1-3 Algebraic Expressions

Common Core State Standards

Reviews A-SSE.A.1a Interpret parts of an expression, such as terms, factors, and coefficients. **Also reviews A-SSE.B.3**

MP 1, MP 2, MP 3

Objectives To evaluate algebraic expressions
To simplify algebraic expressions

Ten weeks is a long time! Perhaps you can solve a simpler problem first.

MATHEMATICAL PRACTICES

Getting Ready!

During summer vacation, you work two jobs. You walk three dogs several times a week, and you work part-time as a receptionist at a hair studio. You earn $8 per hour as a receptionist and $20 per week per dog. Your weekly schedule (shown below) is the same each week. How much will you earn in 10 weeks? Explain.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Walk dogs: 8-9 a.m. Studio: 1-5 p.m.	Studio: 1-5 p.m.	Walk dogs: 8-9 a.m. Studio: 1-5 p.m.	Studio: 1-5 p.m.	Walk dogs: 8-9 a.m.	Studio: Noon-4 p.m.

Lesson Vocabulary
- evaluate
- term
- coefficient
- constant term
- like terms

Essential Understanding You can represent some mathematical phrases and real-world quantities using algebraic expressions.

Problem 1 Modeling Words With an Algebraic Expression

Think

What does "seven fewer than t" mean?
"Seven fewer than t" means your answer will be less than t.

Multiple Choice Which algebraic expression models the word phrase *seven fewer than a number t*?

(A) $t + 7$ (B) $-7t$ (C) $t - 7$ (D) $7 - t$

"Seven fewer than" suggests subtraction. Begin with the number t and subtract 7. This can be represented by the expression $t - 7$. The correct answer is C.

Got It? 1. Which algebraic expression models the word phrase *two times the sum of a and b*?

(F) $a + b$ (H) $2(a + b)$
(G) $2a + b$ (I) $a + 2b$

To model a situation with an algebraic expression, do the following:

- Identify the actions that suggest operations.
- Define one or more variables to represent the unknown(s).
- Represent the actions using the variables and the operations.

Problem 2 Modeling a Situation

Savings You start with \$20 and save \$6 each week. What algebraic expression models the total amount you save?

Plan

How can you identify the variable? Determine which quantity is unknown.

Relate starting amount plus amount saved times number of weeks

Define Let w = the number of weeks.

Write $20 + 6 \cdot w$

The expression $20 + 6w$ models the situation.

Got It? 2. You had \$150, but you are spending \$2 each day. What algebraic expression models this situation?

To **evaluate** an algebraic expression, substitute a number for each variable in the expression. Then simplify using the order of operations.

Problem 3 Evaluating Algebraic Expressions

What is the value of the expression for the given values of the variables?

Plan

What operations should you start with? Do operations that occur in grouping symbols first. Parentheses are grouping symbols.

A $7(a + 4) + 3b - 8$ for $a = -4$ and $b = 5$

$7(-4 + 4) + 3(5) - 8$ Substitute the value for each variable.

$= 7(0) + 3(5) - 8$ Perform operations within grouping symbols.

$= 0 + 15 - 8$ Multiply.

$= 15 - 8$ Add and subtract from left to right.

$= 7$

B $\frac{x}{2} + y^2$ for $x = 1$ and $y = \frac{1}{2}$

$\frac{1}{2} + \left(\frac{1}{2}\right)^2$ Substitute the value for each variable.

$= \frac{1}{2} + \frac{1}{4}$ Simplify the power.

$= \frac{3}{4}$ Add.

Got It? 3. a. What is the value of the expression $\frac{2(x^2 - y^2)}{3}$ for $x = 6$ and $y = -3$?

b. **Reasoning** Will the value of the expression change if the parentheses are removed? Explain.

Problem 4 Writing and Evaluating an Expression

Sports In football, a touchdown (TD) is worth six points, an extra-point kick (EPK) one point, and a field goal (FG) three points. What algebraic expression models the total number of points that a football team scores in a game, assuming each scoring play is one of the three given types? Suppose a football team scores 3 touchdowns, 2 extra-point kicks, and 4 field goals. How many points did the team score?

