

## 6.2 SOLVING LINEAR SYSTEMS BY SUBSTITUTION

Solve the linear system using substitution.

$$\begin{aligned}
 1. \quad & y = 4 \\
 & 3x - y = -9 \\
 & 3x - \cancel{4} = -9 \\
 & \quad \quad +4 \quad +4 \\
 \hline
 & 3x = -5 \\
 & \frac{3x}{3} = \frac{-5}{3} \\
 & x = -\frac{5}{3} \\
 & \left(-\frac{5}{3}, 4\right)
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & x = -5 \\
 & -2x + 7y = 2 \\
 & -2(-5) + 7y = 2 \\
 & \quad \quad \quad \cancel{10} + 7y = 2 \\
 & \quad \quad \quad -10 \quad \quad -10 \\
 \hline
 & 7y = -8 \\
 & \frac{7y}{7} = \frac{-8}{7} \\
 & y = -\frac{8}{7} \\
 & \left(-5, -\frac{8}{7}\right)
 \end{aligned}$$

Solve the linear system using substitution.

$$\begin{aligned}
 3. \quad & y = 2x + 3 \\
 & y = 5x \\
 & \cancel{2x} + 3 = 5x \\
 & \quad \quad -2x \quad -2x \\
 \hline
 & 3 = 3x \\
 & \frac{3}{3} = \frac{3x}{3} \\
 & 1 = x \\
 & y = 2(1) + 3 \\
 & y = 2 + 3 \\
 & y = 5 \\
 & (1, 5)
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & y = -8 + 4x \\
 & y = 2x - 6 \\
 & -8 + 4x = 2x - 6 \\
 & \quad \quad -2x \quad -2x \\
 \hline
 & -8 + 2x = -6 \\
 & \quad \quad +8 \quad \quad +8 \\
 \hline
 & 2x = 2 \\
 & \frac{2x}{2} = \frac{2}{2} \\
 & x = 1 \\
 & y = 2(1) - 6 \\
 & y = 2 - 6 \\
 & y = -4 \\
 & (1, -4)
 \end{aligned}$$

This method is **BEST** to use when one of the variables in either equation has a **coefficient of 1 or -1**.

Solve the linear system using substitution.

5.  $y = x + 1$   
 $2x + y = -2$

$\longrightarrow$

$$\begin{array}{r} 2x + x + 1 = -2 \\ 3x + \cancel{y} = -2 \\ \underline{-1} \quad \underline{-1} \\ 3x = -3 \\ \underline{3} \quad \underline{3} \\ x = -1 \end{array}$$

$y = -1 + 1$   
 $y = 0$

$(-1, 0)$

6.  $y = -3x + 5$

$$2x - y = 10$$

$$2x - (-3x + 5) = 10$$

$$2x + 3x - 5 = 10$$

$$\begin{array}{r} 5x - 5 = 10 \\ \underline{+5} \quad \underline{+5} \\ 5x = 15 \\ \underline{5} \quad \underline{5} \\ x = 3 \end{array}$$

$$y = -3(3) + 5$$

$$y = -9 + 5$$

$$y = -4$$

$(3, -4)$

7.  $x = 2y$

$$2x + 6y = 15$$

$$2(2y) + 6y = 15$$

$$4y + 6y = 15$$

$$\begin{array}{r} 10y = 15 \\ \underline{10} \quad \underline{10} \\ y = 1.5 \end{array}$$

$$x = 2(1.5)$$

$$x = 3$$

$(3, 1.5)$

If an equation is **not** already solved for a variable, you will need to do that first!

Pick the variable with a coefficient of 1 or -1.

