

## **Lesson 7.2: Solving Systems of Non-linear Equations**

### **Substitution Method:**

1. Take one of the two equations and solve for either  $x$  or  $y$   
(pick the easier one to solve for)
2. Substitute into the other equation
3. Solve for the variable
4. Plug the answer in to any equation to find the other variable.

EX 1:  $\begin{cases} y = x^2 + 1 \\ y = 3x + 1 \end{cases}$

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

③  $x^2 - 3x = 0$

$x(x-3) = 0$   
 $\downarrow \quad \downarrow$   
 $x=0 \quad x-3=0$   
 $x=3$

④

$x=0$	$x=3$
$y = 3(0) + 1$	$y = 3(3) + 1$
$y = 1$	$y = 10$
$(0, 1)$	$(3, 10)$

EX 2:

$$\begin{cases} y = \sqrt{x} \\ y = 6 - x \end{cases}$$

\* Square Root Problems: Plug into both equations to check for extraneous solutions.

$$\textcircled{2} (\sqrt{x})^2 = (6-x)^2 \rightarrow (6-x)(6-x)$$

$$x = 36 - 12x + x^2$$

-x

$$0 = x^2 - 13x + 36$$

$$(x' - 9)(x' - 4)$$

$$\begin{aligned} x - 9 &= 0 \\ x &= 9 \end{aligned}$$

$$\begin{aligned} x - 4 &= 0 \\ x &= 4 \end{aligned}$$

~~$x = 9$~~

~~$1. y = \sqrt{9}$~~

~~$y = 3$~~

~~$2. y = 6 - 9$~~

~~$y = -3$~~

$x = 4$

$1. y = \sqrt{4}$

$y = 2 \checkmark$

$2. y = 6 - 4$

$y = 2 \checkmark$

$$(4, 2)$$

Extraneous

EX 3:

$$\begin{cases} xy = \frac{1}{x} \rightarrow y = \frac{1}{x} \\ y - 2x = 1 \end{cases}$$

$$\textcircled{2} \times \left( \frac{1}{x} - 2x = 1 \right)$$

$$\textcircled{3} \quad \begin{array}{c} -1 - 2x^2 = x \\ -1 + 2x^2 \quad + 2x^2 - 1 \end{array}$$

$$0 = 2x^2 + x - 1$$

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

$$2x - 1 = 0$$

$$2x = 1$$

$$x = \frac{1}{2}$$

$$x + 1 = 0$$

$$x = -1$$

④

$$x = \frac{1}{2}$$

$$y = \frac{1}{\frac{1}{2}}$$

$$= 1 \cdot \frac{2}{1}$$

$$y = 2$$

$$\left( \frac{1}{2}, 2 \right)$$

$$x = -1$$

$$y = \frac{1}{-1}$$

$$y = -1$$

$$(-1, -1)$$

EX 4:  $\begin{cases} y^3 = (\sqrt[3]{x})^3 \rightarrow y^3 = x \\ y^2 = 2x \end{cases}$

