

1-7 Logical Reasoning (Pages 37-42)

The statement *If it is raining outside, then I will wear my raincoat* is called a conditional statement. All **conditional statements** can be written in the form *If A, then B*. Statements of this form are known as **if-then statements**. *A*, the portion of the statement immediately following *if*, is called the **hypothesis**. *B*, the portion of the statement immediately following *then*, is called the **conclusion**.

The process of using definitions, rules, properties, or facts as a means of validating conditional statements is **deductive reasoning**. If a true conditional exists, with a known true hypothesis, then deductive reasoning permits the reader to acknowledge that the conclusion is true for the scenario. A counterexample can be used to show that a conditional is not correct. A **counterexample** is a specific situation in which a statement is false. Only one counterexample is necessary to show that a statement is incorrect.

Examples

a. Identify the hypothesis and the conclusion.

If $3a + 12 = 24$, then $a = 4$.
 Hypothesis: $3a + 12 = 24$
 Conclusion: $a = 4$

b. Write the conditional in if-then form.

I will attend the school play on Friday.
 Hypothesis: *It is Friday*
 Conclusion: *I will attend the school play*
 If it is Friday, then I will attend the school play.

Try These Together

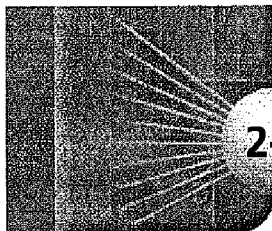
Identify the hypothesis and the conclusion. Write in if-then form.

1. I will earn an A for a score of 90% or higher.
2. Tom will play inside when the weather is bad.

Practice

Use deductive reasoning to verify whether each conditional is *true* or *false*. If it is false, provide a counterexample.

3. If there is a rainbow, then it must have rained while the Sun was shining.
4. If the flowers are wet, then it rained.
5. **Standardized Test Practice** Which numbers are counterexamples for the conditional statement.
If $x \cdot y = 60$, then x and y are positive numbers.
A $x = 10, y = 6$ **B** $x = 3, y = 20$ **C** $x = -2, y = -30$ **D** $x = 1, y = 60$



2-3 Multiplying Rational Numbers (Pages 79–83)

The product of two numbers having the *same sign* is positive. The product of two numbers having *different signs* is negative. It is also useful to note that multiplying a number or expression by -1 results in the opposite of the number or expression. This is called the **multiplicative property of -1** .

Examples

a. Evaluate $-3x^2$ for $x = -\frac{2}{3}$.

$$\begin{aligned} -3x^2 &= -3\left(-\frac{2}{3}\right)^2 && \text{Replace } x \text{ with } -\frac{2}{3}. \\ &= -3\left(\frac{4}{9}\right) && \left(-\frac{2}{3}\right)^2 = -\frac{2}{3} \cdot \left(-\frac{2}{3}\right) \text{ or } \frac{4}{9} \\ &= -\frac{12}{9} && \text{Divide out common factors.} \\ &= -\frac{4}{3} \text{ or } -1\frac{1}{3} && \text{Multiply. The signs are different,} \\ &&& \text{so the product is negative.} \end{aligned}$$

b. Simplify $(-1)(2x)(-3y) + (4x)(-5y)$

$$\begin{aligned} &(-1)(2x)(-3y) + (4x)(-5y) \\ &= 2x(-1)(-3y) + (4x)(-5y) && \text{Commutative Property} \\ &= 2x(3y) + (-20xy) && \text{Multiply.} \\ &= 6xy + (-20xy) && \text{Multiply.} \\ &= -14xy && \text{Combine like terms.} \end{aligned}$$

Practice

Find each product.

- | | | | |
|---|--|---|--|
| 1. $(-2)(3)(-5)$ | 2. $5.26(-0.011)$ | 3. $-10.01(-10.11)$ | 4. $2\left(\frac{3}{5}\right)\left(-\frac{5}{7}\right)$ |
| 5. $\left(-\frac{8}{11}\right)\left(\frac{9}{10}\right)$ | 6. $\left(-\frac{7}{10}\right)\left(-\frac{13}{21}\right)$ | 7. $\left(-\frac{8}{13}\right)(0)\left(-\frac{4}{5}\right)$ | 8. $3\left(\frac{4}{9}\right)(-4)\left(\frac{6}{7}\right)$ |
| 9. $\left(-\frac{2}{5}\right)(-4)\left(-\frac{3}{8}\right)$ | 10. $5\left(\frac{3}{4}\right)(-4)(-2)$ | 11. $8(-0.25)(-3)$ | 12. $\frac{2}{7}(-21)(13)\left(\frac{1}{14}\right)$ |

Evaluate each expression if $r = -\frac{1}{8}$, $s = \frac{4}{5}$, $t = -2\frac{9}{10}$, and $w = -1\frac{2}{9}$.

