THE SCHOOL DISTRICT OF PHILADELPHIA

**Grade:** 7 **Subject:** Math (worksheets taken from enVision Mathematics, Grade 7)

**Topic:** Analyze and Use Proportional Relationships

**What Your Student is Learning:**

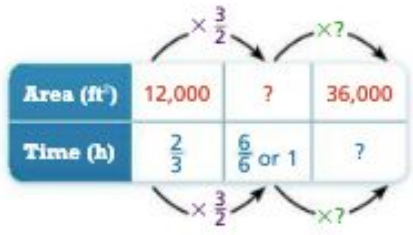
- Use ratios and rates to describe the relationship between two quantities.
- Find equivalent ratios and use unit rates (even with ratios of fractions) to solve multi-step problems.
- Determine whether quantities are proportional by testing for equivalent ratios.
- Use the constant of proportionality to write equations that represent proportional relationships and use those equations to solve problems involving proportional relationships.
- Use a graph to recognize proportionality, identify a constant of proportionality, and interpret a point on a graph of a proportional relationship.
- Explain whether a situation represents a proportional relationship.

**Background and Context for Parents:**

- This concept is all about how quantities change together and helps students make sense of the world around them. It is important for students to see relationships and patterns over following procedures with this content as solutions without understanding the context and how the two quantities are changing are not very useful.

## Ratio and Rate Concepts

- **The Concept of Ratio** In Lesson 2-1, students review and extend ratio concepts from Grade 6 to solve multi-step problems. This lesson provides practice with procedural skills needed to generate ratio tables and compare equivalent ratios.
- **The Concept of Rate** In Lesson 2-1, students compute unit rates associated with ratios of whole numbers and decimals in order to compare quantities and to solve multi-step problems. In Lesson 2-2, students continue to use ratio tables to generate equivalent ratios for rates with rational terms. This lesson also develops the procedural skill needed to compute unit rates for ratios with rational terms by interpreting the rate as division and applying the standard algorithm for division of fractions. Students also interpret unit rates to solve multi-step problems.




$\frac{12{,}000}{\frac{2}{3}} = \frac{12{,}000 \times \frac{3}{2}}{\frac{2}{3} \times \frac{3}{2}} = \frac{18{,}000 \text{ ft}^2}{1 \text{ h}}$

$\frac{18{,}000 \times 2}{1 \times 2} = \frac{36{,}000}{2}$

## Recognize Proportional Relationships

- **Proportional Relationships and Equivalent Ratios** In Lesson 2-3, students study situations presented in verbal descriptions, tables, and diagrams to determine whether quantities are in a proportional relationship. They recognize and understand that quantities described by equivalent ratios are in a proportional relationship. Students understand that the value of the equivalent ratios is a constant multiple that relates the quantities, and they use that constant multiple to solve problems and answer questions about the situation. Students also learn to write and solve proportions to answer questions about situations involving proportional relationships.

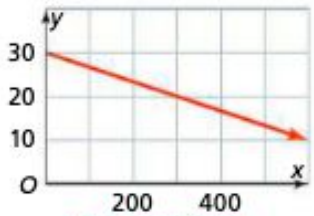
**Hummingbird Wing Beats**

| Seconds ($x$) | 2 | 7 | 10 |
|---|---|---|---|
| Wing Beats ($y$) | 160 | 560 | 800 |

$\frac{160}{2} = \frac{80}{1}$ $\frac{560}{7} = \frac{80}{1}$ $\frac{800}{10} = \frac{80}{1}$

- **Graphs of Proportional Relationships** In Lesson 2-5, students recognize that the graph of a proportional relationship is a straight line through the origin, and similarly recognize that graphs that are not straight lines or do not pass through the origin do not represent proportional quantities.

