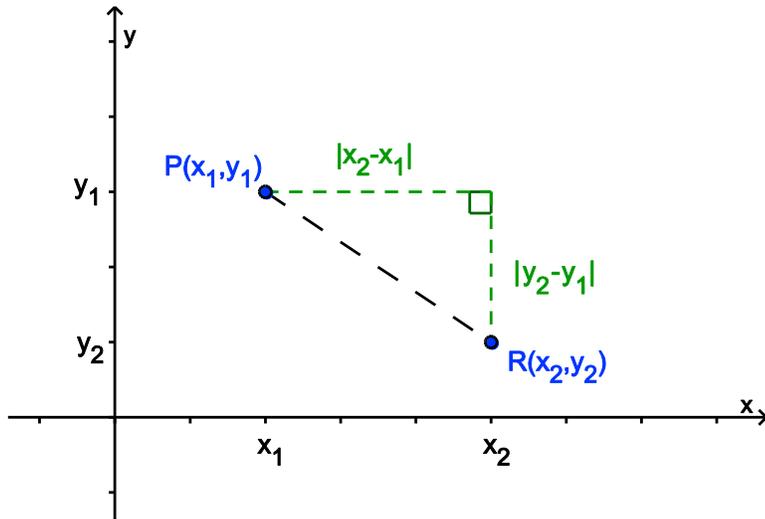# Distance and Midpoint Formulas; Circles

The Distance Formula

Suppose you're looking for the distance from point P at (x_1, y_1) to point R at (x_2, y_2).

Can use Pythagorean Theorem to get the **distance formula**:
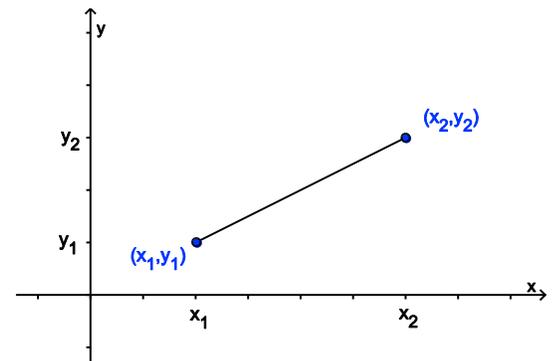$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Ex 1.

Find the distance between $P(3, -5)$ and $Q(-2, 8)$.

The Midpoint Formula

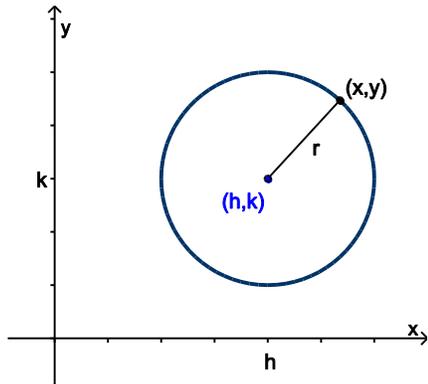**Midpoint formula**: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

Ex 2.

Find the midpoint of the segment with endpoints $(-7, -5)$ and $(-2, 13)$.

Circles

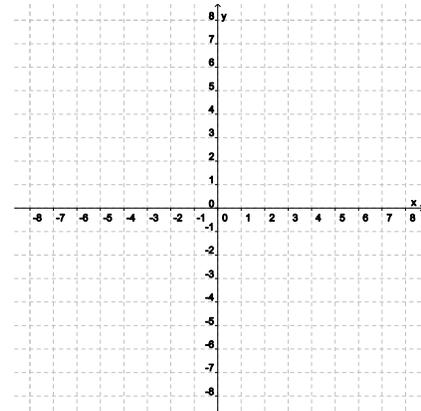A **circle** is the set of all points a given distance (_____) from a given point (_____).

What's the distance from the center (h, k) to any point on the circle (x, y)?