- | | | | |
|-----------|-----------|--------------|------------------------------------|
| 13. $4rs$ | 14. $2tw$ | 15. $rt - s$ | 16. $s^2\left(-\frac{1}{8}\right)$ |
|-----------|-----------|--------------|------------------------------------|

Simplify.

- | | |
|--|-----------------------------------|
| 17. $2m\left(-\frac{1}{3}n\right) + 3m(-2n)$ | 18. $1.2(3x + y) - 0.8(22x - 2y)$ |
|--|-----------------------------------|

19. **Standardized Test Practice** The velocity of an object t seconds after the object is dropped from the top of a tall building is about $-9.8t$ meters per second (m/s). What is its velocity 2.5 seconds after it is dropped?

- A -24.5 m/s B -7.3 m/s C 7.3 m/s D 18.4 m/s

2-4

Dividing Rational Numbers (Pages 84–87)

You can use the same rules of signs when dividing rational numbers that you used for multiplying.

Dividing Two Rational Numbers	The quotient of two numbers having the <i>same sign</i> is positive. The quotient of two numbers having <i>different signs</i> is negative.
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If a fraction has one or more fractions in the numerator or denominator, it is a **complex fraction**. To simplify a complex fraction, rewrite it as a division expression.

Examples

a. Simplify $\frac{\frac{4}{7}}{-8}$.

Rewrite the complex fraction as $\frac{4}{7} \div (-8)$.

$$\begin{aligned} \frac{4}{7} \div (-8) &= \frac{4}{7} \cdot \left(-\frac{1}{8}\right) && \text{Multiply by } -\frac{1}{8}, \text{ the} \\ & && \text{reciprocal of } -8. \\ &= -\frac{4}{56} \text{ or } -\frac{1}{14} && \text{The signs are different,} \\ & && \text{so the product is} \\ & && \text{negative.} \end{aligned}$$

b. Simplify $\frac{-2x + 10y}{5}$.

$$\begin{aligned} \frac{-2x + 10y}{5} &= \frac{-2x}{5} + \frac{10y}{5} && \text{Divide each term by 5.} \\ &= -\frac{2}{5}x + 2y && \text{Simplify.} \end{aligned}$$

Practice

Simplify.

1. $22 \div \left(\frac{11}{13}\right)$

2. $24 \div \left(-\frac{1}{8}\right)$

3. $\frac{-14}{-2}$

4. $\frac{\frac{15}{-64}}{3}$

5. $\frac{-\frac{30}{7}}{-10}$

6. $\frac{8}{-\frac{4}{9}}$

7. $\frac{-32m}{8}$

8. $-18t \div \frac{8}{9}$

9. $\frac{2a + 8}{4}$

10. $\frac{8x + 42y}{6}$

11. $\frac{-12h + (-18g)}{3}$

12. $\frac{54s + 3w}{-6}$

Evaluate each expression if $x = 4$, $y = -5$, and $z = -1.5$.

13. $\frac{y}{z}$

14. $\frac{xy}{xz}$

15. $\frac{x + z}{3}$

16. **Standardized Test Practice** How many boxes of peanuts can you get from

52 pounds of peanuts if each box holds $1\frac{5}{8}$ pounds of peanuts?

A 84

B 32

C 26

D 50

3-5

Solving Equations with the Variable on Each Side

(Pages 149–154)

To solve an equation that has the variable on both sides, use the properties of equality to write an equivalent equation that has the variable on only one side. Then solve. When you solve equations that contain grouping symbols, you may need to use the distributive property to remove the grouping symbols. Some equations may have no solution because there is no value of the variable that will result in a true equation. For example, $x + 1 = x + 2$ has no solution; it cannot be true. An equation that is true for every value of the variable is called an **identity**. For example, $x + x = 2x$ is true for every value of x .

Examples

a. Solve $3(x - 2) = 4x + 5$.

First use the distributive property to remove the parentheses.

$$3x - 6 = 4x + 5$$

Next, collect all the terms with x on one side of the equal sign by subtracting $3x$ from each side.

$$3x - 6 - 3x = 4x + 5 - 3x$$

$$-6 = x + 5$$

Add like terms.

$$-6 - 5 = x + 5 - 5$$

Subtract 5 from each side.

$$-11 = x$$

Simplify.

b. Solve $\frac{1}{2}y = \frac{1}{3}y + 2$.

