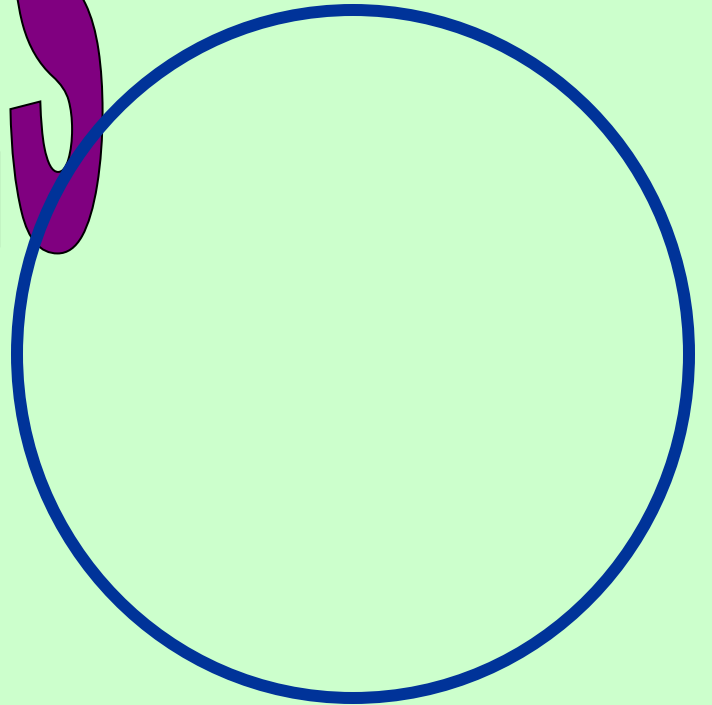
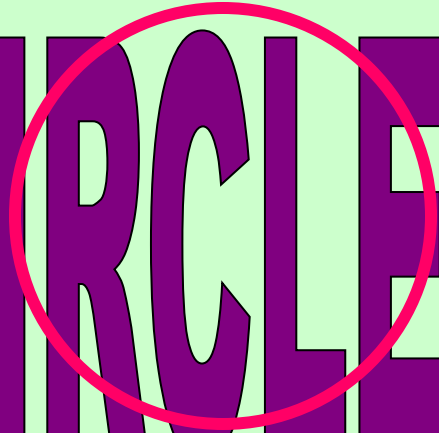
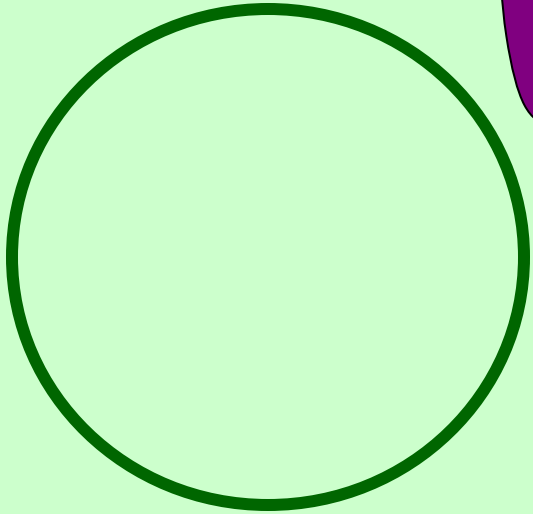



**CIRCLES**



The standard form of the equation of a circle with its center at the origin is

$$x^2 + y^2 = r^2$$


$r$  is the radius of the circle so if we take the square root of the right hand side, we'll know how big the radius is.

Notice that **both the  $x$  and  $y$  terms** are squared. Linear equations don't have either the  $x$  or  $y$  terms squared. Parabolas have only the  $x$  term was squared (or only the  $y$  term, but NOT both).