Know
- Number of points each scoring play is worth
- Number of each type of score

Need
- Algebraic expression to model points scored
- Total number of points scored

Plan
- Determine the variables.
- Write an expression.
- Evaluate the expression.

Think

How many points come from touchdowns?
The number of points from touchdowns is six times the number of touchdowns.

Relate points per TD · number of TDs + points per EPK · number of EPKs + points per FG · number of FGs

Define Let t = the number of touchdowns.
Let k = the number of extra-point kicks.
Let f = the number of field goals.

Write $6 \cdot t + 1 \cdot k + 3 \cdot f$

The expression $6t + 1k + 3f$ models the team's total score.

The football team scores 3 touchdowns, 2 extra-point kicks, and 4 field goals, so $t = 3$, $k = 2$, and $f = 4$.

$6(3) + 1(2) + 3(4)$ Substitute the value for each variable.
$= 18 + 2 + 12$ Multiply.
$= 32$ Add.

The team scored 32 points.

Got It? 4. In basketball, teams can score by making two-point shots, three-point shots, and one-point free throws. What algebraic expression models the total number of points that a basketball team scores in a game? If a team makes 10 two-point shots, 5 three-point shots, and 7 free throws, how many points does it score in all?

An expression that is a number, a variable, or the product of a number and one or more variables is a **term**. A **coefficient** is the numerical factor of a term. A **constant term** is a term with no variables. You can add terms to form longer expressions. The expression below has three terms.

$-4ax + 7w - 6$

coefficients
The numerical coefficient of $-4ax$ is -4.

constant term
Think of $7w - 6$ as $7w + (-6)$.
The constant term is -6.

Like terms have the same variables raised to the same powers.

like terms like terms

$3x^2 + 5x^2 + 9y^3z + 2yz - 4y^3z$

You can simplify an algebraic expression that has like terms. You combine like terms using the properties of real numbers (Lesson 1-2). An expression and its simplified form are equivalent. Their values are equal for all values of their variables.

take note

Concept Summary Properties for Simplifying Algebraic Expressions

Let a, b, and c represent real numbers.

Definition of Subtraction	$a - b = a + (-b)$
Definition of Division	$a \div b = \frac{a}{b} = a \cdot \frac{1}{b}, b \neq 0$
Distributive Property for Subtraction	$a(b - c) = ab - ac$
Multiplication by 0	$0 \cdot a = 0$
Multiplication by −1	$-1 \cdot a = -a$
Opposite of a Sum	$-(a + b) = -a + (-b) = -a - b$
Opposite of a Difference	$-(a - b) = -a + b = b - a$
Opposite of a Product	$-(ab) = -a \cdot b = a \cdot (-b)$
Opposite of an Opposite	$-(-a) = a$

Problem 5 Simplifying Algebraic Expressions

Combine like terms. What is a simpler form of each expression?

Think
Are $7x^2$ and $3y^2$ like terms?
No; they have different variables.

A $7x^2 + 3y^2 + 2y^2 - 4x^2$

$7x^2 + 3y^2 + 2y^2 - 4x^2$	Identify like terms.
$= 7x^2 - 4x^2 + 3y^2 + 2y^2$	Commutative Property of Addition
$= (7 - 4)x^2 + (3 + 2)y^2$	Distributive Property
$= 3x^2 + 5y^2$	Combine like terms.

B $-(3k + m) + 2(k - 4m)$

$-3k - m + 2k - 8m$	Opposite of a Sum and Distributive Property
$= -k - 9m$	Combine like terms.

Got It? 5. Combine like terms. What is a simpler form of each expression?

a. $-4j^2 - 7k + 5j + j^2$ b. $-(8a + 3b) + 10(2a - 5b)$

Lesson Check

Do you know HOW?

Write an algebraic expression that models each word phrase.

1. the quotient of the sum of 2 and a number b, and 3
2. the sum of the product of a number k and 4, and a number m

Evaluate each algebraic expression for $x = 3$ and $y = -2$.

