magnitude and direction of a resultant vector.
- **Resolve** vectors into components using the sine and cosine functions.
- **Add** vectors that are not perpendicular.

Coordinate System in 2 Dim.

- Sometimes you will need to use trigonometry to determine the length or direction of resultant vectors.
- If you are adding together two vectors at right angles, vector **A** pointing north and vector **B** pointing east, you could use the Pythagorean theorem to find the magnitude of the resultant, **C**.
- If vector **A** is at a right angle to vector **B**, then the sum of the squares of the magnitudes is equal to the square of the magnitude of the resultant vector.

$$C^2 = A^2 + B^2$$

Example

- You walk 40 meters East and then 56 meters North. What is the resultant vector?

Coordinate System in 2 Dim.

- If two vectors to be added are at an angle other than 90° , then you can use the law of cosines or the law of sines.
- The square of the magnitude of the resultant vector is equal to the sum of the magnitude of the squares of the two vectors, minus two times the product of the magnitudes of the vectors, multiplied by the cosine of the angle between them.

$$C^2 = A^2 + B^2 - 2AB\cos(\theta)$$

Coordinate System in 2 Dim.

- The magnitude of the resultant, divided by the sine of the angle between two vectors, is equal to the magnitude of one of the vectors divided by the angle between that component vector and the resultant vector.

$$C / \sin(\theta) = A / \sin(a)$$

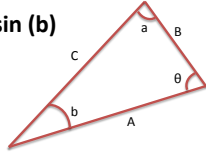
$$A / \sin(a) = B / \sin(b)$$

$$C / \sin(\theta) = B / \sin(b)$$

Coordinate System in 2 Dim.

- Explanation

$A / \sin(a) = B / \sin(b)$



Practice

A car travels 8 km E, then goes 3 km W and finally 12 km E.

Practice

A car travels 8 km E, then goes 3 km N and finally 3 km W.

Resolving Vectors

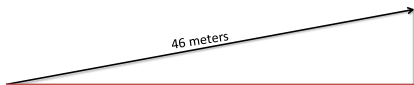
- You can often describe an object's motion more conveniently by breaking a single vector into two **components**, or **resolving the vector**.
- The **components of a vector** are the projections (X and Y) of the vector along the axes of a coordinate system.
- To do this, you use sine, cosine, and tangent

Adding Vectors that are not Perpendicular

- Take each vector and resolve it into its "X" and "Y" components
- Add the "X" together
- Add the "Y" together
- Create a new 90° triangle
- Find resultant

Resolving a vector

- Resolve 46 meters at 26° North of East



Additional Videos

- Make sure to watch the math videos