First, multiply each side by 6, the LCD, to clear the fractions from the problem.

$$6 \cdot \frac{1}{2}y = 6\left(\frac{1}{3}y + 2\right)$$

$$6 \cdot \frac{1}{2}y = 6 \cdot \frac{1}{3}y + 6 \cdot 2$$

$$3y = 2y + 12$$

Next, collect all the terms with y on one side of the equal sign by subtracting $2y$ from each side.

$$3y - 2y = 2y - 2y + 12$$

$$y = 12$$

Try These Together

1. Solve $4x + 3 = 5x + 7$.

HINT: Subtract $4x$ from each side.

2. Solve $7 + 3t = \frac{6-t}{2}$.

HINT: Multiply each side by 2.

Practice

Solve each equation. Then check your solution.

3. $18 + 2n = 4n - 9$

4. $10 - 2.7y = y + 9$

5. $\frac{2}{3}n + 6 = \frac{1}{4}n - 3$

6. $11.1c - 2.4 = -8.3c + 6.4$

7. $3 - 4x = 8x + 8$

8. $\frac{3}{5}d + 5 = \frac{1}{3}d - 3$

9. $3(2x - 1) = 9(x + 3)$

10. $2(2x - 5) = 6x + 4$

11. $-6(4x + 1) = 5 - 11x$

12. $\frac{5}{6}(12p + 4) = -13p + 4$

13. $-8\left(\frac{1}{4}n - 3\right) = n + 2$

14. $\frac{2+t}{3} = 4 - \frac{6}{7}t$

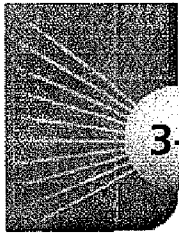
15. **Standardized Test Practice** Nine less than half n is equal to one plus the product of $-\frac{1}{8}$ and n . Find the value of n .

A 24

B -21

C 8

D 16



3-4 Solving Multi-Step Equations (Pages 142-148)

Solving Multi-Step Equations	<ul style="list-style-type: none"> • Work backward to isolate the variable and solve the equation. • Use subtraction to undo addition, and use addition to undo subtraction. • Use multiplication to undo division, and use division to undo multiplication.
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Consecutive integers are integers in counting order, such as -3 , -2 , and -1 .

Examples

a. Solve $\frac{2x - 3}{4} = 9$.

Multiply each side by 4 to eliminate the fraction.

$$4\left(\frac{2x - 3}{4}\right) = 9(4)$$

$$2x - 3 = 36$$

Next, undo the subtraction by adding 3 to each side.

$$2x - 3 + 3 = 36 + 3$$

$$2x = 39$$

Last, undo the multiplication by dividing each side by 2.

$$\frac{2x}{2} = \frac{39}{2}$$

$$x = 19\frac{1}{2}$$

b. Find 3 consecutive odd integers whose sum is -3 .

Let n = the least odd integer. Then $n + 2$ = the next greater odd integer, and $n + 4$ = the greatest of the three odd integers.

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

$$3n + 6 = -3$$

Add like items.

$$3n + 6 - 6 = -3 - 6$$

Subtract 6 from each side.

$$3n = -9$$

Simplify.

$$\frac{3n}{3} = \frac{-9}{3}$$

Divide each side by 3.

$$n = -3$$

Simplify.

$n + 2 = -3 + 2$ or -1 and $n + 4 = -3 + 4$ or 1 , so the consecutive odd integers are -3 , -1 , and 1 .

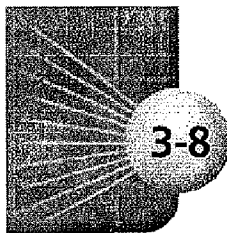
Practice

Solve each equation. Check your solution.

- | | | | |
|-----------------------------|-----------------------------|------------------------------|------------------------------|
| 1. $10 - 7p = -18$ | 2. $-1.9r + 9.3 = 15$ | 3. $6 = \frac{s}{3}$ | 4. $\frac{-4m - 3}{-6} = -9$ |
| 5. $-6 = \frac{-2n - 3}{4}$ | 6. $\frac{t}{5} - 4 = -10$ | 7. $11 = -7 - \frac{g}{3}$ | 8. $\frac{5}{6}b + 8 = -11$ |
| 9. $13 = -8 - 3t$ | 10. $-\frac{3 + n}{7} = -5$ | 11. $\frac{s + 4}{-2} = -16$ | 12. $3 - 9t = 21$ |

Define a variable, write an equation, and solve each problem.