3. $2x - 3y$
4. $5x + y$
5. $y - x$
6. $x + 4y$

Do you UNDERSTAND? MATHEMATICAL PRACTICES

7. **Error Analysis** A student simplified the expression as shown.

$$3p^2q + 2p - (5q + p - 2p^2q) = q^2p + 3p - 5q$$

Identify the errors and correct them.

8. **Vocabulary** Explain the difference between a constant and a coefficient.
9. **Compare and Contrast** How are algebraic expressions and numerical expressions alike? How are they different? Include examples to justify your reasoning.

Practice and Problem-Solving Exercises MATHEMATICAL PRACTICES

A Practice

Write an algebraic expression that models each word phrase. See Problem 1.

10. four more than a number b
11. the product of 8 and the sum of a number x and 3
12. the quotient of the difference between 5 and a number n, and 2

Write an algebraic expression that models each situation. See Problem 2.

13. Jenny had \$130, but she is spending \$10 per week.
14. The piggy bank contained \$25, and \$1.50 is added each day.
15. You had 250 minutes left on your cell phone, and you talk an hour a week.

Evaluate each expression for the given values of the variables. See Problem 3.

16. $4a + 7b + 3a - 2b + 2a$; $a = -5$ and $b = 3$
17. $-k^2 - (3k - 5n) + 4n$; $k = -1$ and $n = -2$
18. $-5(x + 2y) + 15(x + 2y)$; $x = 7$ and $y = -7$
19. $4(2m - n) - 3(2m - n)$; $m = -15$ and $n = -18$

STEM **Physics** **The expression $16t^2$ models the distance in feet that an object falls during the first t seconds after being dropped. What is the distance the object falls during each time?**

20. 0.25 second
21. 0.5 second
22. 2 seconds
23. 10 seconds

Investing The expression $1000(1.1)^t$ represents the value of a \$1000 investment that earns 10% interest per year, compounded annually for t years. What is the value of a \$1000 investment at the end of each period?

24. 2 years **25.** 3 years **26.** 4 years **27.** 5 years

Write an algebraic expression to model the total score in each situation. Then evaluate the expression to find the total score. See Problem 4.

28. In the first set, the volleyball team made only 8 shots worth one point each.

29. In the last baseball game, there were two 3-run home runs and 4 hits that each scored 2 runs.

Simplify by combining like terms. See Problem 5.

30. $5a - a$ **31.** $5 + 10s - 8s$ **32.** $-5a - 4a + b$

33. $2a + 3b + 4a$ **34.** $6r + 3s + 2s + 4r$ **35.** $0.5x - x$

36. $7b - (3a - 8b)$ **37.** $5 + (4g - 7)$ **38.** $-(3x - 4y) + x$

B Apply

Evaluate each expression for the given value of the variable.

39. $x + 2x - x - 1; x = 2$ **40.** $2z + 3 + 5 - 3z; z = -3$ **41.** $3(2a + 5) + 2(3 - a); a = 4$

42. $\frac{5(2k - 3) - 3(k + 4)}{3k + 2}; k = -2$ **43.** $y^2 + 3; y = \sqrt{7}$ **44.** $5c^3 - 6c^2 - 2c; c = -5$

45. Think About a Plan Tran's truck gets very poor gas mileage. If Tran pays \$84 to fill his truck with gas and is able to drive m miles on a full tank, what expression shows his gas cost per mile?

- What operation does "per" indicate?
- Check your expression by substituting 200 miles for m. Does your answer make sense?

Simplify by combining like terms.

46. $-a^2 + 2b^2 + \frac{1}{4}a^2$ **47.** $x + \frac{x^2}{2} + 2x^2 - x$ **48.** $\frac{y^2}{4} + \frac{y}{3} + \frac{y^2}{3} - \frac{y}{5}$

49. $-(2x + y) - 2(-x - y)$ **50.** $x(3 - y) + y(x + 6)$ **51.** $\frac{1}{2}(x^2 - y^2) - \frac{5}{2}(x^2 - y^2)$

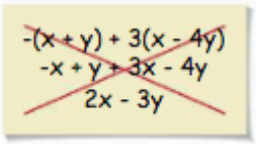
Write an algebraic expression to model each situation.