Let's look at the equation  $x^2 + y^2 = 9$

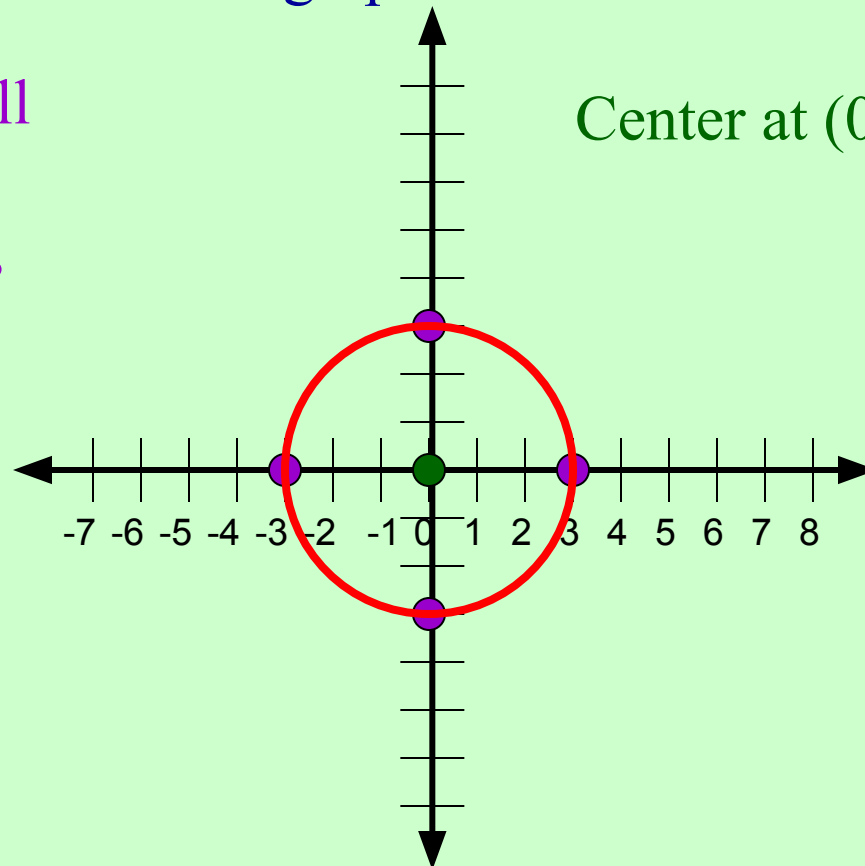
This is  $r^2$  so  $r = 3$

The center of the circle is at the origin and the radius is 3.

Let's graph this circle.

Count out 3 in all directions since that is the radius

Center at  $(0, 0)$



If the center of the circle is NOT at the origin then the equation for the standard form of a circle looks like this:

$$(x - h)^2 + (y - k)^2 = r^2$$

The center of the circle is at  $(h, k)$ .

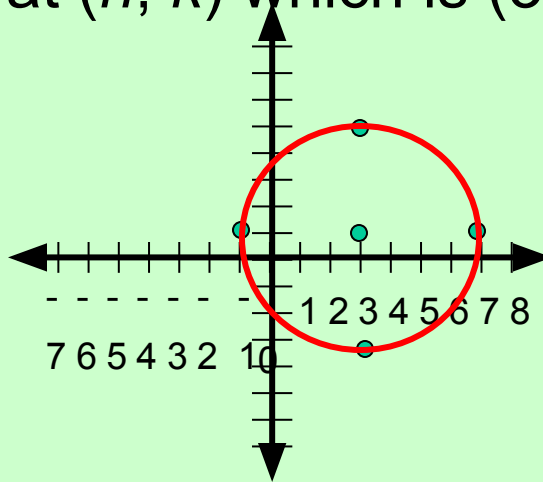
This is  $r^2$  so  $r = 4$

$$(x - 3)^2 + (y - 1)^2 = 16$$

Find the center and radius and graph this circle.

The center of the circle is at  $(h, k)$  which is  $(3, 1)$ .

The radius is 4



If you take the equation of a circle in standard form for example:

$$(x + 2)^2 + (y - 4)^2 = 4$$

← This is  $r^2$  so  $r = 2$

$$(x - (-2))$$

Remember center is at  $(h, k)$  with  $(x - h)$  and  $(y - k)$  since the  $x$  is plus something and not minus,  $(x + 2)$  can be written as  $(x - (-2))$

You can find the center and radius easily.

The center is at  $(-2, 4)$  and the radius is 2.

But what if it was not in standard form but multiplied out (FOILED)

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

Moving everything to one side in descending order and combining like terms we'd have:

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

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

If we'd have started with it like this, we'd have to complete the square on both the  $x$ 's and  $y$ 's to get in standard form.

Group  $x$  terms and a place to complete the square

Group  $y$  terms and a place to complete the square

Move constant to the other side

$$\boxed{x^2 + 4x + \underline{4}} + \boxed{y^2 - 8y + \underline{16}} = -16 + \underline{4} + \underline{16}$$

Complete the square

Write factored and wahlah! back in standard form.

$$(x + 2)^2 + (y - 4)^2 = 4$$

Now let's work some examples:

Find an equation of the circle with center at (0, 0) and radius 7.

Let's sub in center and radius values in the standard form

$$(x - 0)^2 + (y - 0)^2 = 7^2$$

$$x^2 + y^2 = 49$$

Find an equation of the circle with center at  $(0, 0)$  that passes through the point  $(-1, -4)$ .

