

4-1

Writing Expressions and Equations

(pages 150–152)

Problems in the world outside the classroom usually are in the form of words. You translate these words into algebraic expressions.

Writing Phrases as Expressions and Sentences as Equations	Addition: plus, sum, total, more than, increased by	Subtraction: minus, less, difference, less than, decreased by	Multiplication: times, product, multiplied, of, twice	Division: divided, quotient
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EXAMPLES

A Write this phrase as an algebraic expression: 3 less than twice p .

You can write "twice p " as $2p$.

You can write "3 less than $2p$ " as $2p - 3$.

B Write this sentence as an algebraic equation: The sum of t and the quotient of 2 and 8 is 3.25.

You can write the quotient of 2 and 8 as $2 \div 8$ or $\frac{2}{8}$. The sum means to add t and $\frac{2}{8}$.

Is suggests an equals sign.

$$t + \frac{2}{8} = 3.25$$

Try These Together

1. Write an algebraic expression for the sum of a and 9.

HINT: What operation does the word sum suggest?

2. Write an algebraic expression for the difference of x and 5.

HINT: You can translate the words the difference of x and 5 as x minus 5.

PRACTICE

Write each phrase as an algebraic expression.

3. 8 more than w

4. g multiplied by 4

5. 18 less than y

6. the product of m and 7

7. twice z

8. 7 minus n

Write each sentence as an algebraic equation.

9. Five times a number is 15.

10. The sum of a number and three is 12.

11. Five more than 3 times a number is 29.

12. A number decreased by 8 is 11.



13. Standardized Test Practice Suppose an adult bottlenose dolphin weighs 800 pounds. This is 735 pounds more than a typical newborn bottlenose dolphin. Which equation could be used to find the weight of a typical newborn bottlenose dolphin?

A $x - 735 = 800$

B $x + 735 = 800$

C $x - 800 = 735$

D $x + 800 = 735$

Answers: 1. $a + 9$ 2. $x + 3 = 12$ 3. $w + 8$ 4. $4g$ 5. $5y - 18$ 6. $7m$ 7. $2z$ 8. $7 - n$ 9. $5n = 15$ 10. $n + 3 = 29$ 11. $3n + 5 = 29$ 12. $n - 8 = 11$ 13. B

4-2

Solving Addition and Subtraction Equations

(pages 156–159)

To solve an equation and get the variable alone on one side, you can undo what has been done to the variable. The operations of addition and subtraction undo each other. To keep the two sides of an equation equal, you always do the same thing to each side.

Subtraction Property of Equality	If you subtract the same number from each side of an equation, then the two sides remain equal. $a = b$ $a - c = b - c$
Addition Property of Equality	If you add the same number to each side of an equation, then the two sides remain equal. $a = b$ $a + c = b + c$

EXAMPLES

A Solve $7.3 = x + 4.2$.

The number 4.2 has been added to x . To undo adding 4.2, you can subtract 4.2 from each side.

$$\begin{array}{r} 7.3 = x + 4.2 \\ -4.2 \quad -4.2 \\ \hline 3.1 = x \end{array} \quad \begin{array}{l} \text{Check:} \\ \text{Does } 7.3 \text{ equal } 3.1 + 4.2? \\ \text{Yes.} \end{array}$$

B Solve $y - 5 = -8$.

The number 5 has been subtracted from y . To undo subtracting 5, you can add 5 to each side.

$$\begin{array}{r} y - 5 = -8 \\ +5 \quad +5 \\ \hline y = -3 \end{array} \quad \begin{array}{l} \text{Check:} \\ \text{Does } -3 - 5 \text{ equal } -8? \\ \text{Yes.} \end{array}$$

Try These Together

1. Solve $s + 12 = 15$.
HINT: Subtract 12 from each side.

2. Solve $t - 8 = 6$.
HINT: Add 8 to each side.

PRACTICE

Solve each equation. Check your solution.

- 3. $34 = 24 + w$
- 4. $8 + x = 9$
- 5. $2 + y = 11$
- 6. $z - 5 = 4$
- 7. $-3 = r - 7$
- 8. $25 = j - 30$
- 9. $k + 18 = 26$
- 10. $-8 + m = -4$
- 11. $29 = 23 + n$
- 12. $p + 4 = 17$
- 13. $21 = f - 8$
- 14. $8 = g + 16$
- 15. A number decreased by 6 equals -4 . This means $x - 6 = -4$. Solve this equation to find the number.
- 16. The sum of 3 and a number is -2 . Solve $3 + y = -2$ to find the number.



