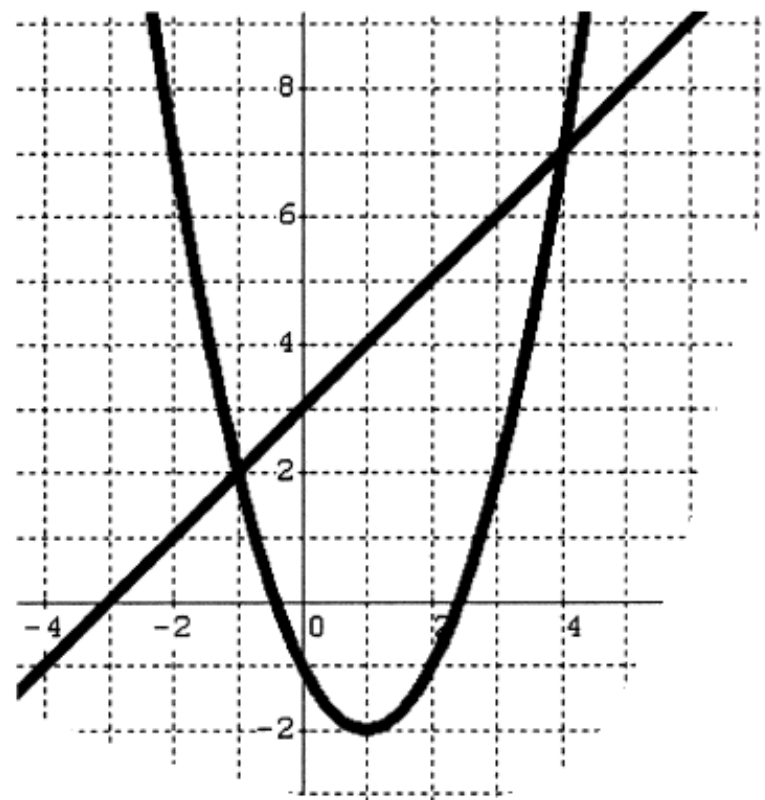# Algebra 2

Lesson U5 D8

When we solve equations graphically, we often create a system of equations. For example, one way to solve this equation $x^2 - 2x - 1 = x + 3$ would be to put it in our calculator as $y_1 = x^2 - 2x - 1$

$y_2 = x + 3$

The solution to the equation would be the x-values of the points of intersection. Use this graph to find the solution to the equation

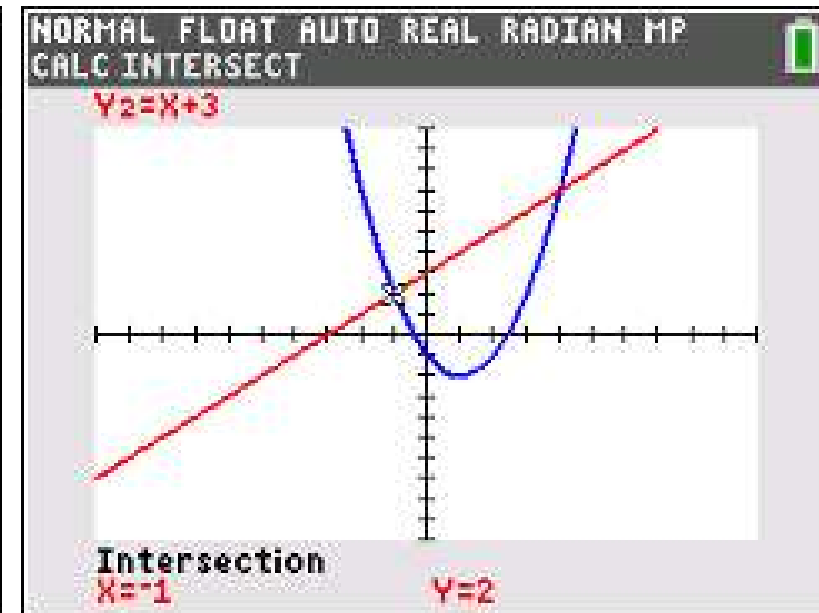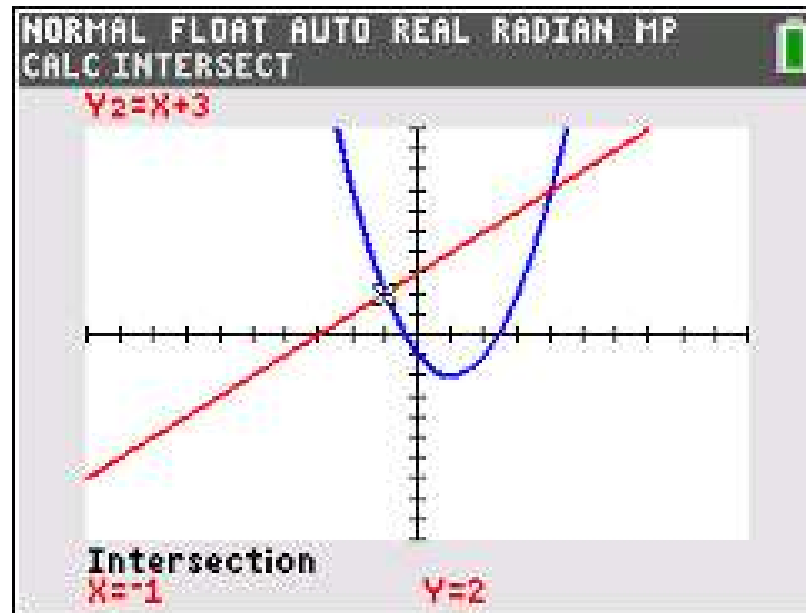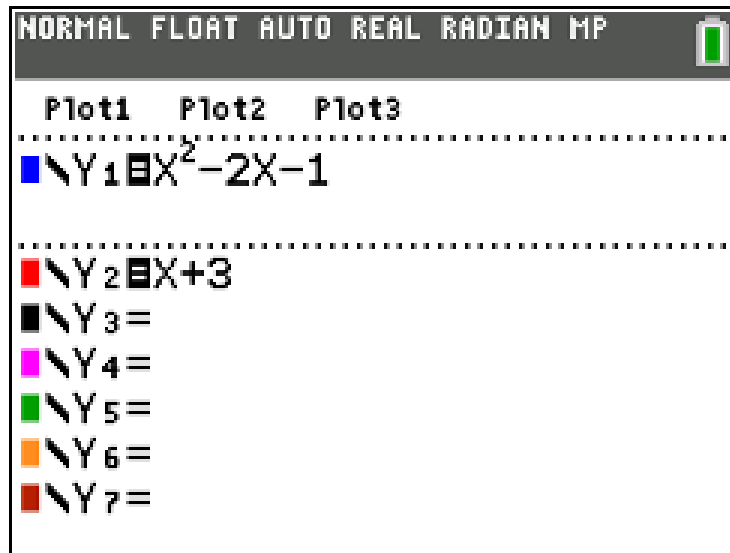$x^2 - 2x - 1 = x + 3$.