13. Find two consecutive odd integers whose sum is 128.
14. Find three consecutive even integers whose sum is 90.
15. **Standardized Test Practice** Sally is eight years older than John. John is fourteen years older than Kareem. If the sum of all three ages is 90, how old is Kareem?
- A 8 B 18 C 28 D 40



3-8 Solving Equations and Formulas

(Pages 166–170)

Some equations contain more than one variable. To solve an equation or formula for a specific variable, you need to get that variable by itself on one side of the equation. When you divide by a variable in an equation, remember that division by 0 is undefined.

When you use a formula, you may need to use **dimensional analysis**, which is the process of carrying units throughout a computation.

Examples

- a. Solve the formula $d = rt$ for t .**

The variable t has been multiplied by r , so divide each side by r to isolate t .

$$\frac{d}{r} = \frac{rt}{r} \text{ or } \frac{d}{r} = t$$

Thus $t = \frac{d}{r}$, where $r \neq 0$.

- b. Find the time it takes to drive 75 miles at an average rate of 35 miles per hour.**

Use the formula you found for t in Example A.

$$t = \frac{d}{r}$$

$$t = \frac{75 \text{ mi}}{35 \frac{\text{mi}}{\text{h}}}$$

Use dimensional analysis.

$$\frac{\text{mi}}{\text{mi}} = \frac{\text{mi}}{1} \cdot \frac{\text{h}}{\text{mi}} = \text{h}$$

$$t = 2\frac{1}{7} \text{ hours}$$

Try These Together

1. Solve $4a + b = 3a$ for a .

HINT: Begin by subtracting $3a$ from each side.

2. Solve $\frac{c+d}{3} = 2c$ for c .

HINT: Begin by multiplying each side by 3.

Practice

Solve each equation for the variable specified.

3. $f = epd$, for e

4. $12g + 31h = -8g$, for h

5. $y = mx + b$, for b

6. $v = r + at$, for r

7. $\frac{3x+y}{c} = 4$, for c

8. $\frac{5xy+n}{2} = -6$, for y

9. $m + n + 2p = 3$, for m

10. $6y + z = bc - 2y$, for y

11. $3x - 4y = 7$, for y

12. $s = \frac{n}{2}(a + t)$, for n

13. $v = \frac{4}{3}r$, for r

14. $W = mgh$, for g

15. $PV = nRT$, for V

16. $G = F - D$, for D

17. $6t + 62s = \frac{1}{2}(3t - 42s)$, for t

18. $3c + 5d = 7d - 6c$, for d

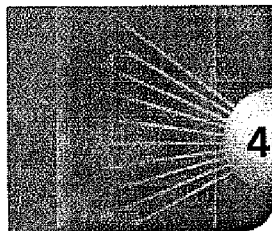
19. **Standardized Test Practice** Four ninths of a number c increased by 4 is 18 less than one eighth times another number d . Solve for c .

A $c = \frac{9}{32}d + 31\frac{1}{2}$

B $c = \frac{4}{72}d + \frac{4}{72}$

C $c = \frac{9}{32}d - 49\frac{1}{2}$

D $c = \frac{4}{72}d - 31\frac{1}{2}$



4-5

Graphing Linear Equations (Pages 218–223)

A **linear equation** may contain one or two variables with no variable having an exponent other than 1. A linear equation can be written in the form $Ax + By = C$, where A , B , and C are any real numbers, and A and B are not both zero. To graph a linear equation, find at least two solutions of the equation. Then, plot the points and draw a straight line through them.

Examples

- a. Determine whether the equation $y = 2x - 1$ is a linear equation. If it is, rewrite the equation in the form $Ax + By = C$.**

This is a linear equation, since the equation contains only two variables and the power on each variable is 1. First, rewrite the equation so that both variables are on the same side of the equation.

$$y = 2x - 1$$

$$-2x + y = -1 \quad \text{Subtract } 2x \text{ from each side.}$$

The equation is now in the form $Ax + By = C$, where $A = -2$, $B = 1$, and $C = -1$.

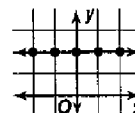
- b. Graph the equation $y = 2$.**

Select five values for the domain and make a table.

x	y	(x, y)
-2	2	(-2, 2)
-1	2	(-1, 2)
0	2	(0, 2)
1	2	(1, 2)
2	2	(2, 2)

Note that because the equation does not contain the variable x , x can be any value and the y value will still be 2.