Proportional



Not Proportional

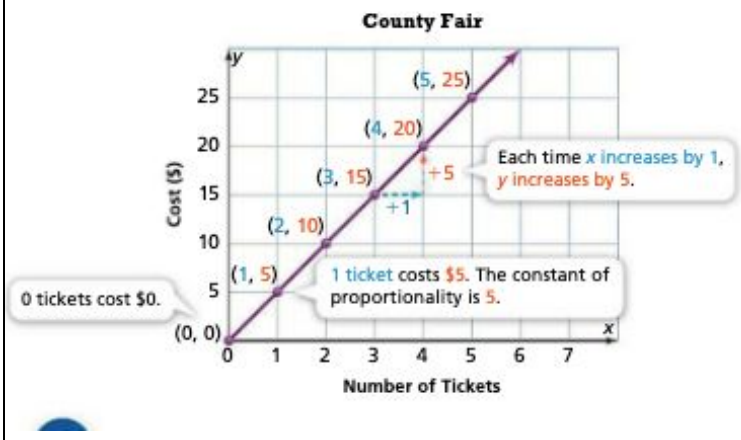
- **Proportional Reasoning** In Lesson 2-6, students determine whether a problem situation describes a proportional relationship in order to choose an appropriate solving strategy.

THE SCHOOL DISTRICT OF PHILADELPHIA

# Represent Proportional Relationships

- **Equations** In Lesson 2-4, students represent proportional relationships with equations in the form $y = kx$, where $k$ is the constant of proportionality that relates two proportional quantities.
- **Graphs** In Lesson 2-5, students graph proportional quantities on a coordinate plane. They understand that all of the $(x, y)$ pairs on the graph of a proportional relationship represent equivalent ratio pairs and solutions to the equation $y = kx$, where $k$ is the constant of proportionality.
- **Interpret Proportional Relationships** In Lesson 2-5, students also explain how each point $(x, y)$, including $(0, 0)$ and $(1, y)$, on the graph of a proportional relationship describes how the quantities are related.

The graph of a proportional relationship is a straight line through the origin. The equation $y = 5x$ represents the proportional situation.

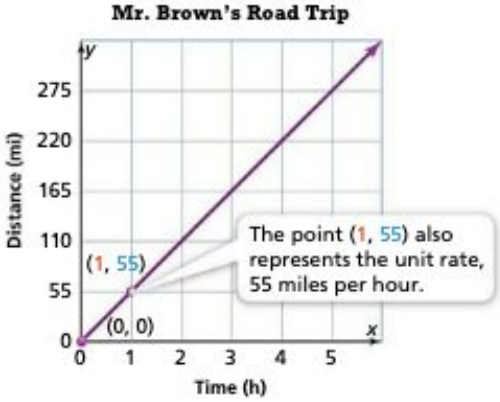



# Conceptual Understanding

- **Recognize Proportional Relationships** Students build on their understanding of equivalent rates and determine whether two quantities are in a proportional relationship. They may test for equivalent ratios in a table or graph the data on a coordinate plane.
- **Identify the Constant of Proportionality** Students know that the relationship between two quantities is preserved when both quantities are multiplied by the same number. They will learn how to identify such numbers as the unit rate, or the constant of proportionality, in tables, graphs, and verbal descriptions.
- **Represent Proportional Relationships with Equations** Students develop the equation $y = kx$ to represent a proportional relationship between the quantities $x$ and $y$. They identify the ratio $k = \frac{y}{x}$ as the constant of proportionality.

$$y = kx$$
$$\frac{y}{x} = \frac{kx}{x}$$
$$\frac{y}{x} = k$$

- **Understand Graphs of Proportional Relationships** Students explain what a point $(x, y)$ on the graph of a proportional relationship means with special attention to the points $(0, 0)$ and $(1, r)$, where $r$ is the unit rate.




(0, 0): Mr. Brown drives 0 miles in 0 hours.

(1, 55): Mr. Brown drives 55 miles in 1 hour.

**Ways to support your student:**

- Read the problem outloud to them.
- Remember, the topic is about situations so ask students to summarize the problem/visual/equation in their own words first. And then ask them what they notice about the relationships between the two variables or the two quantities.
- Before giving your student the answer to their question or specific help, ask them “What have you tried so far?, What do you know?, What might be a next step?
- After your student has solved it, and before you tell them it’s correct or not, have them explain to you how they got their solution and if they think their answer makes sense.

**Online Resources for Students:**

- https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-ratio-proportion - (whole module)
- https://www.mathplayground.com/JakeVSAstro_Archive09.html - online practice around this topic

Name _____

Topic **2**
Readiness Assessment

**1.** The teachers at a middle school voted for one of two locations for the school party. There were 30 votes for the skating rink and 13 votes for the bowling alley. What is the ratio of the number of votes for skating to the number of votes for bowling?