$x = -1 \qquad x = 4$

Solving Systems of Equations

Your solution above is for the <u>equation</u>. What would your solution be if you were asked to find the equation to the following **system of equations**?

Find the solution to the system of equations **graphically**:
$$\begin{cases} y = x^2 - 2x - 1 \\ y - 3 = x \end{cases}$$

Where do these graphs intersect?

Use your calculator!

NORMAL FLOAT AUTO REAL RADIAN MP

 Plot1   Plot2   Plot3

■\Y₁$\blacksquare$X²−2X−1

■\Y₂$\blacksquare$X+3
■\Y₃=
■\Y₄=
■\Y₅=
■\Y₆=
■\Y₇=

NORMAL FLOAT AUTO REAL RADIAN MP
CALC INTERSECT
 Y₂=X+3

Intersection
X=-1   Y=2

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CALC INTERSECT
 Y₂=X+3

Intersection
X=-1   Y=2

We can also solve systems of equations algebraically.

Find the solution to the system of equations **algebraically**:

$$\begin{cases} y = x^2 - 2x - 1 \\ y - 3 = x \end{cases}$$

We can use substitution!

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

$$y = y^2 - 6y + 9 - 2y + 6 - 1$$

$$y = y^2 - 8y + 14$$

$$\underline{-y} \qquad \underline{-y}$$

$$y^2 - 9y + 14 = 0 \qquad (y-2)(y-7) = 0$$

$$y = 2 \qquad y = 7$$

Check Your Answers

$$x = 2 - 3 = -1$$

$$x = 7 - 3 = 4$$

$$(-1, 2)$$

$$(4, 7)$$

Need to find the y-values too!

Solve algebraically each system of equations below. <u>Remember</u>: The solution to a system is a set of ordered pairs (x, y). So once you find the x-values, you must also find their partner y values.

1) $\begin{cases} x^2 - 4x + 3 = y \\ y = x - 1 \end{cases}$

They both equal Y!!! Set them equal to each other and solve the quadratic!

$$x^2 - 4x + 3 = x - 1$$

Let's set it to zero and Factor!

$$x^2 - 5x + 4 = 0$$

$$(x-4)(x-1) = 0$$

$$\{(4,3), (1,0)\}$$

$$x = 4 \qquad x = 1$$

$$y = 3 \qquad y = 0$$

Use substitution!

$$2) \quad \begin{cases} x^2 + y^2 = 5 \\ y = x + 1 \end{cases}$$

Check Your Answers

$$\{(-2, -1), (1, 2)\}$$

$$x^2 + (x+1)^2 = 5$$

$$x^2 + x^2 + 2x + 1 = 5$$

$$2x^2 + 2x - 4 = 0$$

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

$$2(x+2)(x-1) = 0$$

$$\begin{array}{ll} x = -2 & x = 1 \\ y = -1 & y = 2 \end{array}$$

3)
$$(x-3)^2 + (y+2)^2 = 16$$
$$2x + 2y = 10$$

Need to solve for x or y, then use substitution!

