

5-Minute Check

Over Lesson 6-2

- 3** Use substitution to solve the system of equations.

$$4x - y = 2$$

$$\frac{1}{4}y = x - \frac{1}{2}$$

$$\rightarrow 4\left(\frac{1}{4}y\right) = 4\left(x - \frac{1}{2}\right)$$

A. (1, 2)

$$y = 4x - 2$$

B. (2, 6)

$$4x - (4x - 2) = 2$$

$$4x - 4x + 2 = 2$$

C. infinitely many solutions

$$2 = 2 \text{ true}$$

D. no solution


**5-Minute Check**

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- B. (2, 6)
-  C. infinitely many solutions
- D. no solution

**5-Minute Check**

Over Lesson 6-2

- 4** The sum of two numbers is 31. The greater number is 5 more than the lesser number. What are the two numbers?
- A. 10, 15
 - B. 13, 18
 - C. 14, 19
 - D. 16, 21

 **5-Minute Check**

Over Lesson 6-2

4 The sum of two numbers is 31. The greater number is 5 more than the lesser number. What are the two numbers?

A. 10, 15

 B. 13, 18

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D. 16, 21

6-3 Elimination Using Addition and Subtraction

Key Concept Solving by Elimination

- Step 1** Write the system so like terms with the same or opposite coefficients are aligned.
- Step 2** Add or subtract the equations, eliminating one variable. Then solve the equation.
- Step 3** Substitute the value from Step 2 into one of the equations and solve for the other variable. Write the solution as an ordered pair.

EXAMPLE 1 Elimination Using Addition

Use elimination to solve the system of equations.

$$-3x + 4y = 12$$

$$3x - 6y = 18$$

Since the coefficients of the x -terms, -3 and 3 , are additive inverses, you can eliminate the x -terms by adding the equations.

$$-3x + 4y = 12$$

$$\begin{array}{r} (+)3x - 6y = 18 \\ \hline \end{array}$$

$$-2y = 30$$

$$\frac{-2y}{-2} = \frac{30}{-2}$$

$$y = -15$$

Write the equations in column form and add.

The x variable is eliminated.

Divide each side by -2 .

Simplify.

EXAMPLE 1

Elimination Using Addition

Now substitute -15 for y in either equation to find the value of x .

$$-3x + 4y = 12$$

First equation

$$-3x + 4(-15) = 12$$

Replace y with -15 .

$$-3x - 60 = 12$$

Simplify.

$$-3x - 60 + 60 = 12 + 60$$

Add 60 to each side.

$$-3x = 72$$

Simplify.

$$\frac{-3x}{-3} = \frac{72}{-3}$$

Divide each side by -3 .

$$x = -24$$

Simplify.

EXAMPLE 1 Elimination Using Addition

Now substitute -15 for y in either equation to find the value of x .

$$-3x + 4y = 12 \quad \text{First equation}$$

$$-3x + 4(-15) = 12 \quad \text{Replace } y \text{ with } -15.$$

$$-3x - 60 = 12 \quad \text{Simplify.}$$

$$-3x - 60 + 60 = 12 + 60 \quad \text{Add 60 to each side.}$$

$$-3x = 72 \quad \text{Simplify.}$$

$$\frac{-3x}{-3} = \frac{72}{-3} \quad \text{Divide each side by } -3.$$

$$x = -24 \quad \text{Simplify.}$$

Answer: The solution is $(-24, -15)$.

EXAMPLE 2 Write and Solve a System of Equations

Four times one number minus three times another number is 12. Two times the first number added to three times the second number is 6. Find the numbers.

Let x represent the first number and y represent the second number.

Four times one number	minus	three times another number	is	12.
$4x$	-	$3y$	=	12
Two times the first number	added to	three times the second number	is	6.
$2x$	+	$3y$	=	6

EXAMPLE 2**Check Your Progress**

Four times one number added to another number is -10 . Three times the first number minus the second number is -11 . Find the numbers.

- A. $-3, 2$
- B. $-5, -5$
- C. $-5, -6$
- D. $1, 1$

EXAMPLE 2



Check Your Progress

Four times one number added to another number is -10 . Three times the first number minus the second number is -11 . Find the numbers.