Ⓐ $\frac{30}{43}$ Ⓒ $\frac{13}{30}$

Ⓑ $\frac{13}{43}$ Ⓓ $\frac{30}{13}$

**2.** Which ratio below is equivalent to the ratio 7 : 350?

Ⓐ 17 : 950 Ⓒ 17 : 875

Ⓑ 17 : 900 Ⓓ 17 : 850

**3.** The list below shows the number of medals that one nation's team won at the Olympics. What is the ratio of gold medals to the total number of medals that the team won?

| | |
|---|---|
| **Gold** | 34 |
| **Silver** | 30 |
| **Bronze** | 39 |

Ⓐ 34 to 93 Ⓒ 103 to 34

Ⓑ 34 to 103 Ⓓ 34 to 69

**4.** Which two ratios are equivalent to 10 : 12?

Ⓐ 11 : 13 and 20 : 24

Ⓑ 10 : 12 and 11 : 13

Ⓒ 5 : 6 and 20 : 24

Ⓓ 5 : 6 and 11 : 13

**5.** Alondra is nearly 6 feet tall. Her normal stride is 24 inches long. She wants to walk 5 miles each day for exercise. The table below shows how many strides Alondra takes as she builds up to walking 5 miles. How many strides will Alondra take to walk 4 miles?

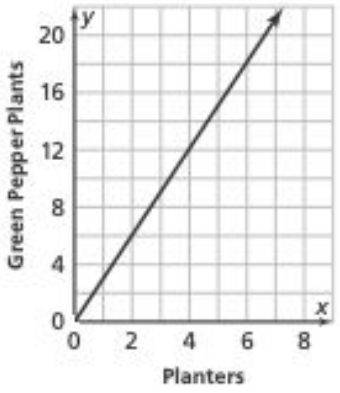
**Exercise Log**

| **Miles** | 1 | 2 | 4 | 5 |
|---|---|---|---|---|
| **Strides** | 2,640 | 5,280 | | 13,200 |

Ⓐ 7,920 Ⓒ 10,560

Ⓑ 9,240 Ⓓ 10,660

**6.** Mr. Drew grows green pepper plants in planters. The graph shows the relationship between the number of planters and the number of pepper plants. How many pepper plants are in 3 planters?




Ⓐ 18 Ⓒ 9

Ⓑ 12 Ⓓ 3



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

**7.** Julia can make a key chain in 1 minute 35 seconds. At this rate, which is closest to the amount of time she will need to make 8 key chains?

Ⓐ 1 minute
Ⓑ 2 minutes
Ⓒ 8 minutes
Ⓓ 12 minutes

---

**8.** Which number correctly completes the ratio table?

| | | | |
|---|---|---|---|
| 2 | 8 | 13 | 14 |
| 16 | | 104 | 112 |

Ⓐ 64
Ⓑ 48
Ⓒ 40
Ⓓ 32

---

**9.** The ratio table below shows the conversion between centigrams and milligrams. How many centigrams would be equal to 0.3 milligram?

| Centigrams | Milligrams |
|---|---|
| 1,000 | 10,000 |
| 100 | 1,000 |
| 10 | 100 |
| 1 | 10 |

Ⓐ 0.03
Ⓑ 0.3
Ⓒ 3
Ⓓ 30

**10.** A loading dock manager is unpacking a delivery truck that has 57 boxes of shoes and 26 boxes of socks. What is the ratio of boxes of socks to boxes of shoes?

Ⓐ 26 : 83
Ⓑ 26 : 57
Ⓒ 57 : 83
Ⓓ 57 : 26

---

**11.** Carlos is going on a boat tour. The boat will travel a total distance of 35 kilometers during the 7-hour tour. If the boat travels at a constant speed during the tour, what distance should the boat travel in 3 hours?

Ⓐ 5 km
Ⓑ 13 km
Ⓒ 15 km
Ⓓ 32 km

---

**12.** Greg has a table that is 3.75 meters in length. He wants to make a tablecloth that is 20 centimeters longer on each end than the table. What steps should Greg use to determine the correct number of centimeters to make the tablecloth?

| Metric Units of Length |
|---|
| 10 millimeters = 1 centimeter |
| 100 centimeters = 1 meter |
| 1,000 meters = 1 kilometer |

Ⓐ Use $(3.75 \times \frac{1}{100})$ and then add 40.
Ⓑ Use $(3.75 \times \frac{1}{100})$ and then add 20.
Ⓒ Use $(3.75 \times \frac{100}{1})$ and then add 20.
Ⓓ Use $(3.75 \times \frac{100}{1})$ and then add 40.


Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

GET READY! TOPIC 2

# Review What You Know!

## Vocabulary

**Choose the best term from the box to complete each definition.**

complex fraction
equivalent ratios
rate
ratio
terms

**1.** The quantities $x$ and $y$ in the ratio $\frac{x}{y}$ are called _____.

**2.** $\frac{2 \text{ dogs}}{3 \text{ cats}}$ and $\frac{10 \text{ dogs}}{15 \text{ cats}}$ are an example of _____.

**3.** A(n) _____ is a type of ratio that has both terms expressed in different units.

**4.** A(n) _____ has a fraction in its numerator, denominator, or both.

## Equivalent Ratios

**Complete each equivalent ratio.**

**5.** $\frac{4 \text{ boys}}{7 \text{ girls}} = \frac{8 \text{ boys}}{\square \text{ girls}}$

**6.** $\frac{16 \text{ tires}}{4 \text{ cars}} = \frac{\square \text{ tires}}{1 \text{ car}}$

**7.** $\frac{8 \text{ correct}}{10 \text{ total}} = \frac{\square \text{ correct}}{50 \text{ total}}$

**8.** $\frac{16 \text{ pearls}}{20 \text{ opals}} = \frac{8 \text{ pearls}}{\square \text{ opals}}$

**9.** $\frac{32 \text{ pencils}}{8 \text{ erasers}} = \frac{8 \text{ pencils}}{\square \text{ erasers}}$

**10.** $\frac{7 \text{ balls}}{9 \text{ bats}} = \frac{\square \text{ balls}}{27 \text{ bats}}$

## Rates

**Write each situation as a rate.**

**11.** John travels 150 miles in 3 hours.

**12.** Cameron ate 5 apples in 2 days.

## Equations

**Write an equation that represents the pattern in the table.**

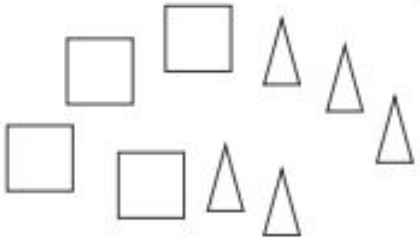
**13.**

| $x$ | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|
| $y$ | 12 | 15 | 18 | 21 | 24 |

Name _____

Reteach to Build Understanding
**2-1**

A ratio is a relationship in which for every *x* units of one quantity there are *y* units of another quantity. There are three ways to write the ratio that relates the number of squares to the number of triangles.



$\frac{4}{5}$ 4 : 5 4 to 5

You can find equivalent ratios by multiplying or dividing both terms of a given ratio by the same nonzero number.

$\frac{8}{10} \overset{\times 3}{\underset{\times 3}{=}} \frac{24}{30}$ $\frac{8}{10} \overset{\div 2}{\underset{\div 2}{=}} \frac{4}{5}$

Alyssa's lemonade recipe calls for 9 lemons for every 2.5 gallons of water. Brian's recipe calls for 12 lemons for every 4 gallons of water. Whose lemonade will require more water if they each use 36 lemons?

**1.** Complete the tables of equivalent ratios to find out how much water each recipe requires if 36 lemons are used.

| Alyssa | |
|---|---|
| **Number of Lemons** | **Gallons of Water** |
| 9 | 2.5 |
| 18 | 5 |
| | 7.5 |
| | 10 |

$\times \square$ $\times 3$

| Brian | |
|---|---|
| **Number of Lemons** | **Gallons of Water** |
| 12 | 4 |
| 24 | |
| | |

**2.** How many gallons of water will Alyssa need?

**3.** How many gallons of water will Brian need?

**4.** Whose recipe requires more water?

## On the Back!

**5.** Mayumi hikes 3 miles in 2 hours. Edwin hikes 4 miles in 3 hours. Who takes more time to complete a 12-mile hiking trail? How much more time?



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

Name _____

Build Mathematical Literacy
**2-1**

**Read the word problem below. Then answer the questions to identify the steps for solving the problem.**

Miguel pays $42.99 per month at Be Fit Gym. Jina pays $215.94 every 6 months at Main Street Gym. Which gym is more expensive? How much more does membership at that gym cost each month?