17. **Standardized Test Practice** Trejon went with her friends to a movie. She had \$10.00 when she left. She came home with only \$4.50. Solve the equation $\$10.00 = \$4.50 + m$ to find out how much she spent.
- A** \$3.50 **B** \$5.50 **C** \$4.50 **D** \$6.50

Answers: 1. 3 2. 14 3. 10 4. 1 5. 9 6. 9 7. 4 8. 55 9. 8 10. 4 11. 6 12. 13 13. 29 14. -8 15. 2 16. -5 17. B

4-3

Solving Multiplication Equations

(pages 160–163)

You can also solve an equation that has a number multiplied by a variable. In the equation $3x = 12$, $3x$ means 3 times the value of x . You undo multiplication by division.

Division Property of Equality	If you divide each side of an equation by the same nonzero number, then the two sides remain equal. $a = b$ $\frac{a}{c} = \frac{b}{c}, c \neq 0$
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EXAMPLES

A Solve $2p = 6$.

To undo multiplying by 2, divide each side by 2.

$$\frac{2p}{2} = \frac{6}{2} \quad \text{Check:}$$

$$p = 3 \quad \text{Does } 2(3) \text{ equal } 6?$$

Yes.

B Solve $-5q = 45$.

To undo multiplying by -5 , divide each side by -5 .

$$\frac{-5q}{-5} = \frac{45}{-5} \quad \text{Check:}$$

$$q = -9 \quad \text{Does } -5(-9) \text{ equal } 45?$$

Yes.

Try These Together

1. Solve $3x = 15$.

HINT: Divide each side by the 3.

2. Solve $5t = 45$.

HINT: Divide each side by 5.

PRACTICE

Solve each equation. Check your solution.

- | | | |
|----------------|-----------------|----------------|
| 3. $10w = 50$ | 4. $36 = 9z$ | 5. $4s = 64$ |
| 6. $54 = 18m$ | 7. $121 = -11n$ | 8. $96 = 12k$ |
| 9. $81 = 9p$ | 10. $100 = 5j$ | 11. $4g = 20$ |
| 12. $-12 = 2h$ | 13. $5d = -25$ | 14. $14c = 56$ |
15. Eight times a number is -56 . Find the solution of $8a = -56$.
16. When a number is multiplied by 30, the result is -90 . Solve $30x = -90$ to find the number.

17. Standardized Test Practice Use the formula $4s = p$ to find the length s of a side of a square with perimeter $p = 28$ cm.

- A** 24 cm **B** 6 cm **C** 112 cm **D** 7 cm

Answers: 1. 5 2. 9 3. 5 4. 4 5. 16 6. 3 7. -11 8. 8 9. 9 10. 20 11. 5 12. -6 13. -5 14. 4 15. -7 16. -3 17. D

4-4**Solving Two-Step Equations** (pages 166–169)**Solving Equations with Two Operations**

You undo what has been done to the variable in an equation by reversing the order of operations. Undo addition and subtraction first before you undo multiplication.

EXAMPLES

A Solve $3p + 5 = 23$.

Undo the $+ 5$ first by subtracting 5 from each side.

$$3p + 5 - 5 = 23 - 5$$

$$3p = 18 \quad \text{Then undo the multiplying 3 by dividing by 3.}$$

$$\frac{3p}{3} = \frac{18}{3} \quad \text{Check by replacing } p \text{ by 6.}$$

$$p = 6 \quad \text{Does } 3(6) + 5 \text{ equal } 23? \\ \text{Yes.}$$

B Solve $-2q - 3 = -1$.

Undo the $- 3$ first by adding 3 to each side.

$$-2q - 3 + 3 = -1 + 3$$

$$-2q = 2 \quad \text{Undo the multiplying } -2 \text{ by dividing by } -2.$$

$$\frac{-2q}{-2} = \frac{2}{-2} \quad \text{Check by replacing } q \text{ by } -2.$$

$$q = -1 \quad \text{Does } -2(-1) - 3 \text{ equal } -1? \\ \text{Yes.}$$

Try These Together

1. Solve $2y + 1 = 5$.

HINT: First subtract 1 from each side. Then divide each side by 2.