- A. $-3, 2$
- B. $-5, -5$
- C. $-5, -6$
- D. $1, 1$

EXAMPLE 3

Elimination Using Subtraction

Use elimination to solve the system of equations.

$$4x + 2y = 28$$

$$4x - 3y = 18$$

Since the coefficients of the x -terms are the same, you can eliminate the x -terms by subtracting the equations.

$$\begin{array}{r} 4x + 2y = 28 \\ (-) 4x - 3y = 18 \\ \hline \end{array}$$

$$5y = 10$$

$$\frac{5y}{5} = \frac{10}{5}$$

$$y = 2$$

Write the equations in column form and subtract.

The x variable is eliminated.

Divide each side by 5.

Simplify.

EXAMPLE 3 Elimination Using Subtraction

Now substitute 2 for y in either equation to find the value of x .

$$4x - 3y = 18$$

Second equation

$$4x - 3(2) = 18$$

$$y = 2$$

$$4x - 6 = 18$$

Simplify.

$$4x - 6 + 6 = 18 + 6$$

Add 6 to each side.

$$4x = 24$$

Simplify.

$$\frac{4x}{4} = \frac{24}{4}$$

Divide each side by 4.

$$x = 6$$

Simplify.

Answer: The solution is $(6, 2)$.

EXAMPLE 3**Check Your Progress**

Use elimination to solve the system of equations.

$$9x - 2y = 30$$

$$x - 2y = 14$$

- A. (2, 2)
- B. (-6, -6)
- C. (-6, 2)
- D. (2, -6)

EXAMPLE 3



Check Your Progress

Use elimination to solve the system of equations.

$$9x - 2y = 30$$

$$x - 2y = 14$$

- A. (2, 2)
- B. (-6, -6)
- C. (-6, 2)
- D. (2, -6)**

6. recycling and reuse, 1,150,000; waste management, 125,000

Check Your Understanding

 = Step-by-Step Solutions begin on page R13.



Examples 1, 3 Use elimination to solve each system of equations.

1. $5m - p = 7$

$7m - p = 11$ (2, 3)

3 $7f + 3g = -6$

$7f - 2g = -31$ (-3, 5)

2. $8x + 5y = 38$

$-8x + 2y = 4$ (1, 6)

4. $6a - 3b = 27$

$2a - 3b = 11$ (4, -1)

Example 2

5. **CCSS REASONING** The sum of two numbers is 24. Five times the first number minus the second number is 12. What are the two numbers? **6, 18**

Example 4

6. **RECYCLING** The recycling and reuse industry employs approximately 1,025,000 more workers than the waste management industry. Together they provide 1,275,000 jobs. How many jobs does each industry provide?

* objective
 ① choose a variable
 ② Make them

opposites (additive)

③ eliminate the variable, solve for the other!

④ etc. ...

②
$$\begin{array}{r} 8x + 5y = 38 \\ -8x + 2y = 4 \end{array}$$

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

$$\begin{array}{r} 7y = 42 \\ \hline 7 \quad 7 \\ \hline y = 6 \end{array}$$

6. recycling and reuse, 1,150,000; waste management, 125,000

Check Your Understanding



= Step-by-Step Solutions begin on page R13.



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1. $5m - p = 7$

$7m - p = 11$ (2, 3)

2. $8x + 5y = 38$

$-8x + 2y = 4$ (1, 6)

3. $7f + 3g = -6$

$7f - 2g = -31$ (-3, 5)

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Example 2

5. **CCSS REASONING** The sum of two numbers is 24. Five times the first number minus the second number is 12. What are the two numbers? **6, 18**

Example 4

6. **RECYCLING** The recycling and reuse industry employs approximately 1,025,000 more workers than the waste management industry. Together they provide 1,275,000 jobs. How many jobs does each industry provide?

Handwritten solution for Example 4:

$$\begin{array}{r} \textcircled{1} \quad \begin{array}{l} 5m - p = 7 \\ 7m - p = 11 \end{array} \Rightarrow \begin{array}{l} 5m - p = 7 \\ -7m + p = -11 \end{array} \\ \hline \begin{array}{l} 5(2) - p = 7 \\ 10 - p = 7 \end{array} \Rightarrow \begin{array}{l} -2m = -4 \\ \hline -2 \end{array} \\ \hline \begin{array}{l} p = 3 \\ m = 2 \end{array} \end{array}$$

Check Your Understanding



= Step-by-Step Solutions begin on page R13.



Examples 1, 3 Use elimination to solve each system of equations.

