✓ 5-Minute Check   Over Lesson 6–3

x y

additive inverse

4 **Find two numbers that have a sum of 151 and a difference of 7.**

A. 67, 84

B. 69, 82

C. 71, 80

D. 72, 79

$x + y = 151. \rightarrow 79 + y = 151$

$x - y = 7$

$-79 \qquad -79$

$\dfrac{2x}{2} \quad \dfrac{=158}{2}$

$y = 72$

$x = 79.$

✓ **5-Minute Check**   Over Lesson 6–3

4 Find two numbers that have a sum of 151 and a difference of 7.

    A.   67, 84

    B.   69, 82

    C.   71, 80

→   D.   72, 79

KeyConcept Solving by Elimination

Step 1 Multiply at least one equation by a constant to get two equations that contain opposite terms.

Step 2 Add 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 **Multiply One Equation to Eliminate a Variable**

Use elimination to solve the system of equations.
$$2x + y = 23$$
$$3x + 2y = 37$$

Multiply the first equation by –2 so the coefficients of the y terms are additive inverses. Then add the equations.

$$2x + y = 23 \longrightarrow -4x - 2y = -46 \quad \text{Multiply by } -2.$$

$$3x + 2y = 37 \quad \underline{(+) \; 3x + 2y = \quad 37}$$

$$-x \qquad = \; -9 \qquad \text{Add the equations.}$$

$$\frac{-x}{-1} = \frac{-9}{-1} \qquad \text{Divide each side by } -1.$$

$$x = 9 \qquad \text{Simplify.}$$

EXAMPLE 1 **Multiply One Equation to Eliminate a Variable**

Now substitute 9 for x in either equation to find the value of y.

$2x + y = 23$	First equation
$2(9) + y = 23$	$x = 9$
$18 + y = 23$	Simplify.
$18 + y - 18 = 23 - 18$	Subtract 18 from each side.
$y = 5$	Simplify.

Answer: The solution is $(9, 5)$.

EXAMPLE 1 ✓ Check Your Progress

Use elimination to solve the system of equations.

$x + 7y = 12$

$3x - 5y = 10$

A. (1, 5)

B. (5, 1)

C. (5, 5)

D. (1, 1)

EXAMPLE 1 ✓ **Check Your Progress**

Use elimination to solve the system of equations.
$x + 7y = 12$
$3x - 5y = 10$

A. (1, 5)

B. (5, 1)

C. (5, 5)

D. (1, 1)

EXAMPLE 2 **Multiply Both Equations to Eliminate a Variable**

Use elimination to solve the system of equations.
$$4x + 3y = 8$$
$$3x - 5y = -23$$

Method 1 Eliminate x.

$4x + 3y = 8$ $\longrightarrow$ $12x + 9y = 24$ Multiply by 3.

$3x - 5y = -23$ $\longrightarrow$ $(+)-12x + 20y = 92$ Multiply by -4.

ccm?

12

EXAMPLE 2 **Multiply Both Equations to Eliminate a Variable**

Now substitute 4 for y in either equation to find x.

$4x + 3y = 8$	First equation
$4x + 3(4) = 8$	$y = 4$
$4x + 12 = 8$	Simplify.
$4x + 12 - 12 = 8 - 12$	Subtract 12 from each side.
$4x = -4$	Simplify.
$\dfrac{4x}{4} = \dfrac{-4}{4}$	Divide each side by 4.
$x = -1$	Simplify.

Answer: The solution is $(-1, 4)$.

EXAMPLE 2 **Multiply Both Equations to Eliminate a Variable**

Method 2 Eliminate y.

$4x + 3y = 8$ → $20x + 15y = 40$ Multiply by 5.

$3x - 5y = -23$ → (+) $9x - 15y = -69$ Multiply by 3.

LCM?

15

Now substitute −1

EXAMPLE 2 **Multiply Both Equations to Eliminate a Variable**

$4x + 3y = 8$	First equation
$4(-1) + 3y = 8$	$x = -1$
$-4 + 3y = 8$	Simplify.
$-4 + 3y + 4 = 8 + 4$	Add 4 to each side.
$3y = 12$	Simplify.
$\dfrac{3y}{3} = \dfrac{12}{3}$	Divide each side by 3.
$y = 4$	Simplify.

Answer: The solution is $(-1, 4)$, which matches the result obtained with Method 1.

EXAMPLE 2 ✔ **Check Your Progress**

Use elimination to solve the system of equations.
$3x + 2y = 10$
$2x + 5y = 3$

A. $(-4, 1)$

B. $(-1, 4)$

C. $(4, -1)$

D. $(-4, -1)$

EXAMPLE 2   ✓ **Check Your Progress**

Use elimination to solve the system of equations.
$3x + 2y = 10$
$2x + 5y = 3$

A. (–4, 1)

B. (–1, 4)

C. (4, –1)

D. (–4, –1)

Examples 1–2 Use elimination to solve each system of equations.

