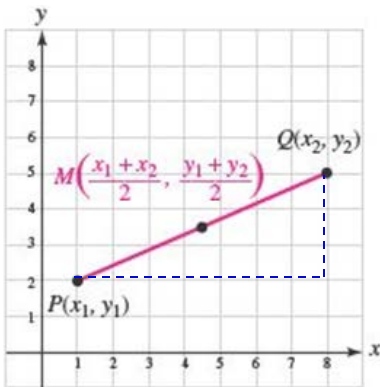


## 2.1 Midpoint and Distance Formula; Equation of a Circle and Graphs



*Recall:* The **midpoint** of a line segment connecting points  $P(x_1, y_1)$  and  $Q(x_2, y_2)$  is the point  $M$  with coordinates

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

The formula for the **distance** between points  $P(x_1, y_1)$  and  $Q(x_2, y_2)$  comes from the Pythagorean Theorem:

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

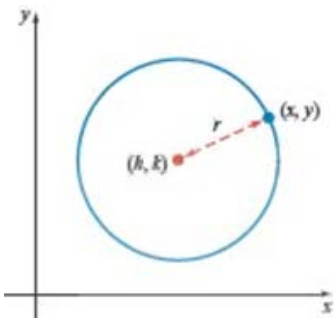
so

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

*Example 1:* Find the midpoint and the length of the line segment connecting points  $A(4, -3)$  and  $B(-2, 7)$ .

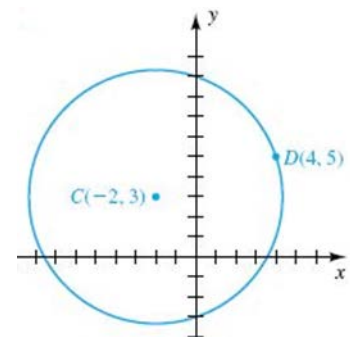
*Definition:* A set of points in a plane that are at the distance  $r$  from a fixed point  $O$  is called a **circle** with the center at  $O$  and the radius  $r$ .

What is the equation of a circle with the centre at  $(h, k)$  and radius  $r$ ?



This is the **standard form** of a circle.

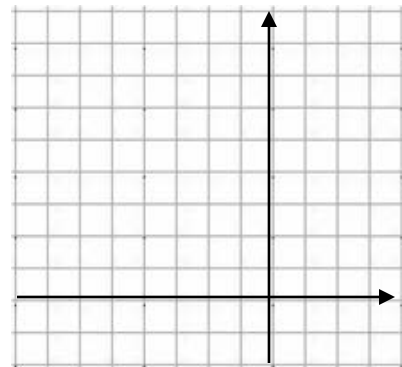
*Example 2:* Find an equation of the circle given on the graph.



*Example 3:* Equation  $x^2 + y^2 + 8x - 10y + 37 = 0$  represents a circle in **general form**.

a) Convert the above equation to the **standard form** of a circle.

b) Find the centre and radius of the circle and then graph it.

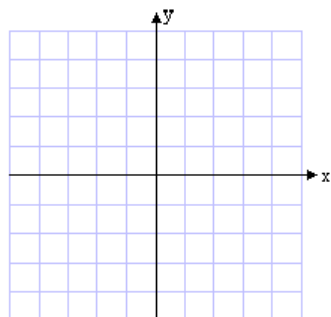


When **graphing** solutions of various equations, it is useful to

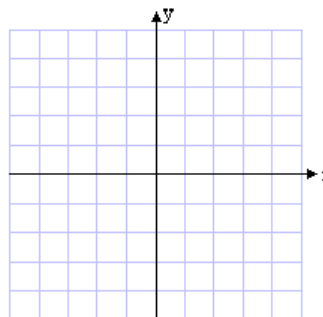
- keep in mind the basic **shape** of the curve,
- find the **x-** and **y-intercepts**
  - to find **x**-intercept, set **y = 0**;
  - to find **y**-intercept, set **x = 0**,
- check additional **points**, if needed

*Example 4:* Graph solutions of the following equations:

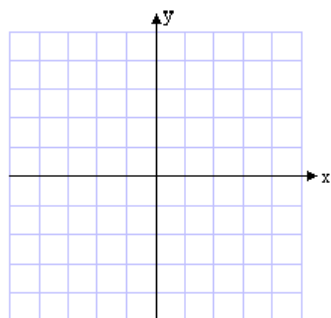
a)  $2x - 3y = 6$



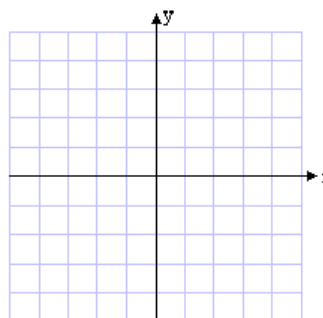
b)  $y = |x + 1| - 2$



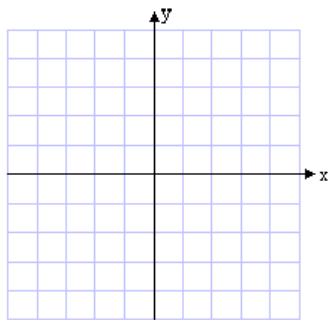
c)  $y = (x - 1)^2 - 3$



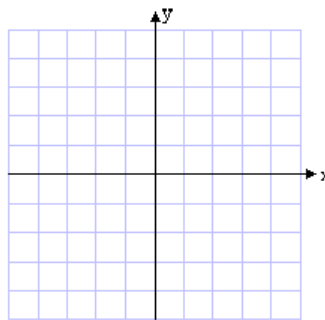
d)  $(x + 1)^2 + (y - 2)^2 = 9$



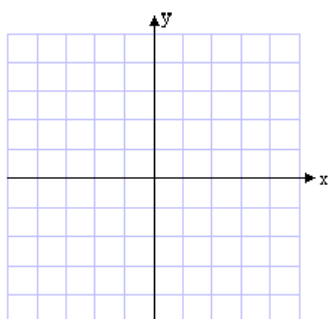
e)  $x = |y| - 2$



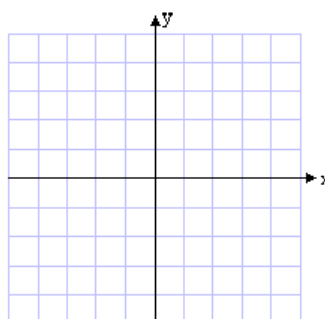
f)  $|x| + |y| = 5$



g)  $x = y^2 + 1$



h)  $x = y^3$



*Example 5:* With the aid of a graphing calculator, graph the equation  $y = \frac{a^3}{x^2 + a^2}$  for various values of  $a$ .