1. Underline the two questions that you need to answer.

2. Circle the information you are given in the problem.

3. Can you compare the two dollar amounts exactly as they are given in the problem? Explain.

4. What is the first step in solving the problem?

5. One student finds the number of months for $1 and another finds the number of dollars for 1 month. Which unit rate is more helpful in solving the problem?

6. What two pieces of information must you include in order to give a complete solution for this problem?

Name _____

Additional Vocabulary Support
**2-1**

Complete the vocabulary chart by filling in the missing information.

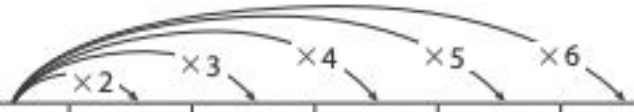
| Word or Phrase | Definition | Picture or Example |
|---|---|---|
| **ratio** | | 4 to 3, 4 : 3, or $\frac{4}{3}$ |
| **equivalent ratios** | Equivalent ratios are ratios that have different numbers but represent the same relationship. They can be found by multiplying or dividing both terms of a given ratio by the same nonzero number. | |
| **rate** | | $\frac{250 \text{ miles}}{5 \text{ hours}}$ <br> $\frac{36 \text{ eggs}}{3 \text{ cartons}}$ |
| **unit rate** | A unit rate compares *x* units of one quantity to 1 unit of another quantity. | |
| **unit price** | | $0.45 per apple |

Name _____

Reteach to Build Understanding
**2-2**

A train moves at a constant speed. The train travels 13 miles in $\frac{1}{6}$ hour. What is the train's speed in miles per hour?

**Step 1** Make a table of equivalent ratios.




| **Miles** | 13 | 26 | 39 | 52 | 65 | 78 |
|---|---|---|---|---|---|---|
| **Hours** | $\frac{1}{6}$ | $\frac{2}{6}$ | $\frac{3}{6}$ | $\frac{4}{6}$ | $\frac{5}{6}$ | $\frac{6}{6} = 1$ |

**Step 2** Identify the unit rate. The train travels $\frac{78 \text{ miles}}{1 \text{ hour}}$, or 78 miles per hour.

An elevator in a skyscraper rises 240 feet in $\frac{1}{5}$ minute. What is the elevator's rate in feet per minute?

**1.** Complete the table of equivalent ratios.

| **Feet** | 240 | | | | |
|---|---|---|---|---|---|
| **Minutes** | $\frac{1}{5}$ | $\frac{2}{5}$ | $\frac{3}{5}$ | $\frac{4}{5}$ | $\frac{5}{5} = 1$ |

**2.** Use the ratio $\frac{240}{\frac{1}{5}}$. What operation can you do on both terms to find an equivalent ratio that has 1 as the second term?

**3.** What is the elevator's rate in feet per minute?

## On the Back!

**4.** Elijah drives 9 miles to his friend's house in $\frac{1}{6}$ hour. How fast does Elijah drive, in miles per hour? If he drives at this rate for 2 hours, how far does he drive?

Name _____

Additional Vocabulary Support
**2-3**

**Use each of these words once to complete the sentences.**

| | | | |
|---|---|---|---|
| **equivalent** | **equivalent ratios** | **proportional** | **proportional relationship** |

1. The fraction $\frac{1}{4}$ is _____ to the decimal 0.25.

2. Each egg carton holds 12 eggs. The number of eggs is _____ to the number of egg cartons.

3. Because $\frac{45 \text{ dogs}}{15 \text{ cats}}$ and $\frac{15 \text{ dogs}}{5 \text{ cats}}$ are both equivalent to $\frac{3 \text{ dogs}}{1 \text{ cat}}$, the number of dogs and the number of cats are in a _____.