Then graph the ordered pairs and connect them to draw the line. Note that the graph of $y = 2$ is a horizontal line through $(0, 2)$.



Try These Together

- Rewrite the equation $x = 3$ in the form $Ax + By = C$.
HINT: Since there is no variable y in this equation, use the placeholder $0y$.
- Graph the equation $3x - y = 5$.
HINT: To find values for y more easily, solve the equation for y . Subtract $3x$ from each side and then divide each side by -1 .

Practice

Determine whether each equation is a linear equation. If an equation is linear, rewrite it in the form $Ax + By = C$.

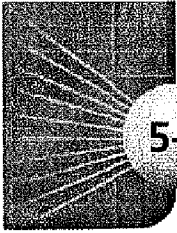
- | | | |
|-------------------|------------------|----------------|
| 3. $y = 2x^2 - 3$ | 4. $x = 2y + 8$ | 5. $y = -1$ |
| 6. $y = -4x + 1$ | 7. $3x = 5y + 7$ | 8. $8 - y = x$ |

Graph each equation.

- | | | |
|-----------------|------------------|------------------|
| 9. $y = x + 4$ | 10. $y = 3x - 1$ | 11. $y = 3 - 2x$ |
| 12. $y - 3 = 0$ | 13. $y + 5 = 0$ | 14. $x - 2 = 0$ |
| 15. $x - y = 6$ | 16. $x + y = 15$ | 17. $2x + y = 4$ |

18. **Standardized Test Practice** Write the equation $y = 2x - 8$ in the standard form $Ax + By = C$.

- A** $y + 2x = -8$ **B** $y - 2x = -8$ **C** $-2x + y = -8$ **D** $2x + y = -8$



5-3 Slope-Intercept Form (Pages 272–277)

The coordinates at which a graph intersects the axes are known as the **x-intercept** and the **y-intercept**.

Finding Intercepts	To find the x-intercept, substitute 0 for y in the equation and solve for x. To find the y-intercept, substitute 0 for x in the equation and solve for y.
Slope-Intercept Form of a Linear Equation	If a line has a slope of m and a y-intercept of b , then the slope-intercept form of an equation of the line is $y = mx + b$.

Example

Find the x- and y-intercepts of the graph of $2x + 3y = 5$. Then, write the equation in slope-intercept form.

$$2x + 3(0) = 5 \quad \text{Let } y = 0. \qquad 2(0) + 3y = 5 \quad \text{Let } x = 0.$$

$$2x = 5 \quad \text{Simplify.} \qquad 3y = 5 \quad \text{Simplify.}$$

$$x = \frac{5}{2} \quad \text{The x-intercept is } \frac{5}{2}. \qquad y = \frac{5}{3} \quad \text{The y-intercept is } \frac{5}{3}.$$

Slope-Intercept Form: $2x + 3y = 5$

$$3y = -2x + 5 \quad \text{Subtract } 2x \text{ from each side.}$$

$$y = -\frac{2}{3}x + \frac{5}{3} \quad \text{Divide each side by 3.}$$

Note that in this form we can see that the slope m of the line is $-\frac{2}{3}$, and the y-intercept b is $\frac{5}{3}$.

Practice

Find the x- and y-intercepts of the graph of each equation.

1. $6x + 2y = 10$ 2. $6x - y = -7$ 3. $8y - 5 = 3x$

Write an equation in slope-intercept form of a line with the given slope and y-intercept. Then write the equation in standard form.

4. $m = 5, b = 5$ 5. $m = 2, b = -7$ 6. $m = -3, b = 0$

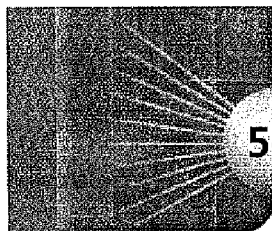
Find the slope and y-intercept of the graph of each equation.

7. $7y = x - 10$ 8. $8x - \frac{1}{2}y = -2$ 9. $4(x - 5y) = 9(x + 1)$

10. Chemistry The graph of an equation to convert degrees Celsius, x , to degrees Fahrenheit, y , has a y-intercept of 32° . Given that water boils at 212°F and at 100°C , write the conversion equation.

11. Standardized Test Practice What is the slope-intercept form of an equation for the line that passes through $(0, 1)$ and $(3, 37)$?

