

Sec. 6-2 Solving Systems Using Substitution

Solve using substitution.

$$a. \textcircled{1} \begin{cases} y = 5x \\ x + y = 12 \end{cases} \rightarrow \begin{cases} y = 5(2) \\ y = 10 \end{cases}$$

$$x + \boxed{y} = 12$$

$$x + 5x \textcircled{2} = 12$$

$$\frac{6x}{6} = \frac{12}{6}$$

$$\textcircled{3} x = 2$$

$$(2, 10)$$

① Solve for a variable

② Replace that value in the other equation.

③ Solve for other variable.

④ Plug this value into ①.

⑤ Write solution as an ordered pair.

Check:

$$\begin{array}{ll} y = 5x & x + y = 12 \\ 10 = 5(2) & 2 + 10 = 12 \\ 10 = 10 & 12 = 12 \end{array}$$

$$\begin{aligned}
 & \text{b.} \quad \begin{array}{l} \downarrow \quad \downarrow \\ 7x - 3y = 2 \end{array} \\
 & \textcircled{2} \quad 7(2y - 6) - 3y = 2 \\
 & \quad 14y - 42 - 3y = 2 \\
 & \quad \quad 11y - 42 = 2 \\
 & \quad \quad \quad +42 \quad +42 \\
 & \quad \quad \quad \hline
 & \quad \quad \quad 11y = 44 \\
 & \quad \quad \quad \frac{11y}{11} = \frac{44}{11} \\
 & \quad \quad \quad \textcircled{3} \quad y = 4
 \end{aligned}$$

$$\begin{aligned}
 & \begin{array}{l} \downarrow \quad \downarrow \\ -2y + x = -6 \end{array} \\
 & \quad \quad +2y \quad \quad +2y \\
 & \quad \quad \hline
 & \textcircled{1} \quad x = 2y - 6 \\
 & \quad \quad x = 2(4) - 6 \\
 & \quad \quad x = 8 - 6 \\
 & \quad \quad x = 2 \\
 & \quad \quad (2, 4)
 \end{aligned}$$

$$\begin{aligned}
 & \text{c.} \quad 6y + 5x = 9 \\
 & \quad 6y + 5(-3y - 7) = 9 \\
 & \quad 6y - 15y - 35 = 9 \\
 & \quad \quad -9y - 35 = 9 \\
 & \quad \quad \quad +35 \quad +35 \\
 & \quad \quad \quad \hline
 & \quad \quad \quad -9y = 44 \\
 & \quad \quad \quad \frac{-9y}{-9} = \frac{44}{-9} \\
 & \quad \quad \quad y = -\frac{44}{9} \quad \frac{44}{3} \\
 & \quad \quad \quad \frac{44}{3}
 \end{aligned}$$

$$\begin{aligned}
 & x + 3y = -7 \\
 & \quad \quad -3y \quad \quad -3y \\
 & \quad \quad \hline
 & \quad \quad x = -3y - 7 \\
 & \quad \quad x = -3\left(-\frac{44}{9}\right) - 7 \\
 & \quad \quad x = \frac{132}{9} - \frac{7}{1} \cdot \frac{9}{9} \\
 & \quad \quad \quad \frac{132}{9} - \frac{63}{9} \\
 & \quad \quad x = \frac{69}{9} = \frac{23}{3} \\
 & \quad \quad \left(\frac{23}{3}, -\frac{44}{9}\right) \text{ OR } \left(7\frac{2}{3}, -4\frac{8}{9}\right)
 \end{aligned}$$

d.

$$\begin{array}{r} y - 2x = 3 \\ + 2x \quad + 2x \\ \hline y = 2x + 3 \\ y = 2(-11) + 3 \\ y = -22 + 3 = -19 \end{array}$$

(-11, -19)

$$\begin{array}{r} 3x - 2y = 5 \\ 3x - 2(2x + 3) = 5 \\ 3x - 4x - 6 = 5 \\ -x - 6 = 5 \\ \quad +6 \quad +6 \\ \hline -x = 11 \\ \quad -1 \quad -1 \\ \hline x = -11 \end{array}$$

* Note, if you get
 $15 = 15$ T same line
 infinitely many solutions

$15 = 13$ F
 no solution

e. $x = -3y + 4$

$$\begin{array}{r} 6y + 2x = 8 \\ 6y + 2(-3y + 4) = 8 \\ 6y - 6y + 8 = 8 \\ 8 = 8 \text{ T} \end{array}$$

infinitely many
 solution

e.

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

$$\begin{array}{l}
 y = 2x - 5 \\
 y = 2(-3) - 5 \\
 y = -6 - 5 \\
 y = -11 \quad (-3, -11)
 \end{array}$$

$$x + y = 10$$

$$x - y = 8$$

(9, 1)

	10	
5	5	= 0
6	4	= 2
7	3	= 4
8	2	= 6
9	1	= 8

Graph:

$$x + y = 10$$

$$x - y = 8$$

x	y
10	0
0	10

$$x - 0 = 8$$

$$x = 8$$

$$0 - y = 8$$

$$-y = 8$$

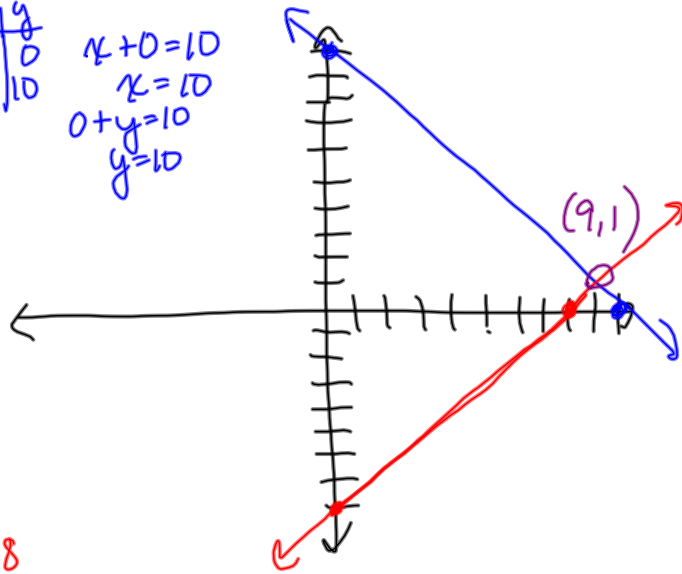
$$y = -8$$

$$x + 0 = 10$$

$$x = 10$$

$$0 + y = 10$$

$$y = 10$$



Substitution

$$x + y = 10$$

$$x - y = 8$$

$$(10 - y) - y = 8$$

$$10 - 1y - y = 8$$

$$\begin{array}{r} 10 - 2y = 8 \\ -10 \quad -10 \\ \hline \end{array}$$

$$\begin{array}{r} -2y = -2 \\ \frac{-2y}{-2} = \frac{-2}{-2} \\ y = 1 \end{array}$$

$$\begin{array}{r} x + y = 10 \\ -y \quad -y \\ \hline \end{array}$$

$$x = 10 - y$$

$$x = 10 - 1$$

$$x = 9$$

(9, 1)

Elimination

$$x + y = 10$$

$$x - y = 8$$

$$\frac{2x}{2} = \frac{18}{2}$$

$$x = 9$$

$$\begin{array}{r} x + y = 10 \\ 9 + y = 10 \\ -9 \quad -9 \\ \hline y = 1 \end{array}$$

$$\begin{array}{r} 2 + 3 = 5 \\ 7 - 3 = 4 \\ \hline 9 = 9 \end{array}$$

 $(9, 1)$

