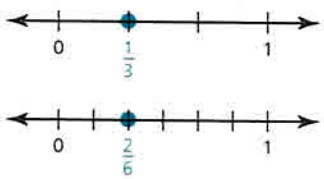
Name _____ Date _____

Equivalent Fractions and Simplifying Fractions

The number lines show the graphs of two fractions, $\frac{1}{3}$ and $\frac{2}{6}$. These fractions represent the same number. Two fractions that represent the same number are called **equivalent fractions**. To write equivalent fractions, you can multiply or divide the numerator and the denominator by the same nonzero number.



Example 1 **Write two fractions that are equivalent to $\frac{8}{12}$.**

Multiply the numerator and denominator by 2.

$$\frac{8}{12} = \frac{8 \cdot 2}{12 \cdot 2} = \frac{16}{24}$$

Divide the number and denominator by 2.

$$\frac{8}{12} = \frac{8 \div 2}{12 \div 2} = \frac{4}{6}$$

▶ Two equivalent fractions are $\frac{16}{24}$ and $\frac{4}{6}$.

A fraction is in **simplest form** when its numerator and its denominator have no common factors besides 1.

Example 2 **Write the fraction $\frac{18}{24}$ in simplest form.**

Divide the numerator and denominator by 6, the greatest common factor of 18 and 24.

$$\frac{18}{24} = \frac{18 \div 6}{24 \div 6} = \frac{3}{4}$$

▶ $\frac{18}{24}$ in simplest form is $\frac{3}{4}$.

Practice

Check your answers at BigIdeasMath.com.

Write two fractions that are equivalent to the given fraction.

1. $\frac{4}{10}$
2. $\frac{3}{7}$
3. $\frac{10}{15}$
4. $\frac{16}{20}$
5. $\frac{9}{30}$
6. $\frac{1}{8}$
7. $\frac{9}{16}$
8. $\frac{12}{14}$

Write the fraction in simplest form.

9. $\frac{18}{27}$
10. $\frac{3}{18}$
11. $\frac{35}{50}$
12. $\frac{14}{32}$
13. $\frac{4}{36}$
14. $\frac{48}{80}$
15. $\frac{24}{63}$
16. $\frac{33}{88}$
17. $\frac{45}{100}$
18. $\frac{60}{150}$
19. $\frac{48}{96}$
20. $\frac{110}{170}$

21. Is the fraction $\frac{45}{61}$ in simplest form? Explain.

22. Write five fractions that each simplify to one-ninth.

23. **SLEEP** It is recommended that 10- to 17-year old students should sleep about 9 hours each night. What fraction of the day is this? Write your answer in simplest form.

Name _____ Date _____

Square Roots

A **square root** of a number is a number that, when multiplied by itself, equals the given number. Every positive number has a positive and a negative square root. A **perfect square** is a number with integers as its square roots.

Example 1 **Find the two square roots of 64.**

$8 \cdot 8 = 64$ and $-8 \cdot (-8) = 64$

▶ So, the square roots of 64 are 8 and -8.

The symbol $\sqrt{\ }$ is called a **radical sign**. It is used to represent a square root. The number under the radical sign is called the **radicand**.

Example 2 **Find the square root(s).**

a. $\sqrt{49}$

▶ Because $7^2 = 49$, $\sqrt{49} = \sqrt{7^2} = 7$.

b. $-\sqrt{\frac{1}{4}}$

▶ Because $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$, $-\sqrt{\frac{1}{4}} = -\sqrt{\left(\frac{1}{2}\right)^2} = -\frac{1}{2}$.

c. $\pm\sqrt{1.21}$

▶ Because $1.1^2 = 1.21$, $\pm\sqrt{1.21} = \pm\sqrt{1.1^2} = \pm 1.1$.

Example 3 **Evaluate $3\sqrt{144} - 10$.**

$3\sqrt{144} - 10 = 3(12) - 10$ Evaluate the square root.

$= 36 - 10$ Multiply.

$= 26$ Subtract.

Practice

Check your answers at BigIdeasMath.com.

Find the two square roots of the number.

1. 9 **2.** 100 **3.** 169 **4.** 400

Find the square root(s).