52. Class Project The freshman class will be selling carnations as a class project. What is the class's income after it pays the florist a flat fee of \$200 and sells x carnations for \$2 each?

53. Jobs You have a summer job at a car wash. You earn \$8.50 per hour and are expected to pay a one-time fee of \$15 for the uniform. If you work x hours per week, how much will you make during the first week?

54. Reasoning Suppose you need to subtract a from b but mistakenly subtract b from a instead. How is the answer you get related to the correct answer? Explain.

55. Error Analysis John simplified the expression as shown. Is his work correct? Explain.



56. Open-Ended Write an example of an algebraic expression that has a nonnegative value regardless of the value of the variable.

Name the property of real numbers illustrated by the equation.

57. $2(s - t) = 2s - 2t$

58. $-[-(x - 10)] = x - 10$

59. $-(2t - 11) = 11 - 2t$

60. $-(a - b) = (-1)(a - b)$

Challenge

61. Simplify $2(b - a) + 5(b - a)$ and justify each step in your simplification.

62. a. Evaluate the expression $2(2x^2 - x) - 3(x^2 - x) + x^2 - x$ for $x = 3$. Do *not* simplify the expression before evaluating it.

b. Simplify the expression in part (a) and then evaluate your answer for $x = 3$.

c. Writing Explain why the values in parts (a) and (b) should be the same.

Apply What You've Learned

MATHEMATICAL PRACTICES
MP 2

Look back at the information on page 3 about Mia helping her friend Cody after Cody's car runs out of gas.

In the Apply What You've Learned in Lesson 1-2, you drew diagrams to show possible locations of Cody's car when it runs out of gas. Choose one of these diagrams to use for parts (a)–(d) below.

a. Assign a variable to one unknown distance in your diagram.

Use your variable from part (a) to write an algebraic expression for each of the following distances.

b. the distance Mia drove from her house to Cody's car

c. the distance Mia drove between the time she picked up Cody's gas can and the time she delivered the full gas can to Cody

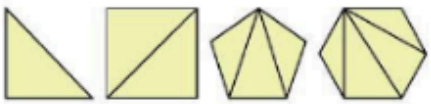
d. the distance Mia drove to the restaurant after leaving Cody

1 Mid-Chapter Quiz

MathXL® for School
Go to PowerAlgebra.com

Do you know HOW?

1. Draw the next figure in the pattern.



Identify a pattern and find the next number in the pattern.

2. $-405, -135, -45, -15, \ldots$
3. $\frac{2x}{3}, \frac{x}{3}, \frac{x}{6}, \frac{x}{12}, \ldots$
4. $101, 92, 83, 74, \ldots$
5. $0.4, 1.2, 3.6, 10.8, \ldots$

Name the property of real numbers illustrated by the equation.

6. $7(x - y) = 7x - 7y$
7. $\sqrt{7} \cdot 1 = \sqrt{7}$
8. $-2 \cdot \left(-\frac{1}{2}\right) = 1$
9. $2.3(3.4 \cdot 12.9) = (2.3 \cdot 3.4)(12.9)$

Write an algebraic expression to model each word phrase.

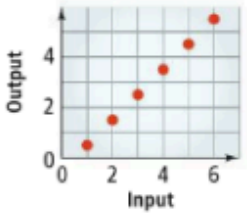
10. eight times the sum of a and b
11. four more than the product of x and y
12. six less than the quotient of d and g
13. ten less than twice the product of s and t

Simplify each expression.

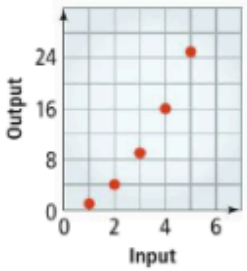
14. $-x^2 + 2y - 3x^2 + 10$
15. $-2(d + 2e) + 5(3d - 8e)$
16. $-(a + 2b) + 4(a + 2b) - 2(a + 2b)$
17. $-3x + 14x + 7x^2 - 3x + 4x(x + 1)$

Identify a pattern by making a table of the inputs and outputs. Include a process column.

