Secondary Math 2 **9.1 Notes** **Solving Systems of Non-Linear Equations**

Note that you will need a graphing calculator (TI-83 or TI-84) for this lesson

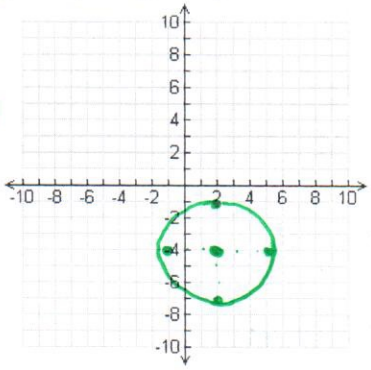
Objectives:

- I can solve a system of linear equations by hand and graphically.
- I can solve a system of equations that involves lines and circles or lines and parabolas graphically.

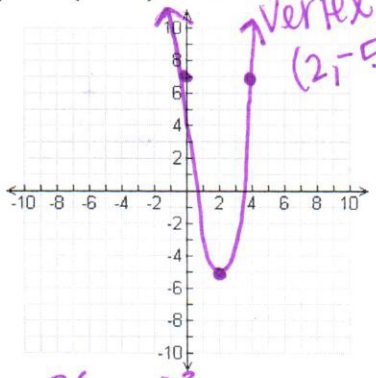
Warm-Up: Do you remember how to graph the following?

1. $(x-2)^2+(y+4)^2=9$ 2. $y=3(x-2)^2-5$ 3. $y=x^2+4x+3$

circle
center
$(2,-4)$
$r^2=9$
$r=3$

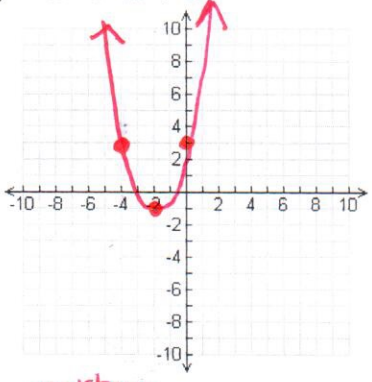


parabola
Vertex
$(2,-5)$



$3(0-2)^2-5=7$

parabola



vertex
$h=\frac{-b}{2a}=\frac{-4}{2(1)}=-2$
$(-2)^2+4(-2)+3=-1$

Example 1: Solve the Linear System of Equations:

$\begin{cases} 2x-3y=-2 \\ 4x+y=24 \end{cases}$

Solve the system algebraically: use substitution

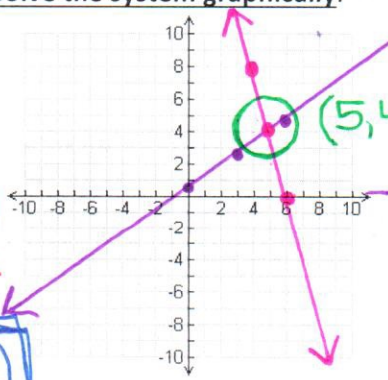
$4x+y=24$
$-4x \quad -4x$
$y=-4x+24$

$2x-3(-4x+24)=-2$
$2x+12x-72=-2$
$+72 \quad +72$
$\frac{14x}{14}=\frac{70}{14}$ $x=5$

$4(5)+y=24$
$20+y=24$
$-20 \quad -20$
$y=4$

$(5,4)$

Solve the system graphically:



$y=-4x+24$

$(5,4)$

$2x-3y=-2$
$-2x \quad -2x$
$\frac{-3y}{-3}=\frac{-2x-2}{-3}$
$y=\frac{2}{3}x+\frac{2}{3}$

Example 2: Solve the Linear System of Equations:

$\begin{cases} x-y=11 \\ 2x+y=19 \end{cases}$

Solve the system algebraically: use elimination

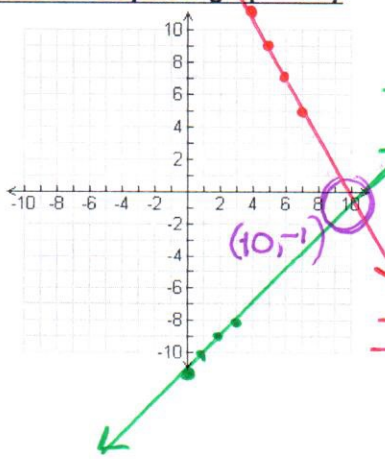
same #, opposite sign
Eliminate the y.