- A $y = 12x - 1$ B $y = 12x + 1$ C $y = -12x - 1$ D $y = -12x + 1$



Geometry: Parallel and Perpendicular Lines

(Pages 292–297)

Parallel Lines	Lines in the same plane that never intersect are called parallel lines . If two nonvertical lines have the same slope, then they are parallel. All vertical lines are parallel.
Perpendicular Lines	Lines that intersect at right angles are called perpendicular lines . If the product of the slopes of two lines is -1 , then the lines are perpendicular. The slopes of two perpendicular lines are negative reciprocals of each other. In a plane, vertical lines and horizontal lines are perpendicular.

Examples

- a. Determine whether the graphs of $2y = -3x + 4$ and $3y = 2x - 9$ are **parallel, perpendicular, or neither**.

Rewrite each line in slope-intercept form to identify its slope.

$$2y = -3x + 4 \qquad 3y = 2x - 9$$

$$y = -\frac{3}{2}x + 2 \qquad y = \frac{2}{3}x - 3$$

$$m = -\frac{3}{2} \qquad m = \frac{2}{3}$$

Since $-\frac{3}{2} \cdot \frac{2}{3} = -1$, these lines are perpendicular.

- b. Write an equation in slope-intercept form of the line that is parallel to the graph of $x + 6y = -12$ and has an **x-intercept of 9**.

Find the slope of the line given.

$$6y = -x - 12 \Rightarrow y = -\frac{1}{6}x - 2$$

A line parallel to this line will have the same slope, or $-\frac{1}{6}$. An x-intercept of 9 means the new line passes through (9, 0).

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - 0 = -\frac{1}{6}(x - 9) \quad m = -\frac{1}{6}, (x_1, y_1) = (9, 0)$$

$$y = -\frac{1}{6}x + \frac{3}{2} \quad \text{Slope-intercept form}$$

Practice

Determine whether the graphs of each pair of equations are **parallel, perpendicular, or neither**.

1. $x = 4y + 12$
 $4y = x + 8$

2. $y = -x + 8$
 $x + 2y = 8$

3. $2y = 5x + 6$
 $2x + 5y = 5$

Write an equation in slope-intercept form of the line having the following properties.

4. is perpendicular to the graph of $y = \frac{1}{2}x + 6$ and passes through (6, 8)

5. is parallel to the graph of $y = \frac{1}{6}x - 2$ and passes through the origin

6. passes through (1, 0) and is parallel to the graph of $3x - 3y = 5$

7. passes through (0, -7) and is perpendicular to the graph of $x - 2y = 7$

8. is parallel to the x-axis and passes through (4, 5)

9. is perpendicular to the graph of $x - 3y = 6$ and passes through (7, -5)

10. **Standardized Test Practice** What is the slope of a line perpendicular to $y + 3x = 2$?

A -3

B $-\frac{1}{3}$

C $\frac{1}{3}$

D 3

Square Roots (Pages 357–361)

The **square root** of a number is one of its two equal factors. The symbol $\sqrt{\quad}$, called a **radical sign**, is used to indicate the square root. For example, $\sqrt{25}$ indicates the positive square root of 25 and $-\sqrt{25}$ indicates the negative square root of 25. A **radical expression** is an expression that contains a square root. You can simplify a radical expression like $\sqrt{676}$ by using prime numbers. A **prime number** is a whole number that has exactly two factors, the number itself and 1. A **composite number** is a whole number that has more than two factors. Every composite number can be written as the product of prime numbers. When a number is expressed as a product of prime factors, the expression is called the **prime factorization** of the number. You can use the following properties to simplify radicals.

Product Property of Square Roots	The square root of a product is equal to the product of each square root. $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$
Quotient Property of Square Roots	The square root of a quotient is equal to the quotient of each square root. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

EXAMPLES

A Simplify $\sqrt{676}$.

$$\begin{aligned}\sqrt{676} &= \sqrt{2 \cdot 2 \cdot 13 \cdot 13} && \text{Prime Factorization} \\ &= \sqrt{4 \cdot 169} && 2 \times 2 = 4, 13 \times 13 = 169 \\ &= \sqrt{4} \cdot \sqrt{169} && \text{Product Property} \\ &= 2 \cdot 13 \text{ or } 26\end{aligned}$$

B Simplify $\sqrt{\frac{25}{36}}$.

$$\begin{aligned}\sqrt{\frac{25}{36}} &= \frac{\sqrt{25}}{\sqrt{36}} && \text{Quotient Property} \\ &= \frac{5}{6}\end{aligned}$$

PRACTICE

Simplify.

