

Solving Systems of Equations by Substitution

Unit 4: Systems

Solve each of the following systems by using **SUBSTITUTION**:

1. $y = 8x - 13$ $y = x + 1$ $(2, 3)$	2. $y = -7x - 11$ $y = 10x + 23$ $(-2, 3)$
3. $y = -7x - 8$ $y = 7x + 6$ $(-1, -1)$	4. $y = -7x + 4$ $y = 4x + 4$ $(0, 4)$
5. $y = -8x + 9$ $y = 3x - 2$ $(1, 1)$	6. $y = 5x + 13$ $-4x + 2y = 20$ $(-1, 8)$
7. $-6x - 8y = 2$ $y = 5$ $(-7, 5)$	8. $y = -9x - 27$ $-9x - y = 27$ Infinite Solutions or ALL REAL NUMBERS
9. $8x - 8y = 0$ $y = -3x - 20$ $(-5, -5)$	10. $y = 8x - 6$ $9x - 9y = -9$ $(1, 2)$

$$\begin{aligned} 11. \quad x + y &= 7 \\ 2x + 4y &= 12 \end{aligned}$$

$$(8, -1)$$

$$\begin{aligned} 12. \quad -8x - y &= -5 \\ -5x + y &= 5 \end{aligned}$$

$$(0, 5)$$

$$\begin{aligned} 13. \quad 9x - 7y &= -12 \\ x + 3y &= 10 \end{aligned}$$

$$(1, 3)$$

$$\begin{aligned} 14. \quad 5x + y &= 0 \\ -7x - 3y &= -8 \end{aligned}$$

$$(-1, 5)$$

$$\begin{aligned} 15. \quad x - 3y &= 10 \\ -2x + 2y &= -8 \end{aligned}$$

$$(1, -3)$$

$$\begin{aligned} 16. \quad -2x - 4y &= -22 \\ 2x - 2y &= -26 \end{aligned}$$

$$(-5, 8)$$

$$\begin{aligned} 17. \quad 10x + 9y &= 20 \\ -3x - 4y &= -6 \end{aligned}$$

$$(2, 0)$$

$$\begin{aligned} 18. \quad -5x - 3y &= -5 \\ 9x + 6y &= 3 \end{aligned}$$

$$(7, -10)$$

$$\begin{aligned} 19. \quad 4x - y &= 6 \\ 4x - 3y &= 26 \end{aligned}$$

$$(-1, -10)$$

$$\begin{aligned} 20. \quad -7x + 9y &= 12 \\ -9x + 3y &= 24 \end{aligned}$$

$$(-3, -1)$$

$$\textcircled{1} \quad y = 8x - 13$$

$$y = x + 1$$

$$\text{So } \begin{array}{r} 8x - 13 = x + 1 \\ -x \quad \quad -x \end{array}$$

$$\begin{array}{r} 7x - 13 = -1 \\ +13 \quad +13 \end{array}$$

$$\frac{7x}{7} = \frac{14}{7}$$

$$\boxed{x = 2}$$

Plug into equation above

$$y = 2 + 1$$

$$\boxed{y = 3}$$

Solution

$$\boxed{(2, 3)}$$

$$\textcircled{2} \quad y = -7x - 11$$

$$y = 10x + 23$$

$$\begin{array}{r} -7x - 11 = 10x + 23 \\ -10x \quad \quad -10x \end{array}$$

$$\begin{array}{r} -17x - 11 = 23 \\ +11 \quad +11 \end{array}$$

$$\frac{-17x}{-17} = \frac{34}{-17}$$

Plug into equation above $\boxed{x = -2}$

Solution

$$\boxed{(-2, 3)}$$

$$y = -7(-2) - 11$$

$$y = 14 - 11$$

$$\boxed{y = 3}$$

$$\textcircled{3} \quad y = -7x - 8$$

$$y = 7x + 6$$

$$\begin{array}{r} -7x - 8 = 7x + 6 \\ +7x \quad \quad +7x \end{array}$$

$$\begin{array}{r} -8 = 14x + 6 \\ -6 \quad \quad -6 \end{array}$$

$$\frac{-14}{14} = \frac{14x}{14}$$

$$\boxed{-1 = x}$$

Plug into equation above

$$y = 7(-1) + 6$$

$$y = -7 + 6$$

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

Solution

$$\boxed{(-1, -1)}$$

$$(4) \quad y = -7x + 4$$

$$y = 4x + 4$$

$$\begin{array}{r} -7x + 4 = 4x + 4 \\ +7x \quad \quad +7x \end{array}$$

$$\begin{array}{r} 4 = 11x + 4 \\ -4 \quad \quad -4 \end{array}$$

$$\frac{0}{11} = \frac{11x}{11}$$

$$\boxed{0 = x}$$

Solution

$$\boxed{(0, 4)}$$

Plug into

$$y = 4x + 4$$

$$y = 4(0) + 4$$

$$y = 0 + 4$$

$$\boxed{y = 4}$$

$$(5) \quad y = -8x + 9$$

$$y = 3x - 2$$

$$\begin{array}{r} -8x + 9 = 3x - 2 \\ +8x \quad \quad +8x \end{array}$$