1. $2x - y = 4$
$7x + 3y = 27$ **(3, 2)**

2. $2x + 7y = 1$
$x + 5y = 2$ **(−3, 1)**

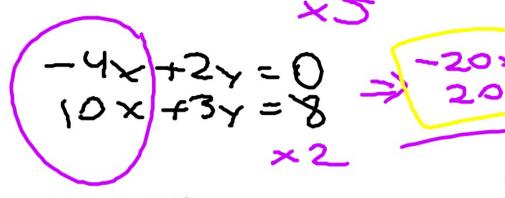**3** $4x + 2y = -14$
$5x + 3y = -17$ **(−4, 1)**

4. $9a - 2b = -8$
$-7a + 3b = 12$ **(0, 4)**

$$\boxed{3}$$

$$4x + 2y = -14 \quad \times 3 \quad = \quad -12x - 6y = 42$$
$$5x + 3y = -17 \quad = \quad 10x + 6y = -34$$
$$\times 2$$

$$LCM$$
$$6$$

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

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

$$4(-4) + 2y = -14$$
$$-16 + 2y = -14$$
$$+16 \qquad +16$$
$$\frac{2y}{2} = \frac{2}{2}$$

$$\boxed{y = 1}$$

$\times 5$

$$-4x + 2y = 0$$
$$10x + 3y = 8$$

$-20x + 10y = 0$
$20x + 6y = 16$

$\times 2$

$16y = 16$

LCM:20

$y = 1$

18. $-4x + 2y = 0$
$10x + 3y = 8$ $\left(\frac{1}{2}, 1\right)$

t.

Examples 1–2 Use elimination to solve each system of equations.

7. $x + y = 2$
$-3x + 4y = 15$ **(−1, 3)**

9. $x + 5y = 17$
$-4x + 3y = 24$ **(−3, 4)**

11. $2x + 5y = 11$
$4x + 3y = 1$ **(−2, 3)**

13. $3x + 4y = 29$
$6x + 5y = 43$ **(3, 5)**

15. $8x + 3y = -7$
$7x + 2y = -3$ **(1, −5)**

17. $12x - 3y = -3$
$6x + y = 1$ **(0, 1)**

Example 3 **(19)** **NUMBER THEORY** Seven times a number plus three times another number equals negative one. The sum of the two numbers is negative three. What are the numbers? **2, −5**

Handwritten work:

(7) ×3

$x + y = 2$
$-3x + 4y = 15$

$x + 3 = 2$
$-3 \quad -3$

$x = -1$

$3x + 3y = 6$
$-3x + 4y = 15$
—————————
$7y = 21$

$\dfrac{7y}{7} = \dfrac{21}{7}$

$y = 3$

Use elimination to solve each system of equations.

7. $x + y = 2$
$-3x + 4y = 15$ **(−1, 3)**

9. $x + 5y = 17$
$-4x + 3y = 24$ **(−3, 4)**

11. $2x + 5y = 11$
$4x + 3y = 1$ **(−2, 3)**

13. $3x + 4y = 29$
$6x + 5y = 43$ **(3, 5)**

15. $8x + 3y = -7$
$7x + 2y = -3$ **(1, −5)**

17. $12x - 3y = -3$
$6x + y = 1$ **(0, 1)**

Example 3

19 **NUMBER THEORY** Seven times a number plus three times another number equals negative one. The sum of the two numbers is negative three. What are the numbers? **2, −5**

20. FOOTBALL A field goal is 3 points and the extra point after a touchdown is 1 point. In a recent post-season, Adam Vinatieri of the Indianapolis Colts made a total of 21 field goals and extra point kicks for 49 points. Find the number of field goals and extra points that he made. **14 field goals; 7 extra points**

Handwritten work:

9)

$x + 5y = 17$ ×4

$-4x + 3y = 24$

$4x + 20y = 68$

$-4x + 3y = 24$

$23y = 92$

$\dfrac{23y}{23} = \dfrac{92}{23}$ $y = 4$

$x = -3$

Examples 1–2 Use elimination to solve each system of equations.

7. $x + y = 2$
   $-3x + 4y = 15$ **(−1, 3)**

9. $x + 5y = 17$
   $-4x + 3y = 24$ **(−3, 4)**

11. $2x + 5y = 11$
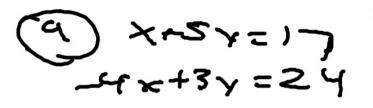 $4x + 3y = 1$ **(−2, 3)**
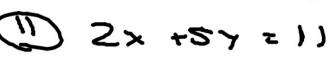
13. $3x + 4y = 29$
    $6x + 5y = 43$ **(3, 5)**

15. $8x + 3y = -7$
    $7x + 2y = -3$ **(1, −5)**

17. $12x - 3y = -3$
    $6x + y = 1$ **(0, 1)**

Handwritten work:

x^{-2}

⓫ $2x + 5y = 11$

$4x + 3y = 1$

___

$-4x - 10y = -22$
$4x + 3y = 1$
___
$-7y = -21$ over -7
$y = 3$

Example 3 ⑲ **NUMBER THEORY** Seven times a number plus three times another number equals negative one. The sum of the two numbers is negative three. What are the numbers? **2, −5**

20. **FOOTBALL** A field goal is 3 points and the extra point after a touchdown is 1 point. In a recent post-season, Adam Vinatieri of the Indianapolis Colts made a total of 21 field goals and extra point kicks for 49 points. Find the number of field goals and extra points that he made. **14 field goals; 7 extra points**