

7.3 Solving Systems Using Elimination

Eliminate means to get rid of something. With our systems, if it was possible to get rid of one variable, then we would be left with an equation in one variable that is easy to solve.

$$\begin{array}{r} 2x + 4y = -4 \\ -2x + 1y = 8 \\ \hline \end{array}$$

$$\frac{3y}{3} = \frac{-12}{3}$$

$$y = -4$$

$$(6, -4)$$

Your goal is to eliminate one of the variables

"x" is easier to eliminate this time.

Once you know what y is, you can substitute it into either equation to find x.

$$\begin{array}{r} 2x + 4y = -4 \\ 2x + 4(-4) = -4 \\ 2x - 16 = -4 \\ \quad +16 \quad +16 \\ 2x = 12 \\ x = 6 \end{array}$$

$$\begin{array}{r} 2x + 1y = 8 \\ 2 \cdot 6 + 1(-4) = 8 \\ 12 - 4 = 8 \\ 8 = 8 \end{array}$$

Try some more...

$$\begin{array}{r} 3x + 5y = 6 \\ + \quad -3x + 1y = 6 \\ \hline 6y = 12 \\ \frac{6y}{6} = \frac{12}{6} \\ y = 2 \end{array}$$

$$\begin{array}{r} 3x + 5y = 6 \\ 3x + 5 \cdot 2 = 6 \\ 3x + 10 = 6 \\ -10 \quad -10 \\ \hline 3x = -4 \\ \frac{3x}{3} = \frac{-4}{3} \\ x = -\frac{4}{3} \end{array}$$

$$\left(-\frac{4}{3}, 2\right)$$

$$\begin{array}{r} -3x + 1y = 6 \\ -3\left(-\frac{4}{3}\right) + 1 \cdot 2 = 6 \\ 4 + 2 = 6 \\ 6 = 6 \end{array}$$

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

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

$$\begin{array}{r} y = -x \\ 1 = -(-1) \\ 1 = 1 \end{array}$$

$$(-1, 1)$$

What happens when you can't eliminate a variable by adding or subtracting like in

$$8x - 9y = 19$$

$$4x + 1y = -7$$

Sometimes, you may have to multiply one of the equations by a constant before you can add or subtract the equation.

$$8x - 9y = 19$$

$4x + 1y = -7$ I can multiply this equation by -2 to eliminate the x variables. Or I can multiply this equation by 9 to eliminate the y variables. Let's try -2 , since it's smaller.

$$8(-1) - 9(-3) = 19$$
$$-8 + 27 = 19 \quad \checkmark$$

$$\begin{array}{r} 8x - 9y = 19 \longrightarrow \\ -2(4x + 1y = -7) \longrightarrow \end{array} \begin{array}{r} + \\ \hline 8x - 9y = 19 \\ -8x - 2y = 14 \\ \hline \end{array}$$

$$4x - 3 = -7$$
$$+3 \quad +3$$

$$4x = -4$$
$$\frac{4x}{4} = \frac{-4}{4}$$

$$x = -1$$

$$\frac{-11y}{-11} = \frac{33}{-11}$$

$$y = -3$$

$$(-1, -3)$$

$$\begin{array}{r}
 2(4x - y = 6) \longrightarrow 8x - 2y = 12 \\
 3x + 2y = 21 \longrightarrow + 3x + 2y = 21 \\
 \hline
 11x = 33 \\
 \frac{11x}{11} = \frac{33}{11} \\
 x = 3
 \end{array}$$

$$\begin{array}{r}
 4 \cdot 3 - y = 6 \\
 12 - y = 6 \\
 -12 \quad -12 \\
 \hline
 -y = -6 \\
 y = 6
 \end{array}$$

$$(3, 6)$$

$$\begin{array}{r}
 3 \cdot 3 + 2 \cdot 6 = 21 \\
 9 + 12 = 21 \\
 21 = 21
 \end{array}$$

$$\begin{array}{r}
 7x + 3y = 25 \\
 3(-2x - 1y = -8) \longrightarrow -6x - 3y = -24 \\
 \hline
 x = 1
 \end{array}$$

$$\begin{array}{r}
 7 \cdot 1 + 3y = 25 \\
 7 + 3y = 25 \\
 -7 \qquad -7
 \end{array}$$

$$\frac{3y}{3} = \frac{18}{3}$$

$$y = 6$$

(1, 6)

$$\begin{array}{r}
 -2 \cdot 1 - 1 \cdot 6 = -8 \\
 -2 - 6 = -8 \\
 -8 = -8 \checkmark
 \end{array}$$

Sometimes, you might have to multiply both of the equations by different numbers.

$$\begin{array}{rcl}
 5x + 7y = -1 & \longrightarrow & 2(5x + 7y = -1) \longrightarrow 10x + 14y = -2 \\
 4x - 2y = 22 & \longrightarrow & 7(4x - 2y = 22) \longrightarrow 28x - 14y = 154 \\
 & & \hline
 & & 38x = 152 \\
 & & \frac{38x}{38} = \frac{152}{38}
 \end{array}$$

$$x = 4$$

$$\begin{array}{r}
 5 \cdot 4 + 7y = -1 \\
 20 + 7y = -1 \\
 -20 \quad -20 \\
 \hline
 7y = -21 \\
 \frac{7y}{7} = \frac{-21}{7} \\
 y = -3
 \end{array}$$

$$(4, -3)$$

$$\begin{array}{r}
 4 \cdot 4 - 2(-3) = 22 \\
 16 + 6 = 22 \\
 22 = 22
 \end{array}$$

$$\begin{array}{l} 2(2x - 3y = -6) \rightarrow 4x - 6y = -12 \\ 3(3x + 2y = 30) \rightarrow^+ 9x + 6y = 90 \end{array}$$

$$\frac{13x}{13} = \frac{78}{13}$$

$$x = 6$$

$$2 \cdot 6 - 3y = -6$$

$$\begin{array}{r} 12 - 3y = -6 \\ -12 \quad -12 \end{array}$$

$$-3y = -18$$

$$y = 6$$

$$(6, 6)$$

$$3 \cdot 6 + 2 \cdot 6 = 30$$

$$18 + 12 = 30$$

$$30 = 30$$

homework
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