5. $\sqrt{4}$ **6.** $-\sqrt{81}$ **7.** $\pm\sqrt{900}$ **8.** $\pm\sqrt{\frac{1}{36}}$

9. $\sqrt{\frac{4}{9}}$ **10.** $-\sqrt{\frac{36}{25}}$ **11.** $\sqrt{2.25}$ **12.** $\pm\sqrt{0.01}$

Evaluate the expression.

13. $\sqrt{10 + 6}$ **14.** $4 - 2\sqrt{9}$ **15.** $12 - \sqrt{\frac{98}{2}}$ **16.** $4(2\sqrt{25} + 3)$

17. PERIMETER What is the perimeter of a square with an area of 900 square feet?

18. DIAMETER What is the diameter of a circle with an are of 100π square yards?

Name _____ Date _____

Simplifying Algebraic Expressions

Parts of an algebraic expression are called *terms*. **Like terms** are terms that have the same variables raised to the same exponents. Constant terms are also like terms.

An algebraic expression is in **simplest form** when it has no like terms and no parentheses. To *combine* like terms that have variables, use the Distributive Property to add or subtract the coefficients.

Example 1 **Simplify $8y + 7y$.**

$8y + 7y = (8 + 7)y$ — Distributive Property

$= 15y$ — Add coefficients.

Example 2 **Simplify $2(x + 5) - 3(x - 2)$.**

$2(x + 5) - 3(x - 2) = 2(x) + 2(5) - 3(x) - 3(-2)$ — Distributive Property

$= 2x + 10 - 3x + 6$ — Multiply.

$= 2x - 3x + 10 + 6$ — Group like terms.

$= -x + 16$ — Combine like terms.

Example 3 **Simplify $xy + 3y - 2x + 5y - 3xy$.**

$xy + 3y - 2x + 5y - 3xy = xy - 3xy + 3y + 5y - 2x$ — Group like terms.

$= -2xy + 8y - 2x$ — Combine like terms.

Practice

Check your answers at BigIdeasMath.com.

Simplify the expression.

1. $7x + 15x$
2. $8y - 14y$
3. $7d + 9 - 5d$
4. $3w + 2(2 - 3w) + 2$
5. $(x + 3) + (3x - 7)$
6. $(5k + 6) + (4k - 8)$
7. $(-7n + 6) + (5n + 15)$
8. $(9z + 12) - (6z + 8)$
9. $(8b + 1) - (-10b - 5)$
10. $s(8 - 2t) + 3t(4 - 2s) + 5t$
11. $qr + 2q^2 - 3qr - r^2 - 6q^2$
12. $g^3(h - 4g) - h(3 - 2g^3)$

13. **EARNINGS** The original price of a model car is d dollars. You use a coupon and buy the kit for $(d - 10)$ dollars. You assemble the model car and sell it for $(2d - 20)$ dollars. Write an expression that represents your earnings. Interpret the expression.

Name _____ Date _____

The Distributive Property

To multiply a sum or difference by a number, multiply each number in the sum or difference by the number outside the parentheses, then evaluate.

Distributive Property	
With addition: $5(7 + 3) = 5(7) + 5(3)$	$a(b + c) = a(b) + a(c)$
With subtraction: $5(7 - 3) = 5(7) - 5(3)$	$a(b - c) = a(b) - a(c)$

Example 2 **Simplify each expression.**

a. $6(x + 9)$

$6(x + 9) = 6(x) + 6(9)$

$= 6x + 54$

b. $10(12 + z + 7)$

$10(12 + z + 7) = 10(12) + 10(z) + 10(7)$

$= 120 + 10z + 70$

$= 10z + 190$

c. $16(8w - 3)$

$16(8w - 3) = 16(8w) - 16(3)$

$= 128w - 48$

d. $5(4m - 3n - 1)$

$5(4m - 3n - 1) = 5(4m) - 5(3n) - 5(1)$

$= 20m - 15n - 5$

Practice

Check your answers at BigIdeasMath.com.

Evaluate.

1. $25(7 + 11)$ **2.** $4(13 - 5)$ **3.** $9(16 + 7 - 8)$ **4.** $-4(10 - 9 - 6)$

Simplify the expression.

