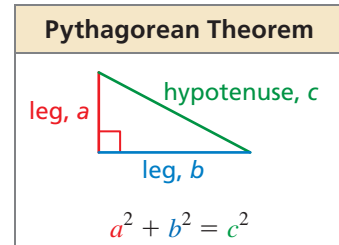Name _____ Date _____

The Pythagorean Theorem

In a right triangle, the **hypotenuse** is the side opposite the right angle. The **legs** are
the two sides that form the right angle.

The **Pythagorean Theorem** states that in any right triangle, the sum of the squares
of the lengths of the legs is equal to the square of the length of the hypotenuse.

Pythagorean Theorem

leg, a hypotenuse, c

leg, b

$a^2 + b^2 = c^2$

Example 1 **Find the missing length of the triangle.**

17 yd a

15 yd
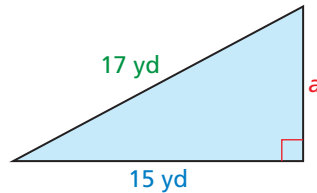
|	
$a^2 + b^2 = c^2$	Write the Pythagorean Theorem.
$a^2 + 15^2 = 17^2$	Substitute 15 for b and 17 for c.
$a^2 + 225 = 289$	Evaluate powers.
$a^2 = 64$	Subtract 225 from each side.
$a = 8$	Take positive square root of each side.

▶   The missing length is 8 yards.

You can use the Pythagorean Theorem to develop the *Distance Formula*.
You can use the **Distance Formula** to find the distance d between any
two points (x_1, y_1) and (x_2, y_2) in a coordinate plane.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

(x_2, y_2)

d $y_2 - y_1$

(x_1, y_1)

$x_2 - x_1$ (x_2, y_1)
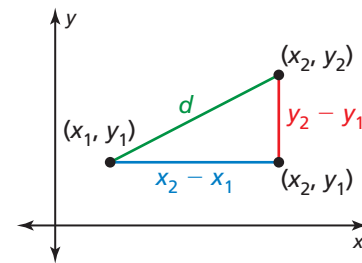
Example 2 **Find the distance between the two points.**

a. $(3, 6), (-2, 4)$

Let $(x_1, y_1) = (3, 6)$ and $(x_2, y_2) = (-2, 4)$.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(-2 - 3)^2 + (4 - 6)^2}$$
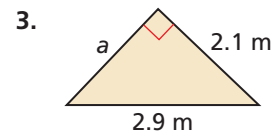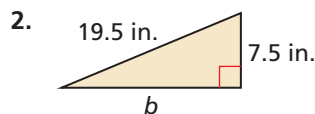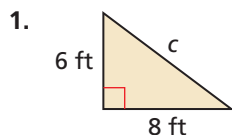$$= \sqrt{25 + 4}$$
$$= \sqrt{29}$$

b. $(0, 5), (4, -1)$

Let $(x_1, y_1) = (0, 5)$ and $(x_2, y_2) = (4, -1)$.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(4 - 0)^2 + (-1 - 5)^2}$$
$$= \sqrt{16 + 36}$$
$$= 2\sqrt{13}$$

Practice

Check your answers at BigIdeasMath.com.

Find the missing length of the triangle.

1.

6 ft c

8 ft

2.

19.5 in.   7.5 in.

b

3.

a 2.1 m

2.9 m

Find the distance between the two points.

4. $(0, 0), (4, 3)$

5. $(0, -7), (5, 5)$

6. $(4, 2), (-1, 5)$

7. $(-5, 6), (-7, -2)$

8. $(-1, -3), (9, 0)$

9. $(-4, -4), (-1, -1)$