A **vector** has both magnitude and direction. (we will use a directed line segment to represent a vector)

***u*** or

*Q* terminal point

Ways of naming a vector

*P* initial point

* + - Use bold face variable: ***u***
    - Use a lower case variable with an arrow over the top of it:
    - Name the vector using the initial and terminal points:

Magnitude of a Vector – The length of a vector is represented by

We can find it using the distance formula.

Ex: Drawing Vectors

Equivalent Vectors

1. Same Magnitude
2. Same Direction

Ex: Let be represented by the directed line segment from to . Let be represented by the directed line segment from to . Show that and are equivalent.

= Slope of =

= Slope of =

**Component Form of a Vector**

The component form of a vector with initial point and terminal point is given by:

or

The magnitude (length) of vector is:

If , then is called a unit vector.

If , then is called a zero vector.

Ex: Find the component form and magnitude of vector that has the initial point and terminal point .

**Vector Operations**

Vector Addition

Vector Subtraction

Scalar Multiplication

Ex: Let and

Find

Find

**Graphical Solutions**

or

3

**Properties of Vector Addition and Scalar Multiplication**

**Unit Vectors**

Let be a unit vector in the same direction as .

Ex: Find a unit vector in the direction of

**Special Unit Vectors**

one unit horizontal one unit vertical

Ex: Write the vector in terms of and

Ex: Find in terms of and

Ex: Let be the vector with initial point and terminal point . Write as a linear combination of the standard unit vectors and .

**Direction Angles**

or or

Ex: Find the direction angle of each vector:

Ex: Find the component form of when and

**Applications:**

Find the component form of the vector that represents the velocity of an airplane descending at a speed of 100 miles per hour at an angle of below the horizontal.

Forces with magnitudes of 2000 newtons and 900 newtons act on a machine part at angles of and , respectively, with the positive x-axis. Find the direction and magnitude of the resultant of these forces.

2000

900

A force of 500 pounds is required to pull a boat and trailer up a ramp inclined at from the horizontal. Find the combined weight of the boat and trailer.

An airplane is traveling at a speed of 724 kilometers per hour at a bearing of northeast. If a wind has a velocity of 32 kilometers per hour from the west, find the resulting speed and direction of the plane.