$$\begin{array}{r} 9 = 11x - 2 \\ +2 \quad \quad +2 \end{array}$$

$$\frac{11}{11} = \frac{11x}{11}$$

$$\boxed{1 = x}$$

Solution

$$\boxed{(1, 1)}$$

Plug into

$$y = 3x - 2$$

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

$$y = 3 - 2$$

$$\boxed{y = 1}$$

$$(6) \quad y = 5x + 13$$

Replace $x = -1$

$$y = 5(-1) + 13$$

$$y = -5 + 13$$

$$\boxed{y = 8}$$

Solution

$$\boxed{(-1, 8)}$$

$$\frac{-4x + 2y}{2} = \frac{20}{2}$$

$$-2x + y = 10$$

$$-2x + 5x + 13 = 10$$

$$3x + 13 = 10$$

$$\begin{array}{r} -13 \quad -13 \\ 3x + 13 = 10 \\ \hline 3x = -3 \end{array}$$

$$\frac{3x}{3} = \frac{-3}{3}$$

$$\boxed{x = -1}$$

$$(7) -6x - 8y = 2$$

$$y = 5$$

$$-6x - 8(5) = 2$$

$$\begin{array}{r} -6x - 40 = 2 \\ +40 \quad +40 \\ \hline \end{array}$$

$$\begin{array}{r} -6x = 42 \\ -6 \quad -6 \\ \hline \end{array}$$

$$x = -7$$

Solution

$$(-7, 5)$$

$$(8) y = -9x - 27$$

$$-9x - y = 27$$

$$-9x - (-9x - 27) = 27$$

$$-9x + 9x + 27 = 27$$

$$27 = 27$$

ALL REAL NUMBERS

OR

Infinite Solutions

$$(9) 8x - 8y = 0$$

$$8x - 8(-3x - 20) = 0$$

$$8x + 24x + 160 = 0$$

$$\begin{array}{r} 32x + 160 = 0 \\ -160 \quad -160 \\ \hline \end{array}$$

$$\begin{array}{r} 32x = -160 \\ 32 \quad 32 \\ \hline \end{array}$$

$$x = -5$$

$$y = -3x - 20$$

$$y = -3(-5) - 20$$

$$y = 15 - 20$$

$$y = -5$$

Solution

$$(-5, -5)$$

$$(10) y = 8x - 6$$

$$y = 8(1) - 6$$

$$y = 8 - 6$$

$$y = 2$$

Solution

$$(1, 2)$$

$$\frac{9x - 9y}{9} = \frac{-9}{9}$$

$$x - y = -1$$

$$x - (8x - 6) = -1$$

$$x - 8x + 6 = -1$$

$$\begin{array}{r} -7x + 6 = -1 \\ -6 \quad -6 \\ \hline \end{array}$$

$$\begin{array}{r} -7x = -7 \\ -7 \quad -7 \\ \hline \end{array}$$

$$x = 1$$

$$(11) \quad x + y = 7$$

$$-2y + 6 + y = 7$$

$$\begin{array}{r} -y + 6 = 7 \\ -6 \quad -6 \\ \hline \end{array}$$

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

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

Solution

$$\boxed{(8, -1)}$$

$$\frac{2x}{2} + \frac{4y}{2} = \frac{12}{2}$$

$$x + 2y = 6$$

$$\begin{array}{r} x + 2y = 6 \\ -2y \quad -2y \\ \hline \end{array}$$

$$x = -2y + 6$$

$$x = -2(-1) + 6$$

$$x = 2 + 6$$

$$\boxed{x = 8}$$

$$(12) \quad -8x - y = -5$$

$$-8x - (5x + 5) = -5$$

$$-8x - 5x - 5 = -5$$

$$\begin{array}{r} -13x - 5 = -5 \\ +5 \quad +5 \\ \hline \end{array}$$

$$\frac{-13x}{-13} = \frac{0}{-13}$$

$$\boxed{x = 0}$$

Solution

$$\boxed{(0, 5)}$$

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

$$y = 5x + 5$$

$$y = 5(0) + 5$$

$$y = 0 + 5$$

$$\boxed{y = 5}$$

$$(13) \quad 9x - 7y = -12$$

$$9(-3y + 10) - 7y = -12$$

$$-27y + 90 - 7y = -12$$

$$\begin{array}{r} -34y + 90 = -12 \\ -90 \quad -90 \\ \hline \end{array}$$

$$\frac{-34y}{-34} = \frac{-102}{-34}$$

$$\boxed{y = 3}$$

Solution

$$\boxed{(1, 3)}$$

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

$$x = -3y + 10$$

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

$$x = -9 + 10$$

$$\boxed{x = 1}$$

$$(14) \quad \begin{array}{r} 5x + y = 0 \\ -5x \quad -5x \\ \hline \end{array}$$