$$y^2 = 2y^3$$

$$0 = 2y^3 - y^2$$

$$0 = y^2 (2y - 1)$$

$$y = 0$$

$$y = \frac{1}{2}$$

$$x = (0)^3$$

$$x = \left(\frac{1}{2}\right)^3$$

$$x = 0$$

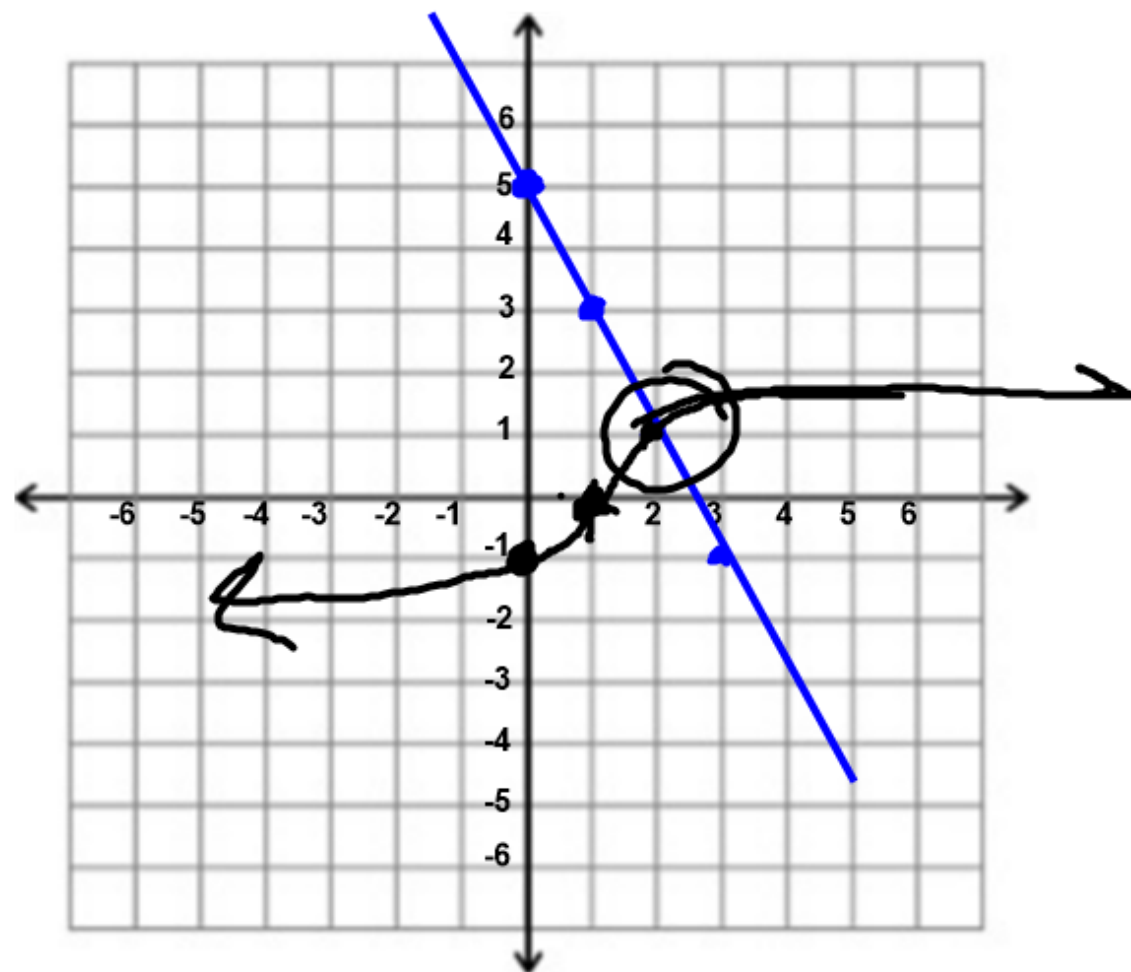
$$x = \frac{1}{8}$$

$$(0, 0)$$

$$\left(\frac{1}{8}, \frac{1}{2}\right)$$

Solve by Graphing.

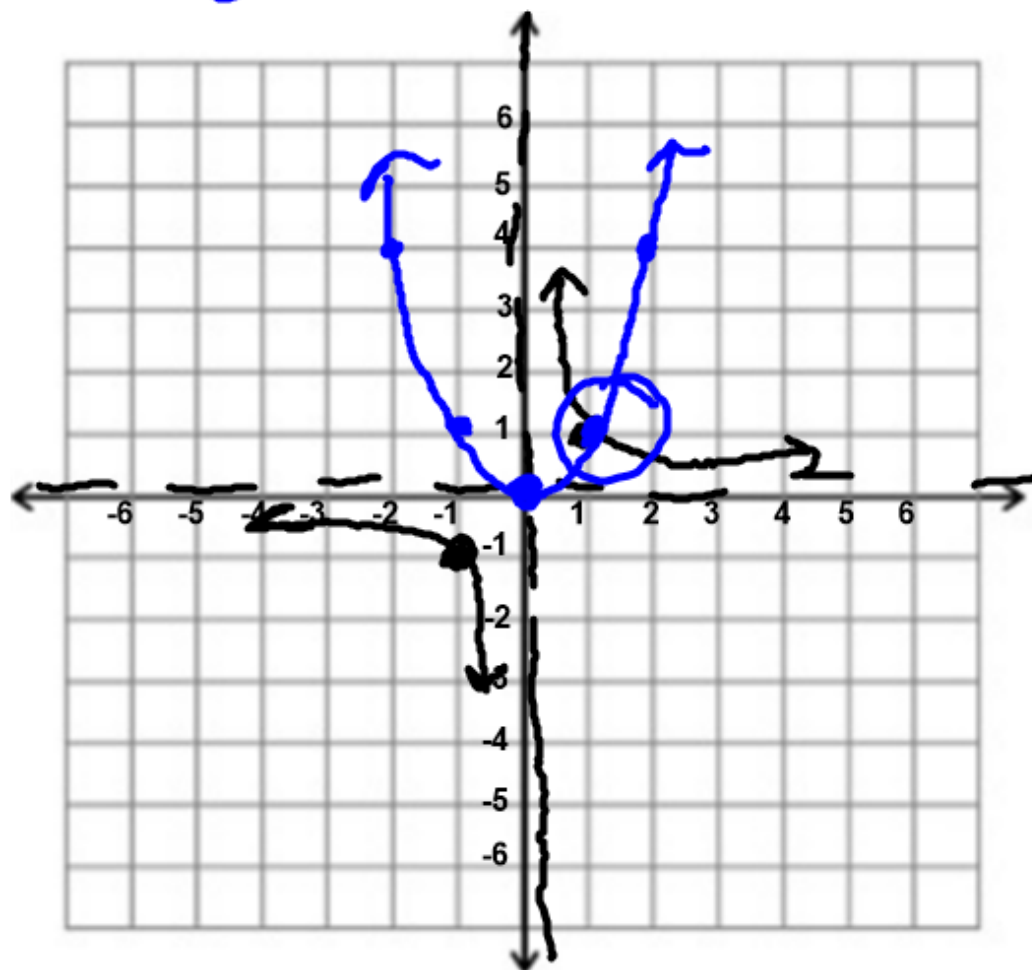
$$\begin{cases} y = \sqrt[3]{x-1} \\ y = -2x + 5 \end{cases}$$



$(2, 1)$

Solve by Graphing.

$$\begin{cases} xy = 1 \\ y = x^2 \end{cases} \rightarrow y = \frac{1}{x} \rightarrow \frac{1}{x} = x^2$$



$(1, 1)$