

Lesson 7-4

Example 1 Multiply One Equation to Eliminate

Use elimination to solve the system of equations.

$$\frac{1}{3}x + 3y = -4$$

$$x + 2y = 9$$

Multiply the first equation by -3 so the coefficients of the x -terms are additive inverses. Then add the equations.

$$\frac{1}{3}x + 3y = -4$$

Multiply by -3 .

$$-x - 9y = 12$$

$$x + 2y = 9$$

$$\underline{(+)\ x + 2y = 9}$$

$$-7y = 21$$

$$\frac{-7y}{-7} = \frac{21}{-7}$$

$$y = -3$$

Now substitute -3 for y in either equation to find the value of x .

$$x + 2y = 9$$

Second equation

$$x + 2(-3) = 9$$

$$y = -3$$

$$x - 6 = 9$$

Simplify.

$$x - 6 + 6 = 9 + 6$$

Add 6 to each side.

$$x = 15$$

Simplify.

The solution is $(15, -3)$.

Example 2 Multiply Both Equations to Eliminate

Use elimination to solve the system of equations.

$$5x - 7y = -2$$

$$-4x + 6y = 4$$

Method 1 Eliminate x .

$$5x - 7y = -2$$

Multiply by 4.

$$20x - 28y = -8$$

$$-4x + 6y = 4$$

Multiply by 5.

$$\underline{(+)\ -20x + 30y = 20}$$

$$2y = 12$$

$$\frac{2y}{2} = \frac{12}{2}$$

$$y = 6$$

Now substitute 6 for y in either equation to find the value of x .

$$5x - 7y = -2$$

First equation

$$5x - 7(6) = -2$$

$$y = 6$$

$$5x - 42 = -2$$

Simplify.

$$5x - 42 + 42 = -2 + 42$$

Add 42 to each side.

$$5x = 40$$

Simplify.

$$\frac{5x}{5} = \frac{40}{5}$$

Divide each side by 5.

$$x = 8$$

Simplify.

The solution is $(8, 6)$.

Method 2 Eliminate y .

$$5x - 7y = -2$$

$$-4x + 6y = 4$$

Multiply by 6.

$$30x - 42y = -12$$

Multiply by 7.

$$(+)\ -28x + 42y = 28$$

$$\underline{2x} = 16$$

$$\frac{2x}{2} = \frac{16}{2}$$

$$x = 8$$

Now substitute 8 for x in either equation to find the value of y .

$$5x - 7y = -2 \quad \text{First equation}$$

$$5(8) - 7y = -2 \quad x = 8$$

$$40 - 7y = -2 \quad \text{Simplify.}$$

$$40 - 7y - 40 = -2 - 40 \quad \text{Subtract 40 from each side.}$$

$$-7y = -42 \quad \text{Simplify.}$$

$$\frac{-7y}{-7} = \frac{-42}{-7} \quad \text{Divide each side by } -7.$$

$$y = 6 \quad \text{Simplify.}$$

The solution is $(8, 6)$, which matches the result obtained in Method 1.

Example 3 Determine the Best Method

Determine the best method to solve the system of equations. Then solve the system.

$$3x + 4y = 4$$

$$5x + 4y = 0$$

- For an exact solution, an algebraic method is best.
- Since neither the coefficients of x nor the coefficients of y are 1 or -1 , you cannot use the substitution method.
- Since the coefficients of y are the same, you can use elimination using subtraction.

The following solution uses elimination using subtraction.

$$3x + 4y = 4$$

Write the equations in column form and subtract.

$$(-)\ \underline{5x + 4y = 0}$$

$$-2x = 4$$

Notice that the variable y is eliminated.

$$\frac{-2x}{-2} = \frac{4}{-2}$$

Divide each side by -2 .

$$x = -2$$

Simplify.

$$3x + 4y = 4$$

First equation

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

$$x = -2$$

$$-6 + 4y = 4$$

Simplify.

$$-6 + 4y + 6 = 4 + 6$$

Add 6 to each side.

$$4y = 10$$

Simplify.

$$\frac{4y}{4} = \frac{10}{4}$$

Divide each side by 4.

$$y = \frac{5}{2}$$

Simplify.

The solution is $\left(-2, \frac{5}{2}\right)$.

Example 4 Write and Solve a System of Equations

A jet travels 2600 miles with the wind in 4 hours. The return trip into the wind took 5 hours. Find the rate of the jet with no wind.

Let j = the rate of the jet with no wind and w = the rate of the wind. Use the formula $\text{rate} \times \text{time} = \text{distance}$, or $rt = d$.

	r	t	d	$rt = d$
With the Wind	$j + w$	4	2600	$4j + 4w = 2600$
Into the Wind	$j - w$	5	2600	$5j - 5w = 2600$

This system cannot easily be solved using substitution. It cannot be solved by just adding or subtracting the equations. The best way to solve this system is to use elimination using multiplication. Since the problem asks for j , eliminate w .

$$\begin{array}{rcl}
 4j + 4w = 2600 & \text{Multiply by 5.} & 20j + 20w = 13000 \\
 5j - 5w = 2600 & \text{Multiply by 4.} & (+) 20j - 20w = 10400 \\
 & & \hline
 & & 40j \qquad = 23400 \\
 & & \frac{40j}{40} = \frac{23400}{40} \\
 & & j = 585
 \end{array}$$

The rate of the jet in no wind is 585 miles per hour.