Let's solve for y!

$$\frac{2y}{2} = \frac{10}{2} - \frac{2x}{2}$$

$$y = 5 - x$$

$$\{ (7,-2), (3,2) \}$$

$$(x-3)^2 + (5-x+2)^2 = 16$$

$$(x-3)^2 + (7-x)^2 = 16$$

$$x^2 - 6x + 9 + 49 - 14x + x^2 - 16 = 0$$

$$2x^2 - 20x + 42 = 0$$

$$2(x^2 - 10x + 21) = 0$$

$$2(x-7)(x-3) = 0$$

$$x=7 \quad x=3$$
$$y=-2 \quad y=2$$

4) $\begin{cases} x^2 - 14 = y \\ y + 1 = 2x \end{cases}$ $y = 2x - 1$

$x^2 - 14 = 2x - 1$

$x^2 - 2x - 13 = 0$

$(x^2 - 2x + 1) - 1 - 13 = 0$

$(x-1)^2 - 14 = 0$

$(x-1)^2 = 14$

$x - 1 = \pm\sqrt{14}$

$\{(1 \pm \sqrt{14}, 1 \pm 2\sqrt{14})\}$

$x = 1 \pm \sqrt{14}$

$y = 2(1 \pm \sqrt{14}) - 1$

$2 \pm 2\sqrt{14} - 1$

$1 \pm 2\sqrt{14}$

5) The army of a country launches a test rocket from a base. The rocket's height h can be determined by the formula $h(t) = -\frac{1}{10}t^2 + 30$, where t is the time in seconds. From a satellite in space, a laser is fired at the rocket to try to destroy it. If the laser is fired at the correct time along the line $y = -2t + 15$, is it possible for the laser to intercept the rocket?

$$-\frac{1}{10}t^2 + 30 = -2t + 15$$
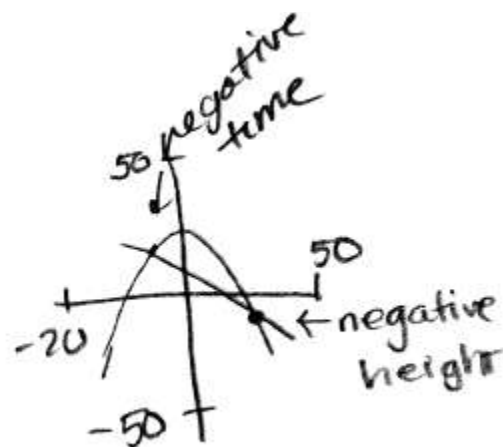
$$-10\left(-\frac{1}{10}t^2 + 2t + 15 = 0\right)$$

$$t^2 - 20t - 150 = 0$$

$$(t^2 - 20t + 100) - 100 - 150 = 0$$

$$(t-10)^2 = 250$$

$$t - 10 = \pm\sqrt{250}$$

no - can't have negative time or height

$t = 10 + \sqrt{250}$
$10 + 15.8 = 25.8$
$h(25.8) = -36.564$

$t = 10 - \sqrt{250}$
$= 10 - 15.8 = -5.8$

It's Time To Practice!

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theMORE YOU PRACTICE THE BETTER YOUGET

Practice answers for you to check your work!

6) $\begin{cases} y = x^2 - 4x + 3 \\ y = x - 1 \end{cases}$ $\{ (4,3), (1,0) \}$

7) $\begin{cases} y = 0.25x^2 - 2x + 3 \\ y + x = 2 \end{cases}$ $\{ (2,0) \}$

8) $\begin{cases} y = -3x^2 - 4x + 7 \\ y = 2 \end{cases}$ $\left\{ \left(-\dfrac{2}{3} \pm \dfrac{\sqrt{19}}{3}, 2 \right) \right\}$

Practice answers for you to check your work!

9) $\begin{cases} \dfrac{y}{x^2 - 9} = 1 \\ y - 3 = x \end{cases}$

$\{(-2, 1)\}$

10) $\begin{cases} 25 = x^2 + y^2 \\ y = -x - 3 \end{cases}$

$\left(-\dfrac{3}{2} + \dfrac{\sqrt{41}}{2},\ -\dfrac{3}{2} - \dfrac{\sqrt{41}}{2} \right)$