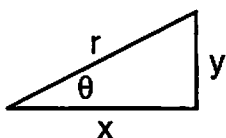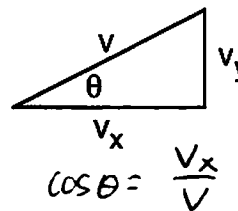# Vector Concepts (Trig)

The diagrams below shows right triangles, one representing position and the other representing velocity.

For each picture, what is the Pythagorean Theorem?

What is the sine of θ?   **What is the cosine of θ?**

$$\sin\theta = \frac{y}{r} \quad \cos\theta = \frac{x}{r}$$

$$\sin\theta = \frac{v_y}{v} \quad \cos\theta = \frac{v_x}{v}$$

In terms of the hypoteneuse and the angles shown above, what are x & y and v_x & v_y?

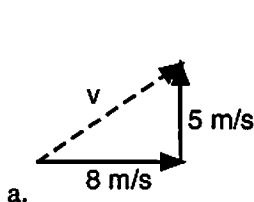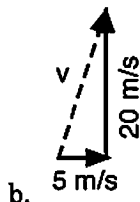|			
$x = r\cos\theta$	$y = r\sin\theta$	$v_x = v\cos\theta$	$v_y = v\sin\theta$

Questions

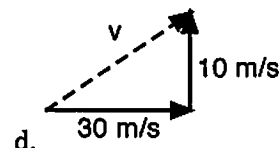1. Use the Pythagorean Theorem to find the speeds of the following velocity vectors:

a. 5 m/s, 8 m/s → 4.43

b. 20 m/s, 5 m/s → 20.6

c. 9 m/s, 4 m/s → 9.85
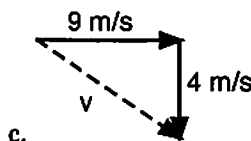
d. 10 m/s, 30 m/s → 31.6

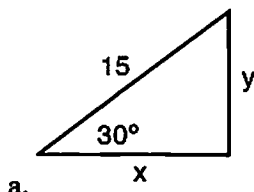2. You are given the horizontal and vertical components of different velocity vectors. Find the resultant speed:

a. $v_x = 7$ m/s $v_y = 5$ m/s   v = 8.6

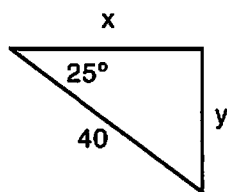b. $v_x = 15$ m/s $v_y = 8$ m/s   v = 17

c. $v_x = 20$ m/s $v_y = 25$ m/s   v = 32

d. $v_x = 10$ m/s $v_y = -15$ m/s   v = 18

3. For each of the triangles shown, calculate the sides of the right triangles, given the hypoteneuse and angle:

a. 15, 30°

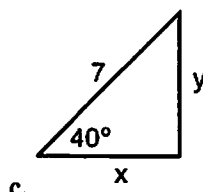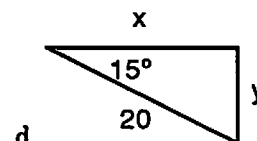$X = 15\cos 30$
$= 13$

$y = 15\sin 30$
$= 7.5$

b. 25°, 40

$x = 40\cos 25$
$= 36.3$

$y = 40\sin 25$
$= -16.9$

c. 7, 40°

$X = 5.36$

$y = 4.50$

d. 15°, 20

$X = 19.3$

$y = -5.18$

Side 1

Vector Concepts (Trig)

4. Calculate the components of each of the velocities shown:

a. 25 m/s, 20° b. 15°, 10 m/s c. 8 m/s, 70° d. 40 m/s, 90°

$V_x = 23.5$ $V_x = 9.66$ $V_x = 2.74$ $V_x = 0$

$V_y = 8.55$ $V_y = -2.59$ $V_y = 7.52$ $V_y = 40$
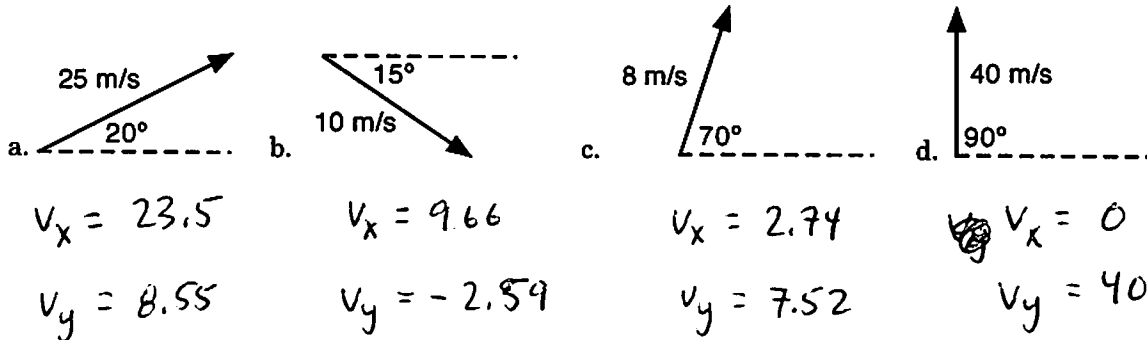
5. Calculate the components of the given velocities:
   a. A ball is kicked with a velocity of 30 m/s at an angle of 35° above the horizontal.

   $v_x = $ 24.6 m/s $v_y = $ 17.2 m/s

   b. A pen is tossed with an initial velocity of 5 m/s at an angle of 65° above the horizontal.

   $v_x = $ 2.11 m/s $v_y = $ 4.53 m/s

   c. A projectile hits the ground with a velocity of 25 m/s at an angle of 40° below the horizontal.

   $v_x = $ 19.2 m/s $v_y = $ -16.1 m/s

   d. A block of ice slides off a roof with an initial velocity of 9 m/s at an angle of 30° below the horizontal.

   $v_x = $ 7.79 m/s $v_y = $ -4.5 m/s

   e. A ball rolls horizontally off a table with a speed of 8 m/s.

   $v_x = $ 8 m/s $v_y = $ 0 m/s

   f. A soccer ball in the air has a velocity of 32 m/s at an angle of 25° above the horizontal.

   $v_x = $ 29.0 m/s $v_y = $ 13.5 m/s

   g. A pen is thrown straight up in the air with an initial velocity of 18 m/s.

   $v_x = $ 0 m/s $v_y = $ 18 m/s

   h. A bullet is fired with an initial velocity of 400 m/s at an angle of 15° above the horizontal.

   $v_x = $ 386 m/s $v_y = $ 104 m/s

→ answers