8.  $2x + 2y = 3$

$$\begin{array}{r} \boxed{x} - 4y = -1 \\ +4y \quad +4y \\ \hline x = 4y - 1 \end{array}$$

$$x = 4(0.5) - 1$$

$$x = 2 - 1$$

$$x = 1$$

$(1, 0.5)$

Which variable should we solve for?  
*x in 2nd eq.*

$$2(4y - 1) + 2y = 3$$

$$8y - 2 + 2y = 3$$

$$\begin{array}{r} 10y - 2 = 3 \\ +2 \quad +2 \\ \hline 10y = 5 \end{array}$$

$$\frac{10y}{10} = \frac{5}{10} \quad y = 0.5$$

9.  $3x + \boxed{y} = 3$

$$7x + 2y = 1$$

$$\begin{array}{r} 3x + \boxed{y} = 3 \\ -3x \quad -3x \\ \hline y = -3x + 3 \end{array}$$

$$y = -3x + 3$$

$$y = -3(-5) + 3$$

$$y = 15 + 3$$

$$y = 18$$

$(-5, 18)$

Which variable should we solve for?  
*y in top eq.*

$$7x + 2(-3x + 3) = 1$$

$$7x - 6x + 6 = 1$$

$$x + 6 = 1$$

$$\begin{array}{r} x + 6 = 1 \\ -6 \quad -6 \\ \hline x = -5 \end{array}$$

$$x = -5$$

10.  $11x - 7y = -14$

$$\boxed{-x} + 2y = 4$$

$$\begin{array}{r} -x + 2y = 4 \\ -2y \quad -2y \\ \hline -x = -2y + 4 \\ -1 \quad -1 \quad -1 \end{array}$$

$$x = 2y - 4$$

$$x = 2(2) - 4$$

$$x = 4 - 4$$

$$x = 0$$

Which variable should we solve for?

 $x$  in bottom eq.

$$\begin{array}{r} 11(2y - 4) - 7y = -14 \\ 22y - 44 - 7y = -14 \end{array}$$

$$\begin{array}{r} 15y - 44 = -14 \\ +44 \quad +44 \\ \hline 15y = 30 \end{array}$$

$$\frac{15y}{15} = \frac{30}{15}$$

$$y = 2$$

 $(0, 2)$ 

11.  $x + y = 16$

$$2y = -2x + 2$$

$$\begin{array}{r} x + y = 16 \\ -x \quad -x \\ \hline y = -x + 16 \end{array}$$

Which variable should we solve for?

 $x$  or  $y$  in top eq.

$$2(-x + 16) = -2x + 2$$

$$\begin{array}{r} -2x + 32 = -2x + 2 \\ +2x \quad +2x \\ \hline 32 = 2 \end{array}$$

$$32 = 2$$

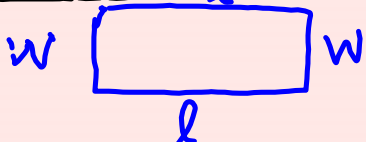
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no solution

12. The length of a rectangle is 3 cm more than 3 times its width. If the perimeter of the rectangle is 30 cm, what are its dimensions?

both length & width



$$l = 3w + 3$$

$$l = 3(3) + 3$$

$$l = 9 + 3$$

$$l = 12$$

12 cm by 3 cm

$$l + w + l + w = P$$

$$2l + 2w = P$$

$$2l + 2w = 30$$

$$2(3w + 3) + 2w = 30$$

$$6w + 6 + 2w = 30$$

$$8w + 6 = 30$$

$$\begin{array}{r} 8w + 6 = 30 \\ -6 \quad -6 \\ \hline 8w = 24 \\ \frac{8w}{8} = \frac{24}{8} \\ w = 3 \end{array}$$

13. The school is selling tickets for a fundraising event. The school sold 35 tickets for \$86 on the first day of the sale. Student tickets cost \$2 each and non-student tickets cost \$3 each.

Find the number of each kind of ticket on the first day.

$x = \#$  of student tickets  
 $y = \#$  of non-student tickets

money  $2x + 3y = 86 \rightarrow 2(-y + 35) + 3y = 86$   
ticket  $x + y = 35$

$$\begin{array}{r} 2x + 3y = 86 \\ x + y = 35 \\ \hline -x - y = -35 \\ \hline y = 16 \end{array}$$

19 student tickets  
16 non-student tickets

$$\begin{array}{r} x = -y + 35 \\ x = -16 + 35 \\ x = 19 \end{array}$$