1. $\sqrt{\frac{9}{16}}$

2. $\sqrt{441}$

3. $-\sqrt{\frac{121}{196}}$

4. $-\sqrt{961}$

5. $\sqrt{324}$

6. $-\sqrt{144}$

7. $\sqrt{1296}$

8. $-\sqrt{484}$

9. $\sqrt{0.09}$

10. $\sqrt{0.0064}$

11. $-\sqrt{\frac{49}{81}}$

12. $\sqrt{\frac{196}{625}}$

13. **Standardized Test Practice** A rectangular field has a length of ℓ feet and a width of w feet. The distance from any corner of the field to the diagonally-opposite corner is $\sqrt{\ell^2 + w^2}$. What is the diagonal distance across a field that is 96 feet long and 28 feet wide?

A 144 ft

B 100 ft

C 124 ft

D 114 ft

10-4

Solving Quadratic Equations by Using the Quadratic Formula (Pages 546–552)

You can use the quadratic formula to solve any quadratic equation involving any variable.

The Quadratic Formula	The solutions of a quadratic equation in the form $ax^2 + bx + c = 0$, where $a \neq 0$, are given by the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
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Example

Use the Quadratic Formula to solve $x^2 - 2x - 5 = 0$.

In the equation $x^2 - 2x - 5 = 0$, $a = 1$, $b = -2$, and $c = -5$.
Substitute these values into the Quadratic Formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \left| \quad x = \frac{2 \pm \sqrt{24}}{2}$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-5)}}{2(1)} \quad \left| \quad x = \frac{2 + \sqrt{24}}{2} \text{ or } x = \frac{2 - \sqrt{24}}{2}$$

$$x = \frac{2 \pm \sqrt{4 + 20}}{2} \quad \left| \quad x \approx 3.45 \quad x \approx -1.45 \quad \text{Use a calculator.}$$

The solutions are approximately 3.45 and -1.45.

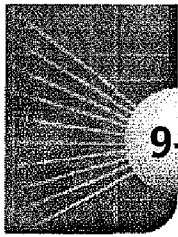
Practice

Solve each equation by using the Quadratic Formula. Approximate irrational roots to the nearest hundredth.

- | | | |
|-------------------------|--------------------------|--------------------------|
| 1. $x^2 + 6x + 8 = 0$ | 2. $n^2 - 12n + 32 = 0$ | 3. $c^2 + 4c + 8 = 0$ |
| 4. $p^2 + 4p - 1 = 0$ | 5. $d^2 - 2d - 15 = 0$ | 6. $5h^2 + 4h + 4 = 0$ |
| 7. $3e^2 - 6e + 3 = 0$ | 8. $2m^2 + 8m + 2 = 0$ | 9. $g^2 - 3g + 2 = 0$ |
| 10. $4k^2 + 2k + 3 = 0$ | 11. $3f^2 - 11f - 4 = 0$ | 12. $4v^2 + 12v + 9 = 0$ |
| 13. $x^2 - 12x = -27$ | 14. $3x^2 + 6x = 1$ | 15. $3x - 1 = -x^2$ |
| 16. $2x(x + 1) = -5$ | 17. $x^2 = 2(4x - 1)$ | 18. $2(x^2 + 3) = 3x$ |

19. Automotive Sales Mark decided that the price of a car tire is a quadratic function of the radius of the tire. He modeled this using the equation $p = -r^2 + 36r - 255$, where p is the price of the tire in dollars and r is the radius of the tire in inches. Find the price that the model predicts for a tire of radius 14 inches. Then find the price the model predicts for a tire of radius 16 inches.

20. Standardized Test Practice For a certain quadratic equation, the value of $b^2 - 4ac$ is -8 . How many real number roots does the equation have?
A 3 roots **B** 2 roots **C** 1 root **D** 0 roots



9-3

Factoring Trinomials: $x^2 + bx + c$

(Pages 489—495)

The goal of factoring quadratic trinomials is the same as factoring monomials and polynomials using the distributive property, you want to write a multiplication problem consisting of factors of the trinomial. Sometimes a trinomial can be factored into the product of two binomials. This is essentially going from a trinomial to a FOIL problem. This process can be done through trial and error, however, that may be quite time consuming. So, it may be helpful to use the following rule to help limit your trials.

To factor a trinomial of the form $x^2 + bx + c$, find two numbers, m and n , where the sum $m + n = b$ and the product $mn = c$. Then write the trinomial $x^2 + bx + c$ as $(x + m)(x + n)$. Always use the FOIL method to check your answer. If your binomials are correct, then the product of your binomials should be the original trinomial.