2. Solve $8x - 12 = 12$.

HINT: Add 12 to each side and then divide each side by 8.

PRACTICE**Solve each equation.**

3. $4z + 18 = 34$

4. $9b - 60 = 30$

5. $3k + 11 = 35$

6. $-7m + 14 = 7$

7. $76 = 5d + 16$

8. $19 = 3e - 8$

9. $-6f - 2 = -20$

10. $100 = 11h - 10$

11. $98 = 9c + 17$

12. $-12 = -2r + 2$

13. $5t + 8 = 33$

14. $6s - 5 = 37$

15. Subtract seven from the product of a number and 3. The result is 29.

Solve $3x - 7 = 29$ to find the number.

16. Multiply a number by 2 and add 6. The result is 18. Find the solution of

$2y + 6 = 18$ to find the number.

17. **Internet** An Internet company charges \$15 a month for Internet

access. They also charge a one-time \$20 setup fee. How many months would you have to use the company for the total cost to be \$170? Solve the equation $15m + 20 = 170$, where m is the number of months.



18. **Standardized Test Practice** Esteban saved his weekly allowance of \$5 for a few weeks. He then spent \$13 of it on comic books. If he has \$7 left, how many weeks did he save his allowance? Solve the equation $5w - 13 = 7$, where w is the number of weeks.

A 2 weeks**B** 3 weeks**C** 4 weeks**D** 5 weeks

Answers: 1. 2 2. 3 3. 4 4. 10 5. 8 6. 1 7. 12 8. 9 9. 3 10. 10 11. 9 12. 7 13. 5 14. 7 15. 12 16. 6 17. 10 18. C

4-5**Inequalities** (pages 172–175)

An **inequality** is a mathematical sentence that contains one or more of the symbols $<$, $>$, \leq , and \geq . You can solve an inequality much like you solve an equation. The solution of an inequality may include many numbers.

EXAMPLE

Solve the inequality $x + 4 \leq 6$. Graph the solution.

$$x + 4 \leq 6$$

$$x + 4 - 4 \leq 6 - 4 \quad \text{Subtract 4 from each side.}$$

$$x \leq 2$$

The solution is $x \leq 2$, all numbers less than or equal to 2. To graph the solution, draw a number line.

Since 2 is included in the solution, fill in a circle at 2.

Then draw a thick arrow over the numbers to the left.

**Try These Together**

1. Solve $y - 2 < 8$ and graph the solution.

HINT: Add 2 to each side.

2. Solve $5x > 25$ and graph the solution.

HINT: Divide each side by 5.

PRACTICE

Solve each inequality. Graph the solution on a number line.

3. $c + 4 < 7$

4. $j - 5 \leq 3$

5. $7 + r < 14$

6. $g - 4 > 3$

7. $x + 5 > 4$

8. $9z \geq 9$

9. $4d \geq 24$

10. $3f - 2 \leq 10$

Write an inequality for each sentence. Then solve the inequality.

11. Eight times a number is less than 24.

12. Eight less than a number is greater than or equal to 12.

13. **Sales** Ian is earning money for a school trip by selling frozen pizzas.

Each pizza costs \$8. Ian needs to earn at least \$160 for the trip. Write an inequality for the number of pizzas Ian needs to sell to earn at least \$160. Then solve the inequality.

14. **Standardized Test Practice** In order to be the president of the United States, you must be at least 35 years old. Which inequality shows the possible ages of presidents?

A $a \leq 35$

B $a > 35$

C $a < 35$

D $a \geq 35$

Answers: 1–10. See Answer Key. 11. $8n < 24, n < 3$ 12. $n - 8 \geq 12, n \geq 20$ 13. $8p \geq 160, p \geq 20$ 14. D

4-6

Functions and Linear Equations

(pages 177–181)

A **linear equation** has a graph that is a straight line. A linear equation looks like $y = ax + b$, where a and b are positive or negative numbers.

Graphing a Linear Equation

To graph an equation:

- Select a few values for x . Substitute and solve for y . Use each solution to write an ordered pair (x, y) .
- Graph the points for two of the (x, y) pairs.
- Draw a line through the two points you graphed.
- Check by graphing the other (x, y) pairs to make sure that they are on the same line that you drew. Make corrections if they are not.

EXAMPLE

For $y = 2x$, find four ordered pairs that make the equation true.

Choose four values for x , for example, 0, 1, 2, and 3.