$x-y=11$
$+2x+y=19$
$\frac{3x}{3}=\frac{30}{3}$
$x=10$

$2(10)+y=19$
$20+y=19$
$-20 \quad -20$
$y=-1$

$(10,-1)$

Solve the system graphically:



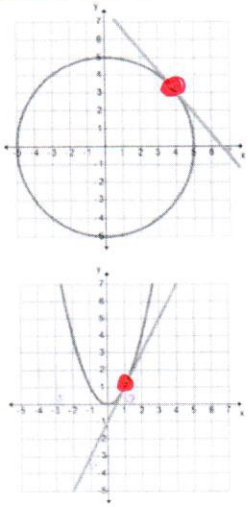
$x-y=11$
$+y \quad +y$
$x=y+11$
$-11 \quad -11$
$y=x-11$

$(10,-1)$

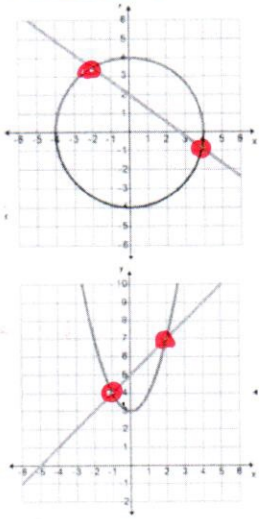
$2x+y=19$
$-2x \quad -2x$
$y=-2x+19$

Vocabulary: What does it mean to solve a system of equations?

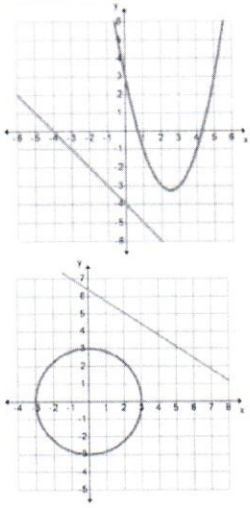
1. One Solution:



2. Two Solutions:



3. No Solutions:



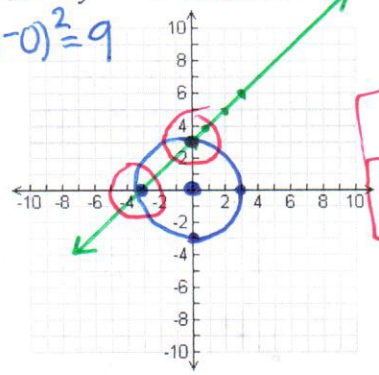
Example 3: Graph the following equations and state the solutions(s) to the systems if any exist.

1. $\begin{cases} y = x + 3 \\ x^2 + y^2 = 9 \end{cases}$ line, circle

$(x-0)^2 + (y-0)^2 = 9$

center $(0,0)$

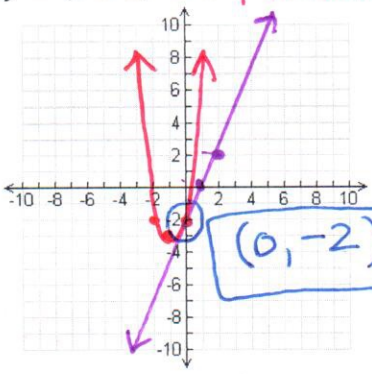
$r = 3$



$(0,3)$

$(-3,0)$

2. $\begin{cases} y = 2x - 2 \\ y = (x+1)^2 - 3 \end{cases}$ line, parabola

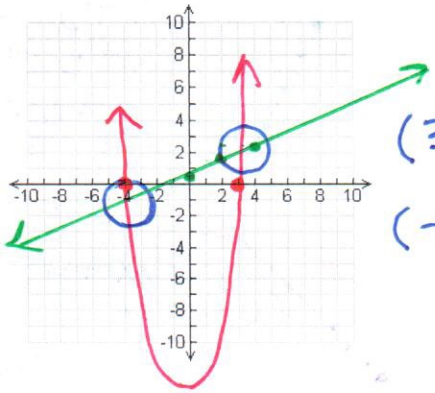


$(0,-2)$

Example 4: Some systems of equations are not easy to approximate a solution when graph by hand and so a graphing calculator becomes a very useful tool. *Note that it is very hard to graph a circle using the calculator so we will only do this with lines and parabolas.* I will be using the TI-84 Calculator.

$$\begin{cases} y_1 = \frac{1}{2}x + \frac{1}{2} \\ y_2 = (x+4)(x-3) \end{cases}$$

Graph the following equations on your calculator and approximate the solutions. Draw the graphs below.



$(3.29, 2.15)$

$(-3.79, -1.40)$

Notes on how to use your calculator:

- y= enter equations
- zoom 6: ZStandard
- 2nd trace 5: intersect