

## 7.4 – Solving Systems of Linear Equations by Substitution

We can eliminate a variable by solving one equation for a variable and substituting it into the other one.

### Substitution Steps:

1. Solve for one variable from one of the equations (Select the variable whose coefficient is **one**).
2. Substitute the result from step 1 into the other equation.
3. Solve for the variable in the resulting equation from step 2.
4. Substitute known value into either original equation and solve for the other variable.
5. Check your answer using both equations.

**Example 1:** Solve the linear system by substitution and verify your answer. Express your final answer as ordered pairs.

①  $x = y + 5 \rightarrow$  "x" is already isolated

a)  $x + 3y = -15$

②

Replace "x" with  
"y + 5" into equation

②

②  $x + 3y = -15$

$y + 5 + 3y = -15$

Now we have one equation with one variable that we can solve for.

$4y + 5 = -15$   
 $\quad -5 \quad -5$

$\frac{4y}{4} = \frac{-20}{4}$

$y = -5$

Now we can solve for x

$x = y + 5$

$x = -5 + 5$

$x = 0$

Final answer  
or  $(0, -5)$

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①  $7x + y = 10 \rightarrow$  rewrite (isolate "y")

b)  $3x - 2y = -3$

②

①  $7x + y = 10$   
 $\quad -7x \quad -7x$

$y = -7x + 10$  } sub into ②

$3x - 2(-7x + 10) = -3$

$3x + 14x - 20 = -3$   
 $\quad +20 \quad +20$

$\frac{17x}{17} = \frac{17}{17}$

$x = 1$

$y = -7x + 10$   
 $= -7(1) + 10$

$y = 3$

Final answer  
or  $(1, 3)$

Verify/Check:

①  $7(1) + 3 \stackrel{?}{=} 10 \quad \checkmark$

②  $3(1) - 2(3) \stackrel{?}{=} -3$

$3 - 6 = -3 \quad \checkmark$

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$$\textcircled{1} \quad 3x + y = 3 \rightarrow \text{rewrite (isolate "y")}$$

$$\text{c) } 7x - 2y = 20$$

$\textcircled{2}$

$$\textcircled{1} \quad \begin{array}{l} 3x + y = 3 \\ -3x \quad -3x \end{array} \quad y = -3x + 3$$

$$\textcircled{2} \quad 7x - 2(-3x + 3) = 20$$

$$\begin{array}{l} 7x + 6x - 6 = 20 \\ \underline{\quad\quad} \quad +6 \quad +6 \end{array}$$

$$\frac{13x}{13} = \frac{26}{13} \quad \text{cloud } x = 2$$

$$y = -3(2) + 3$$

$$= -6 + 3$$

$$\text{cloud } y = 3$$

$$\frac{x}{2} + y = \frac{5}{2}$$

$$\text{e) } \frac{1}{3}x - \frac{1}{3}y = -\frac{1}{3}$$

$$6x - y - 1 = 0$$

$$\text{d) } 4x = 3y - 4$$

$$\frac{1}{2}x + \frac{2}{3}y = -1$$

$$\text{f) } y = \frac{1}{4}x - \frac{5}{3}$$