18.



19.



Evaluate each expression for $a = 4$, $b = -3$, and $c = 10$.

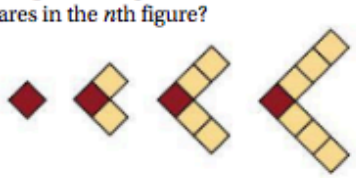
20. $7a - 5b$
21. $4a + b - |2c|$
22. $|a - b - c^2|$

Write an algebraic expression to model each situation.

23. You have 16 tomatoes, and your tomato plants produce 5 tomatoes each day.
24. Your car's gas tank holds 25 gallons, and you use 1.5 gallons of gas each day.

Do you UNDERSTAND?

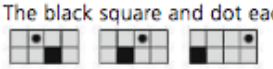
25. **Writing** Explain why every integer is also a rational number.
26. **Reasoning** What expression describes the number of squares in the nth figure?



27. **Reasoning** Is there a Closure Property of Subtraction that applies to whole numbers? Explain.

21. Output = Input − 1

Input	Process Column	Output
1	(1) − 1	0
2	(2) − 1	1
3	(3) − 1	2
4	(4) − 1	3
5	(5) − 1	4
⋮	⋮	⋮
n	(n) − 1	$n - 1$

23. 40 **25.** add 6 or $6n$; 30, 36, 42 **27.** add 3, then add 4, then add 5, and so on; 21, 28, 36 **29.** multiply by 3; 243, 729, 2187 **31.** The black square and dot each move clockwise one block  **33.** 9216 in.^{3} **35.** $n + 10$, where n is the number of months **37.** 21; $4n + 1$ **39.** −13; $7 - 4n$; or $-4n + 7$ **41.** Answers may vary. Sample: Jesse will not grow at the same rate between the ages of 15 and 20 as he has during the 4 years prior to age 15. **43.** D **45. a.** Each number is a result of the division of the previous number by 2. **b.** 36 ÷ 2 = 18, 18 ÷ 2 = 9, 9 ÷ 2 = 4.5, so 4.5 is the first noninteger number. **46.** 1.9 **47.** −3.8 **48.** 27 **49.** 0 **50.** −0.4 **51.** 7 **52.** 50% **53.** 25% **54.** 33.33% **55.** 140% **56.** 172% **57.** 123%

Lesson 1-2 pp. 11–17

Got It? 1. rational numbers

2. 

3. a. $\sqrt{26} < 6.25$ or $6.25 > \sqrt{26}$ **b.** $a < c$; a will be to the left of c on the number line.

4. a. Distr. Prop.

b. $a + [3 + (-a)]$

$= a + [(-a) + 3]$ Comm.

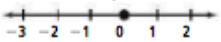
$= [a + (-a)] + 3$ Assoc.

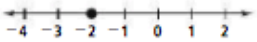
$= 0 + 3$ Inverse

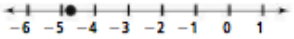
$= 3$ Identity

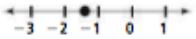
Lesson Check 1. Answers may vary. Sample: the number of times a cricket chirps **2.** Answers may vary. Sample: the change in number of people on a bus after a stop **3.** Answers may vary. Sample: the outdoor temperature in tenths of a degree **4.** Inv. Prop. of Add. **5.** Assoc. Prop. of Mult. **6.** multiplicative inverse **7.** Both properties result in the original term; 0 is the additive identity, whereas 1 is the multiplicative identity. **8.** The equation illustrates the Comm. Prop. of Add. **9.** Answers may vary. Sample: $\sqrt{2}$ is not a rational number because it cannot be written as a quotient of integers.

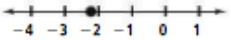
Exercises 11. y, natural numbers; p, rational numbers

13. 

15. 

17. 

19. 

21. 