Since the center is at  $(0, 0)$  we'll have

$$x^2 + y^2 = r^2$$

The point  $(-1, -4)$  is on the circle so should work when we plug it in the equation:

$$(-1)^2 + (-4)^2 = r^2 = 1 + 16 = 17$$

Subbing this in for  $r^2$  we have:

$$x^2 + y^2 = 17$$



Find an equation of the circle with center at  $(-2, 5)$  and radius 6

Subbing in the values in standard form we have:

$$(x - -2)^2 + (y - 5)^2 = 6^2$$

$$(x + 2)^2 + (y - 5)^2 = 36$$


Find an equation of the circle with center at  $(8, 2)$  and passes through the point  $(8, 0)$ .

Subbing in the center values in standard form we have:

$$(x - 8)^2 + (y - 2)^2 = r^2$$

Since it passes through the point  $(8, 0)$  we can plug this point in for  $x$  and  $y$  to find  $r^2$ .

$$(8 - 8)^2 + (0 - 2)^2 = r^2 = 4$$

$$(x - 8)^2 + (y - 2)^2 = 4$$


Identify the center and radius and sketch the graph:

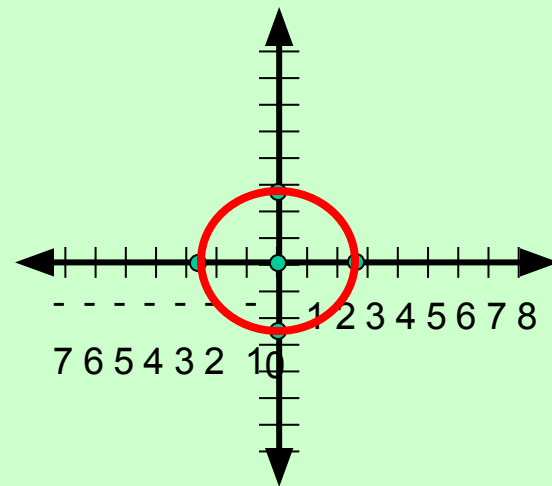
$$\frac{9x^2}{9} + \frac{9y^2}{9} = \frac{64}{9}$$

To get in standard form we don't want coefficients on the squared terms so let's divide everything by 9.

$$x^2 + y^2 = \frac{64}{9}$$

Remember to square root this to get the radius.

So the center is at (0, 0) and the radius is 8/3.

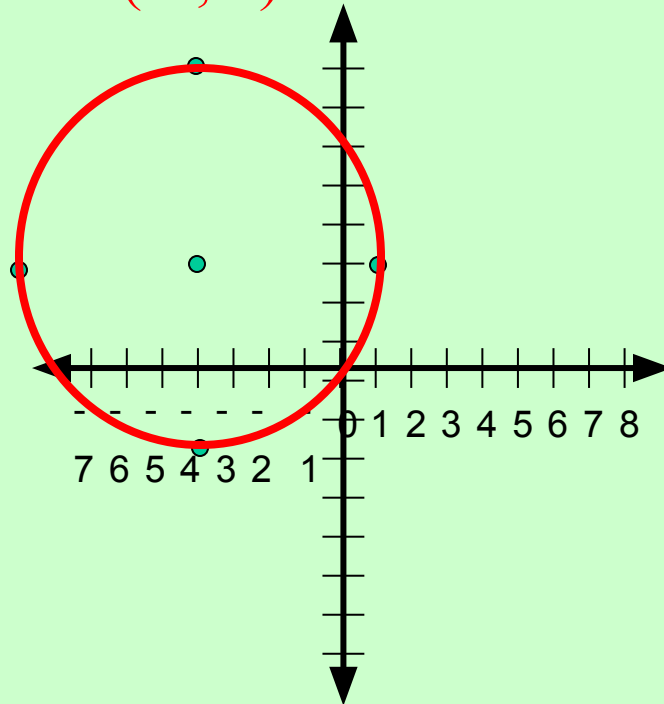


Identify the center and radius and sketch the graph:

$$(x + 4)^2 + (y - 3)^2 = 25$$

Remember the center values end up being the opposite sign of what is with the  $x$  and  $y$  and the right hand side is the radius squared.

So the center is at  $(-4, 3)$  and the radius is 5.



Find the center and radius of the circle:

$$x^2 + y^2 + 6x - 4y - 3 = 0$$

We have to complete the square on both the x's and y's to get in standard form.

Group x terms and a place to complete the square      Group y terms and a place to complete the square      Move constant to the other side

$$x^2 + 6x + \underline{9} + y^2 - 4y + \underline{4} = +3 + \underline{9} + \underline{4}$$

Write factored for standard form.

$$(x + 3)^2 + (y - 2)^2 = 16$$

So the center is at (-3, 2) and the radius is 4.

**Thank you for your  
attention!!!**