5. $4(y + 7)$ **6.** $-2(z + 5)$ **7.** $5(b - 11)$ **8.** $-8(d - 1)$

9. $12(4a + 13)$ **10.** $9(20 + 17m)$ **11.** $11(2k - 11)$ **12.** $-7(-2n - 9)$

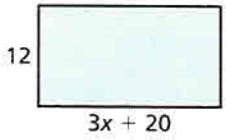
13. $3(x + 4 + 9)$ **14.** $6(25 + 6z + 10)$ **15.** $8(p - 6 - 5)$ **16.** $-10(4 + v - 1)$

17. $7(2x + 7 + 9y)$ **18.** $-4(4r - s + 17)$ **19.** $-3(-12 - 3d - 8)$ **20.** $2 - 6(2n - 9)$

21. $1.5(6c + 10d + 3)$ **22.** $\frac{3}{4}\left(q + \frac{1}{6} + \frac{7}{8}\right)$ **23.** $-2.4(5h - 10 + 4)$ **24.** $0.5(2.6x + 5.8)$

Write and simplify an expression for the area of the rectangle.

7.



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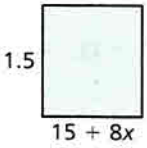

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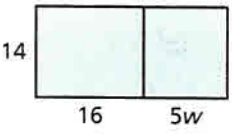


Name _____ Date _____

Solving Linear Equations

To determine whether a value is a solution of an equation, substitute the value into the equation and simplify.

Example 1 **Determine whether (a) $x = 1$ or (b) $x = -2$ is a solution of $5x - 1 = 4$.**

a. $5x - 1 = -2x + 6$

$5(1) - 1 \stackrel{?}{=} -2(1) + 6$ Substitute.

$4 = 4$ ✓ Simplify.

▶ So, $x = 1$ is a solution.

b. $5x - 1 = -2x + 6$

$5(-2) - 1 \stackrel{?}{=} -2(-2) + 6$ Substitute.

$-11 \neq 10$ ✗ Simplify.

▶ So, $x = -2$ is *not* a solution.

To solve a linear equation, isolate the variable.

Example 2 **Solve each equation. Check your solution.**

a. $4x - 3 = 13$

$4x - 3 + 3 = 13 + 3$ Add 3.

$4x = 16$ Simplify.

$\frac{4x}{4} = \frac{16}{4}$ Divide by 4.

$x = 4$ Simplify.

Check

$4x - 3 = 13$

$4(4) - 3 \stackrel{?}{=} 13$

$13 = 13$ ✓

b. $2(y - 8) = y + 6$

$2y - 16 = y + 6$ Distributive Property

$2y - y - 16 = y - y + 6$ Subtract y.

$y - 16 = 6$ Simplify.

$y - 16 + 16 = 6 + 16$ Add 16.

$y = 22$ Simplify.

Check

$2(y - 8) = y + 6$

$2(22 - 8) \stackrel{?}{=} 22 + 6$

$28 = 28$ ✓

Practice

Check your answers at BigIdeasMath.com.

Determine whether (a) $x = -1$ or (b) $x = 3$ is a solution of the equation.

1. $5x + 7 = 2$
2. $-4x + 8 = -4$
3. $2x - 1 = 3x - 4$

Solve the equation. Check your solution.

4. $x - 9 = 24$
5. $n + 14 = 0$
6. $-16 = 4y$
7. $-\frac{5}{6}t = -15$
8. $81 = 46 - x$
9. $4x + 5 = 1$
10. $x + 5 = 11x$
11. $9(y - 3) = 45$
12. $6 = 7k + 8 - k$
13. $6n + 3 = -4n + 7$
14. $2c + 5 = 3(c - 8)$
15. $18m + 3(2m + 8) = 0$
16. $\frac{w - 6}{5} = 8$
17. $\frac{15 + h}{3} = 10$
18. $\frac{8 - 3x}{5} = x$
19. $(8r + 6) + (4r - 1) = 14$
20. $\frac{2}{3}y - 3 = 9$
21. $\frac{1}{2}x - \frac{3}{10} = \frac{5}{2}x + \frac{7}{10}$

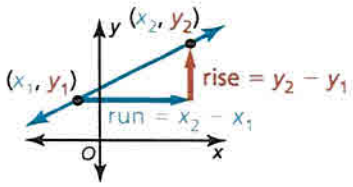
22. **MONEY** You have a total of \$3.25 in change made up of 25 pennies, 6 nickels, 2 dimes, and x quarters. How many quarters do you have?