23. > **25.** < **27.** > **29.** > **31.** > **33.** < **35.** Distr. Prop. **37.** Assoc. Prop. of Mult. **39.** Ident. Prop. of Add. **41–48.** Answers may vary. Samples are given. **41.** −5 **43.** $-1\frac{1}{4}$ **45.** $1\frac{2}{3}$ **47.** 4 **49.** $\sqrt{50}$ in. × $\sqrt{50}$ in. × $\sqrt{50}$ in. **51.** natural numbers **53.** irrational numbers **55.** irrational numbers **57.** 8, 1, $\frac{1}{3}$, $-\sqrt{2}$, −3 **59.** 5.73, $\frac{1}{4}$, −0.06, $-3\sqrt{3}$, −17 **61.** Answers may vary. Sample: 7 **63.** Answers may vary. Sample: $\sqrt{2}$ and $\sqrt{2}$ **65.** Answers may vary. **67.** Answers may vary. **69.** $5(x + 2y - 7)$ **71.** No; $\frac{1}{0}$ is undefined. **73.** H

Lesson 1-3 pp. 18–24

Got It? 1. H **2.** $150 - 2d$, with d = the number of days **3. a.** 18 **b.** Yes; the numerator will become $2x^2 - y^2$, not $2x^2 - 2y^2$. **4.** Let x = the number of two-point shots, y = the number of three-point shots, z = the number of one-point free throws, $2x + 3y + 1z$; 42 points **5. a.** $-3j^2 - 7k + 5j$ **b.** $12a - 53b$

Lesson Check 1. $\frac{2 + b}{3}$ **2.** $4k + m$ **3.** 12 **4.** 13 **5.** −5 **6.** −5 **7.** The student did not distribute the −1. $3p^2q + 2p - (5q + p - 2p^2q) = 3p^2q + 2p - 5q - p + 2p^2q = 5p^2q + p - 5q$ **8.** A constant is a term with no variables, whereas a coefficient is the numerical factor in a term. **9.** Answers may vary. Sample: Both algebraic expressions and numerical expressions represent a quantity using numbers, operations and grouping symbols. An algebraic expression includes variables when representing a quantity. Examples: numerical expression: $3 + 6(5 - 2)$; algebraic expression: $2z + 3z(6 + 5z)$.

Exercises 11. $8(x + 3)$ **13.** $130 - 10w$, with w = number of weeks **15.** $250 - 60w$, with w = number of weeks **17.** −16 **19.** −12 **21.** 4 ft **23.** 1600 ft **25.** \$1331 **27.** \$1610.51 **29.** Let x = the number of 3-run home runs and y = the number of 2-run hits; $3x + 2y$; 14 **31.** $2s + 5$ **33.** $6a + 3b$ **35.** $-0.5x$ **37.** $4g - 2$ **39.** 3 **41.** 37 **43.** 10 **45.** $\frac{\$84}{m}$ **47.** $\frac{5x^2}{2}$ **49.** y **51.** $-2x^2 + 2y^2$ **53.** $8.5x - 15$ **55.** No; John did not use the opposite of a sum correctly; $-(x + y) + 3(x - 4y)$; $-x - y + 3x - 12y$; $2x - 13y$ **57.** Distr. Prop. **59.** Opposite of a Difference

61. Answers may vary. Sample:

$2(b-a)+5(b-a)$

$=(2+5)(b-a)$ Distr. Prop.

$=7(b-a)$ Add.

$=7b-7a$ Distr. Prop.

Lesson 1-4 pp. 26–32

Got It? **1.** $\frac{3}{2}$ **2.** -1 **3.** 40 m $\times$ 120 m **4. a.** never **b.** always **5. a.** $C = K - 273$ **b.** always

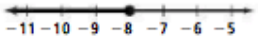
Lesson Check **1.** 23.2 **2.** -90 **3.** 12 **4.** $k = \frac{1}{2}(r - 15)$ **5.** $k = \frac{1}{3}(z + 6)$ **6.** $k = -\left(\frac{1}{6}\right)(h + 14)$ **7.** To find a solution of an equation means to find the value of the variable that makes the equation true. **8.** Four buses are not enough. The number of buses must be a whole number, so round the number of buses to 5. **9.** The 2nd line is incorrect; subtract 10 from both sides: $12x = -12x = -1$