4. The ratios $\frac{4}{16}$ and $\frac{1}{4}$ are examples of _____.

**In each table, shade the row that contains the information you can use to determine whether the relationship between the quantities is proportional. Then circle *proportional* or *not proportional*.**

5.

| | | |
|---|---|---|
| **Time in Hours ($x$)** | 3 | 4 |
| **Distance in Miles ($y$)** | 180 | 240 |
| **$\frac{\text{Distance in Miles } (y)}{\text{Time in Hours } (x)}$** | 60 | 60 |

Proportional Not proportional

6.

| | | |
|---|---|---|
| **Number of Tanks ($x$)** | 1 | 3 |
| **Number of Fish ($y$)** | 12 | 39 |
| **$\frac{\text{Number of Fish } (y)}{\text{Number of Tanks } (x)}$** | 12 | 13 |

Proportional Not proportional

Name _____

Build Mathematical Literacy
**2-2**

**Review the Key Concept from the lesson. Then answer the questions to help you understand how to read a Key Concept.**

**KEY CONCEPT**

You can use what you know about equivalent ratios and operations with fractions to write a ratio of fractions as a unit rate.

Tia skateboards $\frac{2}{3}$ mile for every $\frac{1}{6}$ hour.

$$\frac{\frac{2}{3}}{\frac{1}{6}} = \frac{\frac{2}{3} \times \frac{6}{1}}{\frac{1}{6} \times \frac{6}{1}} = \frac{4}{1} = 4$$

| | | ×6 |
|---|---|---|
| **Miles** | $\frac{2}{3}$ | 4 |
| **Hours** | $\frac{1}{6}$ | 1 |
| | ×6 | |

She skateboards 4 miles per hour.

1. Circle the first ratio of fractions in the Key Concept box.

2. How does the complex fraction show you how to write the ratio of fractions as a unit rate?

3. How are the calculations shown in the table like the calculations with the complex fraction?

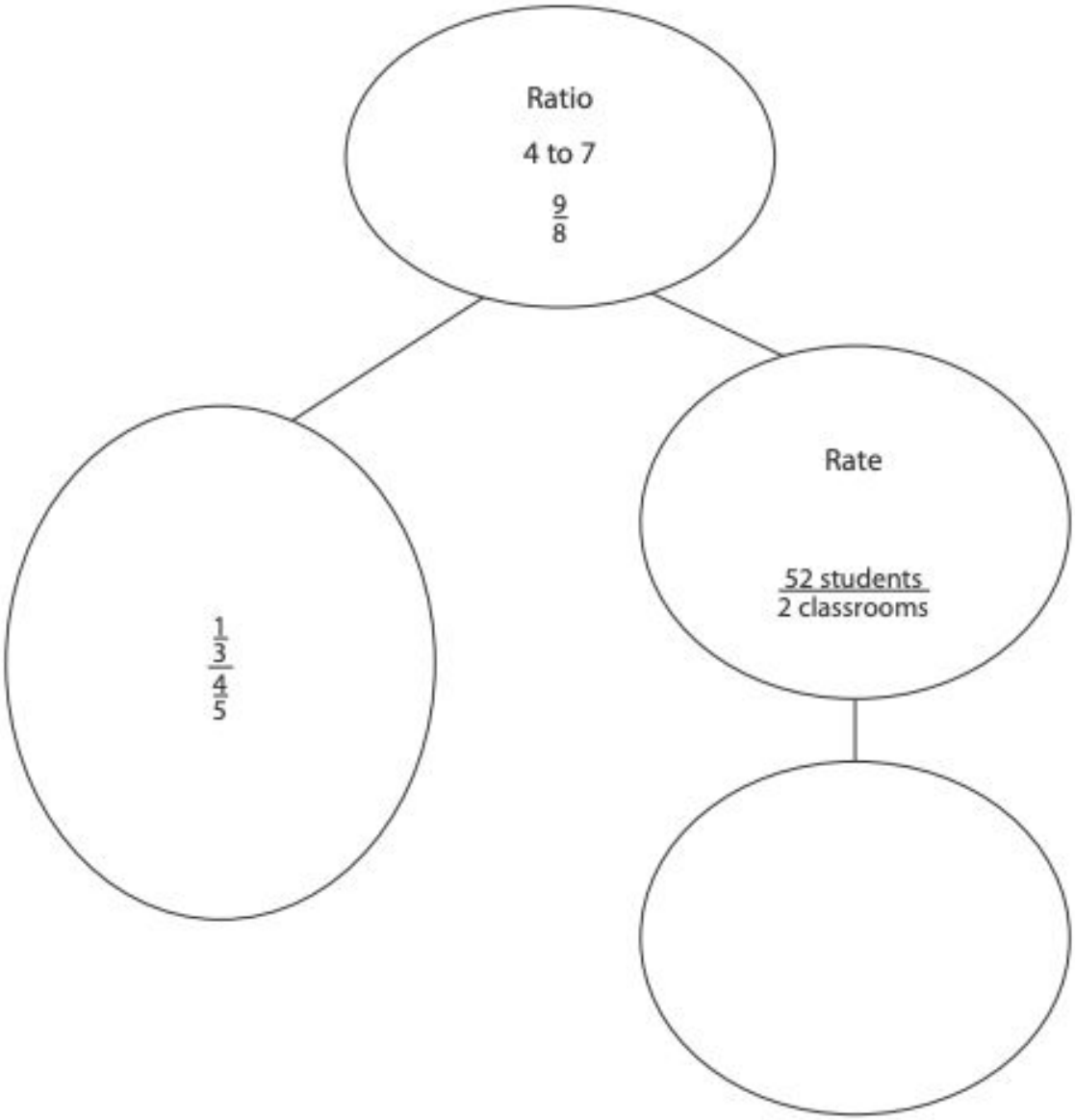
4. Does it matter whether you use a complex fraction or a table to find a unit rate? Explain.