Replace x and solve for y .	$y = 2(0)$ or 0	Write the result as an ordered pair. (0, 0)
	$y = 2(1)$ or 2	Write the result as an ordered pair. (1, 2)
	$y = 2(2)$ or 4	Write the result as an ordered pair. (2, 4)
	$y = 2(3)$ or 6	Write the result as an ordered pair. (3, 6)

Try These Together

1. Graph $y = 2x$.

HINT: Use the four ordered pairs you found in the Example.

2. Graph $y = 3x - 5$.

HINT: Choose four values for x , such as 0, 1, 2 and 3. Then replace x with each value and solve for y .

PRACTICE

Graph each equation.

3. $y = x - 2$

4. $y = 4x$

5. $y = -4x + 8$

6. $y = 5x - 10$

Make a table of values for each sentence. Then write an equation.

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

- The second number is 2 less than the first.
- The second number is 3 times the first.
- The sum of the numbers is 5.
- The second number is the product of 6 and the first number.



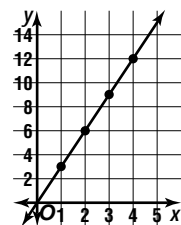
11. **Standardized Test Practice** What is the equation for this graph?

A $y = 5x$

B $2x - 1 = y$

C $y = 3x$

D $y = 4x - 2$



4-7**Lines and Slope** (pages 182–185)

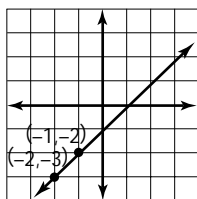
The change in y with respect to the change in x is called the **slope** of a line. Slope is a number that tells how steep the line is.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} \quad \begin{array}{l} \leftarrow \text{vertical change, or rise} \\ \leftarrow \text{horizontal change, or run} \end{array}$$

The slope is the same for any two points on a straight line. A line with a positive slope *rises* to the right. A line with a negative slope *falls* to the right.

EXAMPLE

Find the slope of the line.

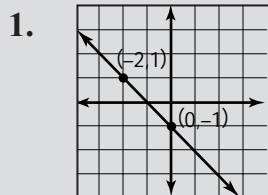


$$\begin{aligned} \text{slope} &= \frac{\text{change in } y}{\text{change in } x} \\ &= \frac{-1}{-1} \text{ or } 1 \end{aligned}$$

The slope of the line is 1.

Try These Together

Find the slope of each line.



2. a line that passes through the points (0, 3) and (7, 5)

HINT: Find the change in y first, then find the change in x .

PRACTICE

Find the slope of the line that passes through each pair of points.

3. $(-2, 5), (6, -1)$ 4. $(0, 7), (9, 3)$ 5. $(-4, -1), (-8, -5)$
6. $(2, -10), (4, 6)$ 7. $(9, 0), (3, -6)$ 8. $(5, -1), (8, 1)$

9. **Standardized Test Practice** The slope of a line that passes through the points $(-2, 0)$ and $(x, 8)$ is 4. What is the value of x ?

A -4

B 0

C 2

D 4

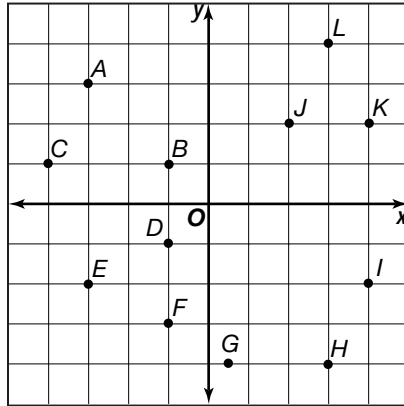
Answers: 1. -1 2. $\frac{7}{2}$ 3. $-\frac{4}{3}$ 4. $-\frac{9}{4}$ 5. 1 6. 8 7. 1 8. $\frac{3}{2}$ 9. B

4

Chapter 4 Review

Function Map

Daniel has this map of Rocky Creek State Park. He is supposed to meet his friends at a campsite in the park. The campsite lies on the graph of the equation $y = -2x - 3$.



1. Which points on the map could possibly be the campsite?
2. If the campsite is in Quadrant II on the map, which point is it?
3. There is a scenic lookout that is also on the graph of the equation in Quadrant III. Which point is the scenic lookout?
4. The entrance to the park is on the graph of the function in Quadrant IV. Which point is the entrance to the park?

Answers are located on page 107.