

3.2 Solving Linear Systems by Substitution

Learning Targets for today

- ① To be able to solve linear systems by substitution

Vocabulary

Linear System (2 equations) – two equations that both contain “x and y”.

Ex:

$$\begin{aligned}x + y &= 5 \\ 2x + 3y &= 13\end{aligned}$$

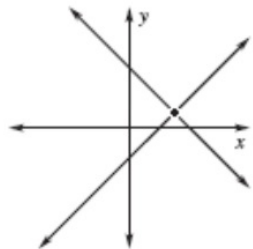
Solution of the system – An order pair that makes both equations in the system true!

Ex:

$$(2, 3)$$

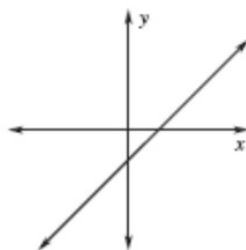
Three Different Types of Solutions – One Solution (x, y), Infinitely Many solutions, or No Solutions.

*Exactly one
solution*



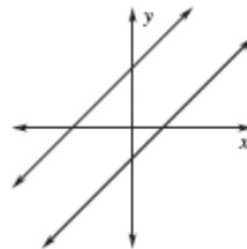
*A Consistent system
that is **independent!***

*Infinitely many
solutions*



*A Consistent system
that is **dependent!***

No Solutions



An Inconsistent system!

Solve by *Substitution* RULES:

1. Isolate the variable in one of the equations of your system.
2. Substitute what that variable equals into the other equation.
3. Solve for the variable.
4. Substitute the value of the variable that you just solved and solve for the other variable.

Solve by Substitution

Solve the system by using the substitution method.

$$\begin{aligned} 1. \quad x &= 2y \\ 2x + 2y &= 12 \\ 2(2y) + 2y &= 12 \\ 4y + 2y &= 12 \\ 6y &= 12 \\ \frac{6y}{6} &= \frac{12}{6} \\ y &= 2 \checkmark \end{aligned}$$

$$\begin{aligned} x &= 2y \\ x &= 2(2) \\ x &= 4 \checkmark \end{aligned}$$

$$(4, 2)$$

Solve the system by using the substitution method.

$$\begin{aligned} 2. \quad x - 9y &= -10 \\ 6x + y &= -5 \end{aligned} \quad x = 9y - 10$$
$$\begin{aligned} 6(9y - 10) + y &= -5 \\ 54y - 60 + y &= -5 \\ 55y - 60 &= -5 \\ \frac{55y}{55} &= \frac{55}{55} \\ y &= 1 \checkmark \end{aligned}$$

$$\begin{aligned} x &= 9(1) - 10 \\ x &= 9 - 10 \\ x &= -1 \end{aligned}$$

$$(-1, 1)$$

Solve by Substitution – YOUR TURN!!

Solve the system by using the substitution method.

$$\begin{aligned} 1. \quad & x + 2y = -2 \\ & 3x + 4y = 6 \end{aligned}$$

$x = -2y - 2$

$$3(-2y - 2) + 4y = 6$$
$$-6y - 6 + 4y = 6$$
$$-2y - 6 = 6$$
$$\begin{array}{r} -2y - 6 = 6 \\ +6 \quad +6 \\ \hline -2y = 12 \\ \frac{-2}{-2} \quad \frac{12}{-2} \\ y = -6 \end{array}$$
$$X = -2(-6) - 2$$
$$X = 12 - 2$$
$$X = 10 \checkmark$$

$$(10, -6)$$

Solve the system by using the substitution method.

$$\begin{aligned} 2. \quad & 2x + y = -2 \\ & 5x + 3y = -8 \end{aligned}$$

$y = -2x - 2$

$$5x + 3(-2x - 2) = -8$$
$$5x - 6x - 6 = -8$$
$$-x - 6 = -8$$
$$\begin{array}{r} -x - 6 = -8 \\ +6 \quad +6 \\ \hline -x = -2 \\ \frac{-1}{-1} \quad \frac{-2}{-1} \\ x = 2 \end{array}$$
$$y = -2(2) - 2$$
$$y = -4 - 2$$
$$y = -6 \checkmark$$

$$(2, -6)$$

Solving with Substitution when there is No Solution or Many Solutions.

Solve the system by using the substitution method.

1. $x = -3y + 4$
 $6y + 2x = 8$

$$6y + 2(-3y + 4) = 8$$

$$\cancel{6y} + \cancel{-6y} + 8 = 8$$

$$8 = 8 \checkmark$$

Many Solutions

Solve the system by using the substitution method.

2. $y = 4x - 9$
 $-4x + y = 6$

$$\cancel{-4x} + \cancel{4x} - 9 = 6$$

$$-9 = 6 \quad \text{!!}$$

No Solution