Name _____

Additional Vocabulary Support
**2-2**

**Each section of the graphic organizer contains a vocabulary term and two examples. Use each item from the list below to complete the graphic organizer.**

| | | |
|---|---|---|
| complex fraction | 16 oranges for $4 | $\frac{4.5 \text{ cups of juice}}{1 \text{ pitcher}}$ |
| unit rate | $\frac{\frac{1}{2}}{\frac{2}{3}}$ | 17 feet per second |



Name _____

Reteach to Build Understanding
**2-3**

Two quantities have a proportional relationship if all of the ratios that relate the quantities are equivalent. This table shows a proportional relationship because all of the ratios $\frac{y}{x}$ are equivalent to 4.

| $x$ | 2 | 4 | 5 | 6 | 7 | 10 |
|---|---|---|---|---|---|---|
| $y$ | 8 | 16 | 20 | 24 | 28 | 40 |
| $\frac{y}{x}$ | $\frac{8}{2}=4$ | $\frac{16}{4}=4$ | $\frac{20}{5}=4$ | $\frac{24}{6}=4$ | $\frac{28}{7}=4$ | $\frac{40}{10}=4$ |

Sophie records the total number of cans of cat food she uses after different numbers of days. She wants to know if the number of cans of cat food she uses is proportional to the number of days.

After 3 days – 6 cans
After 4 days – 8 cans
After 9 days – 18 cans

**1.** Complete the table.

| **Number of Days ($x$)** | 3 | 4 | 9 |
|---|---|---|---|
| **Number of Cans ($y$)** | 6 | 8 | 18 |
| **$\frac{\text{Number of Cans } (y)}{\text{Number of Days } (x)}$** | $\frac{6}{3}=2$ | $\frac{\square}{\square}=\square$ | $\frac{\square}{\square}=\square$ |

**2.** Is the number of cans of cat food used proportional to the number of days? Explain.

**3.** How many cans of cat food will Sophie use after 12 days?

## On the Back!

**4.** Is the relationship between the number of books and the number of shelves proportional? Explain.

| **Number of Shelves ($x$)** | **Number of Books ($y$)** |
|---|---|
| 3 | 135 |
| 5 | 225 |
| 6 | 270 |

Name _____

Build Mathematical Literacy
**2-3**

**Read the problem below. Then answer the questions to understand the problem.**

The table below gives the prices of rose corsages at John's Flower Shop. Is there a proportional relationship between the number of roses in a corsage and the price of the corsage?

| Number of Roses | Price ($) |
|---|---|
| 1 | 5 |
| 2 | 10 |
| 3 | 15 |
| 4 | 20 |

1. Underline the question that you need to answer.

2. What is a proportional relationship between two quantities?

3. What information is given in the table?

4. What do you need to do to answer the question?

5. What ratios can you use to determine whether the relationship is proportional?

THE SCHOOL DISTRICT OF PHILADELPHIA

Name _____

Reteach to Build Understanding
**2-4**

Jack uses 1.5 cups of water for every 2 cups of raspberries to make a raspberry syrup. What is an equation that relates the amount of water to the amount of raspberries in the syrup?