$$y = -5x$$

$$y = -5(-1)$$

$$\boxed{y = 5}$$

Solution

$$\boxed{(-1, 5)}$$

$$-7x - 3y = -8$$

$$-7x - 3(-5x) = -8$$

$$-7x + 15x = -8$$

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

$$\boxed{x = -1}$$

$$(15) \quad x - 3y = 10$$

$$x - 3(x-4) = 10$$

$$x - 3x + 12 = 10$$

$$\begin{array}{r} -2x + 12 = 10 \\ -12 \quad -12 \\ \hline \end{array}$$

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

$$\boxed{x = 1}$$

Solution

$$\boxed{(1, -3)}$$

$$\frac{-2x}{2} + \frac{2y}{2} = \frac{-8}{2}$$

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

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

$$y = 1 - 4$$

$$\boxed{y = -3}$$

$$(16) \quad \frac{-2x}{-2} - \frac{4y}{-2} = \frac{-22}{-2}$$

$$x + 2y = 11$$

$$y - 13 + 2y = 11$$

$$\begin{array}{r} 3y - 13 = 11 \\ +13 \quad +13 \\ \hline \end{array}$$

$$\begin{array}{r} 3y = 24 \\ 3 \quad 3 \\ \hline \end{array}$$

$$\boxed{y = 8}$$

Solution

$$\boxed{(-5, 8)}$$

$$\frac{2x}{2} - \frac{2y}{2} = \frac{-26}{2}$$

$$\begin{array}{r} x - y = -13 \\ +y \quad +y \\ \hline \end{array}$$

$$x = \boxed{y - 13}$$

$$x = 8 - 13$$

$$\boxed{x = -5}$$

$$(17) \quad 10x + 9y = 20$$

$$\begin{array}{r} 10x + 9y = 20 \\ -9y \quad -9y \\ \hline \end{array}$$

$$\frac{10x}{10} = \frac{-9y}{10} + \frac{20}{10}$$

$$x = \boxed{\frac{-9}{10}y + 2}$$

$$x = \frac{-9}{10}(0) + 2$$

$$x = 0 + 2$$

$$\boxed{x = 2}$$

Solution

$$(2, 0)$$

$$-3x - 4y = -6$$

$$-3\left(\frac{-9}{10}y + 2\right) - 4y = -6$$

$$10 \left[\frac{27}{10}y - 6 - 4y = -6 \right] 10$$

$$27y - 60 - 40y = -60$$

$$\begin{array}{r} -13y - 60 = -60 \\ +60 \quad +60 \\ \hline \end{array}$$

$$\begin{array}{r} -13y = 0 \\ -13 \quad -13 \\ \hline \end{array}$$

$$\boxed{y = 0}$$

$$\textcircled{18} \quad \begin{array}{r} -5x - 3y = -5 \\ +3y \quad +3y \\ \hline \end{array}$$

$$\frac{-5x}{-5} = \frac{3y - 5}{-5} \frac{-5}{-5}$$

$$x = \boxed{-\frac{3}{5}y + 1}$$

$$x = \frac{-3}{5} \left(\frac{-10}{1} \right) + 1$$

$$x = \frac{30}{5} + 1$$

$$x = 6 + 1$$

$$\boxed{x = 7}$$

Solution

$$\boxed{(7, -10)}$$

$$9x + 6y = 3$$

$$9\left(-\frac{3}{5}y + 1\right) + 6y = 3$$

$$5 \left[-\frac{27}{5}y + 9 + 6y = 3 \right] 5$$

$$-27y + 45 + 30y = 15$$

$$\begin{array}{r} 3y + 45 = 15 \\ -45 \quad -45 \\ \hline \end{array}$$

$$\frac{3y}{3} = \frac{-30}{3}$$

$$\boxed{y = -10}$$

$$\textcircled{19} \quad \begin{array}{r} 4x - y = 6 \\ -4x \quad -4x \\ \hline \end{array}$$

$$\frac{-y}{-1} = \frac{-4x + 6}{-1} \frac{-1}{-1}$$

$$y = \boxed{4x - 6}$$

$$y = 4(-1) - 6$$

$$y = -4 - 6$$

$$\boxed{y = -10}$$

Solution

$$\boxed{(-1, -10)}$$

$$4x - 3y = 26$$

$$4x - 3(4x - 6) = 26$$

$$4x - 12x + 18 = 26$$

$$\begin{array}{r} -8x + 18 = 26 \\ -18 \quad -18 \\ \hline \end{array}$$

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

$$\boxed{x = -1}$$

$$\textcircled{20} \quad -7x + 9y = 12$$

$$-7x + 9(3x + 8) = 12$$

$$-7x + 27x + 72 = 12$$

$$\begin{array}{r} 20x + 72 = 12 \\ -72 \quad -72 \\ \hline \end{array}$$

$$\frac{20x}{20} = \frac{-60}{20}$$

$$\boxed{x = -3}$$

Solution

$$\boxed{(-3, -1)}$$

$$\begin{array}{r} -9x + 3y = 24 \\ +9x \quad +9x \\ \hline \end{array}$$

$$\frac{3y}{3} = \frac{9x + 24}{3} \frac{3}{3}$$

$$y = \boxed{3x + 8}$$

$$y = 3(-3) + 8$$

$$y = -9 + 8$$

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