Exercises **11.** -81 **13.** 14 **15.** 8 **17.** -5 **19.** $-\frac{1}{9}$ **21.** $\frac{3}{2}$ **23.** -6 **25.** 0 **27.** 300 mi/h; 600 mi/h **29.** sometimes **31.** sometimes **33.** $h = \frac{2A}{b}$ **35.** $w = \frac{V}{\ell h}$ **37.** $x = \frac{c}{a+b}$, $a \neq -b$ **39.** $x = 2(m + n) + 2$ **41.** 1.5 **43.** $\frac{23}{3}$, or $7\frac{2}{3}$ **45.** 34° and 56° **47.** $b_2 = \frac{2A}{h} - b_1$ **49.** $v = \frac{h + 5t^2}{t}$ **51.** $r_2 = \frac{Rr_1}{r_1 - R}$ **53.** 40°, 140° **55.** $x = \frac{3b + 2c - 5}{b - c}$, $\frac{b^\circ}{c}$ **57.** $x = \frac{4a - 3bc}{aq - 5bp}$, $5bp \neq aq$ **59.** $x = \frac{10c}{a}$, $a \neq 0$ **61.** Let c = number of swim days; $3c = 82 + c$; 41 days **63.** No; $n = \frac{s}{1-s}$ ***not*** $\frac{s}{s-1}$ **65.** 264 ft

Lesson 1-5 pp. 33–40

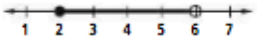
Got It? **1.** $\frac{x}{3} \leq 15$

2. $x \leq -8$



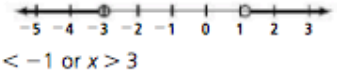
3. more than 32 songs **4.** always

5. a. $x \geq 2$ and $x < 6$

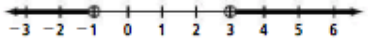


b. sometimes; The compound inequality is true when $x = 5$ and not true when $x = 7$.

6. a. $w < -3$ *or* $w > \frac{8}{7}$

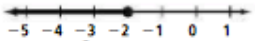


b. $x < -1$ or $x > 3$



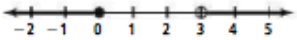
Lesson Check **1.** $R \geq J$ **2.** $w \geq 40$ and $w < 74$

3. $x \leq -2$



4. $1 < x < \frac{9}{5}$

5. $x \leq 0$ or $x > 3$



6. Answers may vary. Sample: $5 < 6$, but $-5 > -6$.

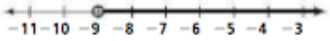
7. The transitive, addition and subtraction properties of inequality are similar to the properties of equality. The multiplication and division properties differ. Multiplying or dividing each side of an inequality by a negative number reverses the direction of the inequality symbol.

8. Answers may vary. Sample: $3x + 5 < 3(x + 5)$

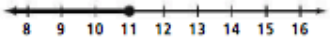
9. No; Answers may vary. Sample: $2x < x + 1$ and $x + 1 > 3$

Exercises **11.** $8x \geq 25$ **13.** $\frac{x}{12} \leq 6$

15. $k > -9$

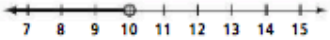


17. $t \leq 11$

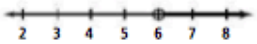


19. $y \leq -6$

21. $m < 10$

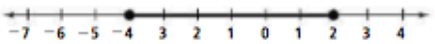


23. $w > 6$

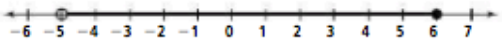


25. The longest side is less than 21 cm. **27.** at most 40 students **29.** always **31.** never **33.** sometimes **35.** sometimes

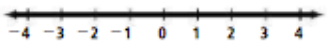
37. $-4 \leq x \leq 2$



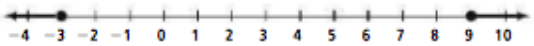
39. $-5 < x \leq 6$



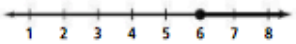
41. all real numbers



43. $x \leq -3$ or $x \geq 9$



45. $z \geq 6$



47. $x \geq -48$