Squaring both sides, we get the **standard form** of the equation of a circle with center (h, k) and radius r: $(x - h)^2 + (y - k)^2 = r^2$
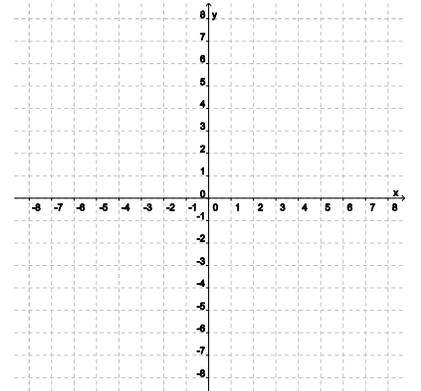
Ex 3.

Find the standard form of the equation for a circle with center $(1, -2)$ and radius 3, and graph it.

Ex 4.

Find the center and radius of the circle whose equation is $(x + 3)^2 + (y - 1)^2 = 4$, and graph it.

The **general form** of the equation of a circle is $x^2 + y^2 + Dx + Ey + F = 0$

We can convert from general form to standard form by _____.

Ex 5.

Write in standard form: $x^2 + y^2 + 4x - 6y - 23 = 0$

Practice

1. Find the distance between the following pair of points. Simplify any radicals.
    $(-4, -1)$ and $(2, -3)$

2. Find the midpoint of the line segment with the given endpoints.
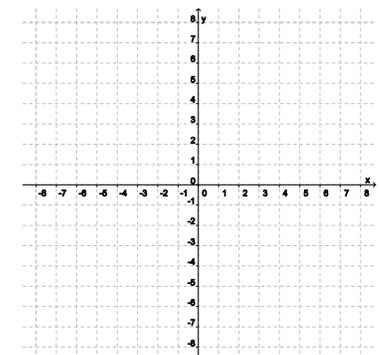 $(-4, -1)$ and $(2, -3)$

3. Write the standard form of the equation of the circle with center $(-3,5)$ and radius 3.

4. Give the center and radius of the circle described by the equation.
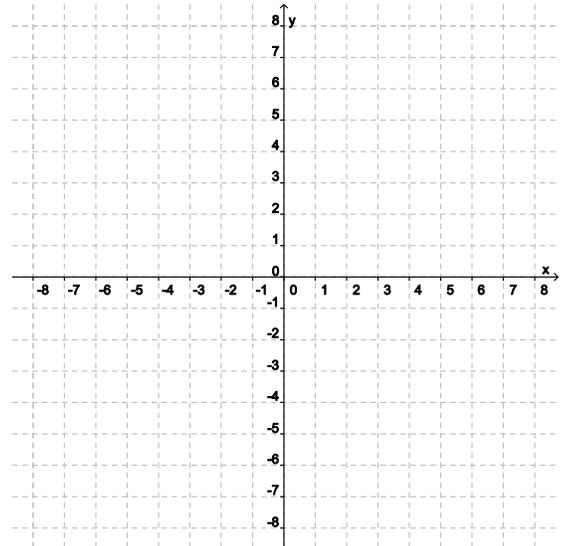   Then graph the equation.
a) $x^2 + y^2 = 16$
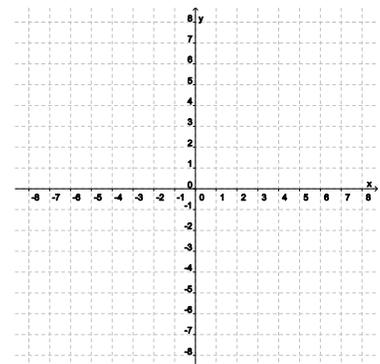
b) $(x + 1)^2 + (y - 2)^2 = 25$

5. Complete the square and write the equation in standard form. Then give the center and radius of the circle and graph the equation.

$x^2 + y^2 + 8x + 4y + 16 = 0$

Q: There was a green house. Inside the green house there was a white house. Inside the white house there was a red house. Inside the red house there were lots of babies. What is it?