Examples**a. Factor $x^2 + 10x + 21$.**

$b = 10 \text{ and } c = 21$

$m = 7, n = 3$

$(x + 7)(x + 3)$

Find an m and an n such that
 $m + n = 10$ and $mn = 21$.

Write as $(x + m)(x + n)$.

b. Solve the equation by factoring.

$x^2 + 5x + 4 = 0$

$m = 4 \text{ and } n = 1$

$(x + 4)(x + 1) = 0$

$x + 4 = 0 \text{ or } x + 1 = 0$

$x = -4 \text{ or } x = -1$

$m + n = 5, mn = 4$

$(x + m)(x + n) = 0$

Zero Product

Solve for x .

Practice

Factor each trinomial.

1. $x^2 + 3x + 2$

2. $x^2 - x - 56$

3. $x^2 + 5x - 6$

4. $x^2 - 7x + 12$

Solve by factoring.

5. $x^2 + 12x + 20 = 0$

6. $x^2 - 5x - 24 = 0$

7. $x^2 - 18x + 80 = 0$

8. $x^2 + 7x - 44 = 0$

9. **Standardized Test Practice** The area of a rectangle is given by the quadratic trinomial equation $x^2 + 6x = 27$. Use factoring and the zero property to solve for x . HINT: In measurement only positive numbers are realistic answers.

$$A = lw$$

$$27 = x^2 + 6x$$

$$0 = x^2 + 6x - 27$$

A $x = 9$ units

B $x = 6$ units

C $x = 3$ units

D $x = 1$ unit

7-3

Elimination Using Addition and Subtraction

(Pages 382–386)

In systems of equations where the coefficients of terms containing the same variable are *opposites*, the **elimination** method can be applied by adding the equations. If the coefficients of those terms are the *same*, the elimination method can be applied by subtracting the equations.

Examples Solve each system of equations using elimination.

a. $x - 2y = 13$ and $3x + 2y = 15$

Add the two equations, since the coefficients of the y -terms, -2 and 2 , are opposites.

$$\begin{array}{r} x - 2y = 13 \\ (+) 3x + 2y = 15 \\ \hline 4x = 28 \end{array} \text{ Solve for } x.$$

$$x = 7 \text{ Divide each side by 4.}$$

$$\begin{array}{l} x - 2y = 13 \text{ Use the first equation.} \\ 7 - 2y = 13 \text{ Substitute 7 for } x. \\ -2y = 6 \Rightarrow y = -3 \end{array}$$

The solution of the system is $(7, -3)$.

b. $3x + 4y = 5$ and $3x - y = -5$

Subtract the two equations, since the coefficients of the x -terms are the same.

$$\begin{array}{r} 3x + 4y = 5 \\ (-) 3x - y = -5 \\ \hline 5y = 10 \end{array} \text{ Solve for } y.$$

$$y = 2 \text{ Divide each side by 5.}$$

$$\begin{array}{l} 3x - y = -5 \text{ Use the second equation.} \\ 3x - 2 = -5 \text{ Substitute 2 for } y. \\ 3x = -3 \Rightarrow x = -1 \end{array}$$

The solution of the system is $(-1, 2)$.

Try These Together

State whether addition, subtraction, or substitution would be most convenient to solve each system of equations. Then solve the system.

1. $x - y = 3$
 $3x + y = 1$

2. $3x + 4y = 2$
 $2x + 4y = 8$

3. $2x + 4y = 8$
 $y - 3 = x$

Practice

State whether addition, subtraction, or substitution would be most convenient to solve each system of equations. Then solve the system.

4. $x + 2y = 3$
 $-x + y = 6$

5. $x + y = -2$
 $x - y = 8$

6. $2y - 3x = 12$
 $-2y + 6x = -5$

7. $2x + y = -5$
 $x + 3y = 25$

8. $x - 4y = 16$
 $2x - 4y = 18$

9. $2x + 4y = 6$
 $3x - 4y = 2$

10. $8x + y = 1$
 $-8x - 4y = 3$

11. $2x - 5y = -6$
 $2x + 3y = -9$

12. **Shopping** A can of juice and a can of beef stew together cost \$2.05. Two cans of juice and a can of beef stew cost \$2.70. How much does a single can of juice cost?

13. **Standardized Test Practice** Solve the system. $2y - 5x = 1$
 $3y + 5x = 14$

A (3, 1)

B (1, 3)

C (-1, 3)

D (3, -1)