

5.3 Solving Systems of Linear Equations (Elimination)

Steps for solving a system of equations by elimination:

- 1) Multiply, if necessary, one or both equations by a constant so at least 1 pair of like terms have the opposite coefficients.
- 2) Add the equations to eliminate one of the variables.
- 3) Solve the resulting equation for the remaining variable.
- 4) Substitute the value from step 3 into one of the original equations and solve.

Solve the system of linear equations by elimination. Check your solution.

1) $x - y = 4$

$x + y = 2$

$$\begin{array}{r} 2x \\ \hline 2 \end{array} = \frac{6}{2}$$

$x = 3$

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

$(3, -1)$

2) $x + 3y = 5$

$2x - 3y = 1$

$$\begin{array}{r} 3x \\ \hline 3 \end{array} = \frac{6}{3}$$

$x = 2$

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

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

$y = 1$

$(2, 1)$

3) $4x - y = 7$

$-4x + 2y = -2$

$y = 5$

$$\begin{array}{r} 4x - 5 = 7 \\ +5 \quad +5 \\ \hline 4x = 12 \end{array}$$

$$\begin{array}{r} 4x = 12 \\ \hline 4 \quad 4 \end{array}$$

$x = 3$

$(3, 5)$

4) $2x + 3y = -2$

$3(3x - y = -14) \rightarrow$

$$2x + 3y = -2$$

$$9x - 3y = -42$$

$$\begin{array}{r} 11x \\ \hline 11 \end{array} = \frac{-44}{11}$$

$x = -4$

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

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

$$\begin{array}{r} 3y = 6 \\ \hline 3 \quad 3 \end{array}$$

$y = 2$

$(-4, 2)$

$$\begin{array}{l}
 5) \quad \begin{cases} x - 3y = 1 \\ 4x + 5y = 4 \end{cases} \\
 \begin{array}{r}
 -4x + 12y = -4 \\
 4x + 5y = 4 \\
 \hline
 17y = 0 \\
 \frac{17y}{17} = \frac{0}{17} \\
 y = 0 \\
 \boxed{y = 0}
 \end{array} \\
 \begin{array}{l}
 x - 3(0) = 1 \\
 x - 0 = 1 \\
 \boxed{x = 1}
 \end{array} \\
 \boxed{(1, 0)}
 \end{array}$$

$$\begin{array}{l}
 6) \quad \begin{cases} 3x - 5y = 9 \\ 6x - 6y = 6 \end{cases} \\
 \begin{array}{r}
 3x - 5(-3) = 9 \\
 3x + 15 = 9 \\
 -15 \quad -15 \\
 \hline
 3x = -6 \\
 \frac{3x}{3} = \frac{-6}{3} \\
 \boxed{x = -2}
 \end{array} \\
 \begin{array}{r}
 -6x + 10y = -18 \\
 6x - 6y = 6 \\
 \hline
 4y = -12 \\
 \frac{4y}{4} = \frac{-12}{4} \\
 \boxed{y = -3}
 \end{array} \\
 \boxed{(-2, -3)}
 \end{array}$$

$$\begin{array}{l}
 7) \quad \begin{cases} 3x - y = 0 \\ -3x + 5y = 0 \end{cases} \\
 \begin{array}{r}
 3x - 0 = 0 \\
 3x = 0 \\
 x = 0 \\
 \boxed{x = 0}
 \end{array} \\
 \begin{array}{r}
 4y = 0 \\
 \frac{4y}{4} = \frac{0}{4} \\
 y = 0 \\
 \boxed{y = 0}
 \end{array} \\
 \boxed{(0, 0)}
 \end{array}$$

$$\begin{array}{l}
 8) \quad \begin{cases} 2y = -5x - 3 \\ 4x - 2 = -6y \end{cases} \\
 \begin{array}{r}
 2y = -5(-1) - 3 \\
 2y = 5 - 3 \\
 \frac{2y}{2} = \frac{2}{2} \\
 \boxed{y = 1}
 \end{array} \\
 \begin{array}{r}
 3(5x + 2y = -3) \\
 4x + 6y = 2 \\
 \begin{array}{r}
 -15x - 6y = 9 \\
 4x + 6y = 2 \\
 \hline
 -11x = 11 \\
 \frac{-11x}{-11} = \frac{11}{-11} \\
 \boxed{x = -1}
 \end{array}
 \end{array} \\
 \boxed{(-1, 1)}
 \end{array}$$

9) For what values of a and b should you solve the system by elimination?

$$\begin{array}{l}
 a) \quad \begin{cases} 3x + 5y = 10 \\ 2x + ay = 4 \end{cases}
 \end{array}$$

$$a = \underline{-5}$$

$$\begin{array}{l}
 b) \quad \begin{cases} -4x - 3y = 9 \\ bx + 7y = 2 \end{cases}
 \end{array}$$

$$b = \underline{4}$$