Name _____ Date _____

Slope of a Line

The **slope** of a nonvertical line is the ratio of vertical change (*rise*) to horizontal change (*run*) between any two points on the line. If a line in the coordinate plane passes through points (x_1, y_1) and (x_2, y_2), then the slope m is

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}.$$



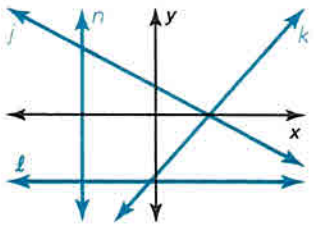
Slopes of Lines in the Coordinate Plane

Negative slope: falls from left to right, as in line j

Positive slope: rises from left to right, as in line k

Zero slope (slope of 0): horizontal, as in line ℓ

Undefined slope: vertical, as in line n



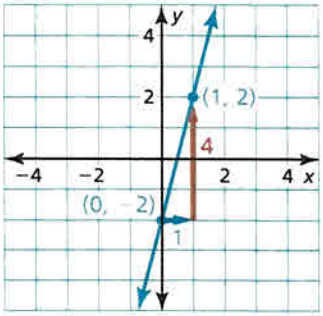
Example 1 **Find the slope of the line shown.**

Let $(x_1, y_1) = (0, -2)$ and $(x_2, y_2) = (1, 2)$.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$ Write formula for slope.

$$= \frac{2 - (-2)}{1 - 0}$$ Substitute.

$$= 4$$ Simplify.



Practice

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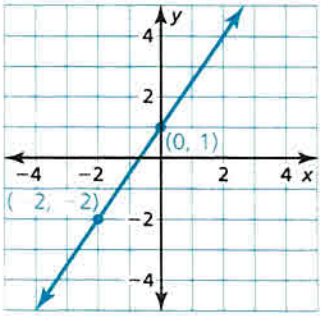
Find the slope of the line.

1.



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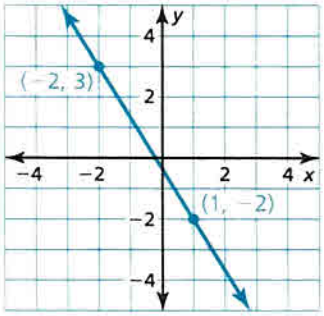

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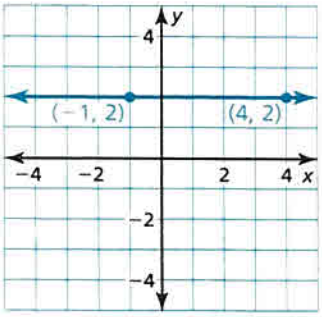
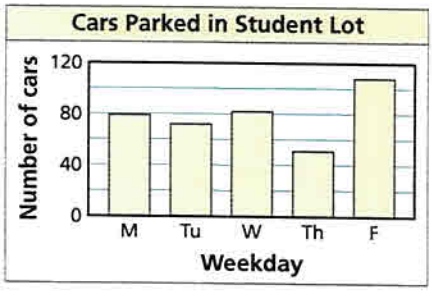


Name _____ Date _____

Bar Graphs and Line Graphs

A **bar graph** shows data in specific categories. A **line graph** shows how data change over time.

Example 1 **Use the bar graph to answer each question.**



a. On which day of the week were the greatest number of cars parked in the student lot?

▶ The tallest bar on the graph is the bar for Friday. So, the answer is Friday.

b. How many cars were parked in the student lot on Monday?

▶ The bar for Monday shows that about 80 cars were parked in the student lot.

Example 2 **Use the line graph to answer each question.**

a. In which month(s) was Linda's account balance $150?

▶ From the graph, Linda's account balance was $150 in May and October.

b. Between which two consecutive months did Linda's account balance increase the most?

▶ Of the graph's line segments that have positive slopes, the graph is steepest from June to July. So, Linda's account balance increased the most between June and July.

Practice

Check your answers at BigIdeasMath.com.

Use the bar graph in Example 1 to answer the question.

1. On which day of the week were the least number of cars parked in the student lot?
2. On which day(s) of the week were there about 70 cars parked in the student lot?
3. About how many more cars were parked in the student lot Friday than on Thursday?
4. About how many more cars were parked in the student lot on Friday than on Monday?

Use the line graph in Example 2 to answer the question.

5. In which month(s) was Linda's account balance $250?
6. Between which two consecutive months did Linda's account balance decrease the most?
7. How much less was Linda's account balance in October than in July?
8. How much more was Linda's account balance in September than in April?