1. $5m - p = 7$

$7m - p = 11$ (2, 3)

2. $8x + 5y = 38$

$-8x + 2y = 4$ (1, 6)

3. $7f + 3g = -6$

$7f - 2g = -31$ (-3, 5)

4. $6a - 3b = 27$

$2a - 3b = 11$ (4, -1)

Handwritten solution for Example 3:

$$\begin{array}{r} \textcircled{3} \quad 7f + 3g = -6 \\ 7f - 2g = -31 \\ \hline + 5g = 25 \end{array}$$

$\times (-1)$

$$\begin{array}{r} 7f + 3g = -6 \\ -7f + 2g = 31 \\ \hline 5g = 25 \end{array}$$

$\div 5$

$$g = 5$$

\uparrow

$$7f - 2(5) = -31$$

$$7f - 10 = -31$$

$$\begin{array}{r} 7f - 10 = -31 \\ +10 \quad +10 \\ \hline 7f = -21 \\ \hline f = -3 \end{array}$$

\circlearrowleft

$f = -3$

$g = 5$

Example 2

5. **CCSS REASONING** The sum of two numbers is 24. Five times the first number minus the second number is 12. What are the two numbers? **6, 18**

Example 4

6. **RECYCLING** The recycling and reuse industry employs approximately 1,025,000 more workers than the waste management industry. Together they provide 1,275,000 jobs. How many jobs does each industry provide?

5

$$\begin{array}{r} x + y = 24 \\ 5x - y = 12 \\ \hline 6x = 36 \\ x = 6 \end{array}$$

$$\begin{array}{l} 6 + y = 24 \\ y = 18 \end{array}$$

Example 4

6. **RECYCLING** The recycling and reuse industry employs approximately 1,025,000 more workers than the waste management industry. Together they provide 1,275,000 jobs. How many jobs does each industry provide?

$$\begin{aligned} x &= r + r \text{ ind.} \\ y &= w m \text{ ind.} \end{aligned}$$

$$\begin{aligned} x &= \frac{y + 1,025,000}{1} \\ x + y &= 1,275,000 \end{aligned}$$

then solve 😊

Examples 1, 3 Use elimination to solve each system of equations.

7. $-v + w = 7$

$v + w = 1$ **(-3, 4)**

10. $5m - 2p = 24$

$3m + 2p = 24$ **(6, 3)**

13. $6c - 9d = 111$

$5c - 9d = 103$ **(8, -7)**

16. $3j + 4k = 23.5$

$8j - 4k = 4$ **(2.5, 4)**

8. $y + z = 4$

$y - z = 8$ **(6, -2)**

11. $a + 4b = -4$

$a + 10b = -16$ **(4, -2)**

14. $11f + 14g = 13$

$11f + 10g = 25$ **(5, -3)**

17. $-3x - 8y = -24$

$3x - 5y = 4.5$ **(4, 1.5)**

9. $-4x + 5y = 17$

$4x + 6y = -6$ **(-3, 1)**

12. $6r - 6t = 6$

$3r - 6t = 15$ **(-3, -4)**

15. $9x + 6y = 78$

$3x - 6y = -30$ **(4, 7)**

18. $6x - 2y = 1$

$10x - 2y = 5$ **(1, 2.5)**

17

$$\begin{array}{r} -3x - 8y = -24 \\ 3x - 5y = 4.5 \\ \hline -13y = -19.5 \\ \hline -13 \end{array}$$

$$y = \frac{-19.5}{-13} = \frac{19.5}{13} = \frac{195}{130} = 1\frac{65}{130} = 1\frac{1}{2}$$

Example 2

19. The sum of two numbers is 22, and their difference is 12. What are the numbers? 5, 17

20. Find the two numbers with a sum of 41 and a difference of 9. 25, 16

21. Three times a number minus another number is -3. The sum of the numbers is 11. Find the numbers. 2, 9

22. A number minus twice another number is 4. Three times the first number plus two times the second number is 12. What are the numbers? 4, 0

22 $x - 2y = 4$

$3x + 2y = 12$

19

$$\begin{array}{r} x + y = 22 \\ x - y = 12 \\ \hline 2x = 34 \\ \hline x = 17 \end{array}$$

20

$$\begin{array}{r} x + y = 41 \\ x - y = 9 \\ \hline 2x = 50 \\ \hline x = 25 \end{array}$$

21

$$\begin{array}{r} 3x - y = -3 \\ x + y = 11 \\ \hline 4x = 8 \\ \hline x = 2 \end{array}$$

