

# Math 1060 ~ Trigonometry

## 22 The Unit Vector and Vector Applications

### The Unit Vector

It is often useful in solving problems to find a vector in the same direction as the given vector, but of magnitude 1. This is called a unit vector. If  $\|\mathbf{v}\| = 1$ , then  $\hat{\mathbf{v}}$  is a unit vector.

If  $\mathbf{v}$  is a nonzero vector, then  $\frac{\mathbf{v}}{\|\mathbf{v}\|}$  is a unit vector in the direction of  $\mathbf{v}$ .

#### EX 1

Find a unit vector in the direction of  $\mathbf{v} = \langle 3, -4 \rangle$ .

### The Principal Unit Vectors

It is also useful to have names for the principal unit vectors.

- The vector  $\hat{\mathbf{i}}$  is defined by  $\hat{\mathbf{i}} = \langle 1, 0 \rangle$ .
- The vector  $\hat{\mathbf{j}}$  is defined by  $\hat{\mathbf{j}} = \langle 0, 1 \rangle$

This gives us another way to describe vectors. Thus  $\langle a, b \rangle$  may also be  $a\hat{\mathbf{i}} + b\hat{\mathbf{j}}$ .

#### EX 2

Describe the vector from example 1 in terms of unit vectors.

# Applications of Vectors

Vectors are useful in airplane navigation.

## EX 3

A plane is flying N  $30^\circ$  E at 400 mph and the wind is blowing west at 40 mph. What is the effective direction and speed of the plane?

### 3a)

Draw a picture.

### 3b)

Place the vectors for proper addition.

### 3c)

Remember: the resultant is from the tail of the first to the tip of the last.

### 3d)

Now do the math.

Vectors may be used to analyze forces acting on an object.

## EX 4

Two forces are pushing on an object, one exerts 30 lbs of pressure and a second exerts 20 lbs of pressure. The angle between the two forces is  $70^\circ$ . What is the resultant force on the object?

**EX 5**

A 500-lb rock is being wheeled up a 30 degree ramp. What force is necessary to keep it from rolling back down the ramp? What is the weight the ramp is actually supporting?