**Step 1** Are the quantities proportional?

| **Cups of Raspberries ($x$)** | 2 | 4 | 6 |
|---|---|---|---|
| **Cups of Water ($y$)** | 1.5 | 3 | 4.5 |
| $\frac{y}{x}$ | $\frac{1.5}{2} = 0.75$ | $\frac{3}{4} = 0.75$ | $\frac{4.5}{6} = 0.75$ |

The quantities are proportional. The constant of proportionality is 0.75.

**Step 2** Write an equation in the form $y = kx$, where $k$ is the constant of proportionality, to relate proportional quantities $x$ and $y$.

Use $k = 0.75$. $y = kx$

$y = 0.75x$

The equation $y = 0.75x$ relates the amount of water to the amount of raspberries.

**1.** Complete the table to determine whether the quantities $x$ and $y$ are proportional.

| $x$ | 2 | 5 | 7 |
|---|---|---|---|
| $y$ | 4.5 | 11.25 | 15.75 |
| $\frac{y}{x}$ | $\frac{4.5}{2} = \square$ | $\frac{11.25}{\square} = \square$ | $\frac{\square}{7} = \square$ |

**2.** What is the constant of proportionality that relates the quantities $x$ and $y$?

$\frac{y}{x} = \square$

**3.** Write an equation that relates the quantities.

$y = kx$

$y = \square x$

## On the Back!

**4.** The table shows how the quantities $x$ and $y$ are related. Are the quantities proportional? Write an equation to represent the relationship.

| $x$ | 5 | 7 | 9 |
|---|---|---|---|
| $y$ | 6.5 | 9.1 | 11.7 |

Name _____

Build Mathematical Literacy
**2-4**

**Read the problem. Then answer the questions to help you write an equation.**

The Drama Club members sell magazine subscriptions to raise money. The total amount raised increases by $5 for every 10 subscriptions sold. Write an equation to represent this situation.

1. Circle the words that describe the quantities involved in the problem.

2. Underline the sentence in the problem that describes how the quantities are related. Then complete the table. Include a title for the quantity in the first column.

| | **Total Amount Raised ($)** |
|---|---|
| 10 | 5 |
| 20 | |
| 30 | |

3. How does the table help you see the relationship between the two quantities?

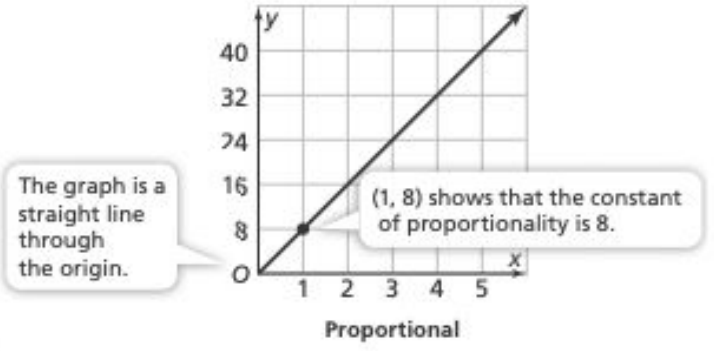
4. Circle the equation below that represents the relationship in the problem. Tell what $x$ and $y$ represent and explain your choice.

$y = 0.5x$ $y = 5x$ $y = 10x$

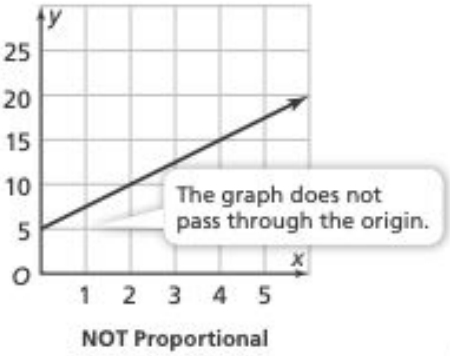
Name _____

Reteach to Build Understanding
**2-5**

The graph of a proportional relationship is a straight line through the origin, (0, 0).



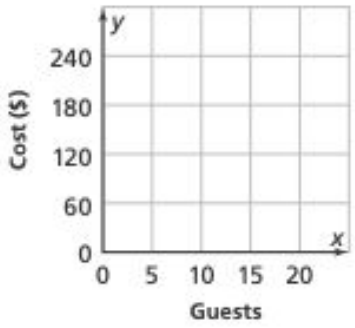

Proportional




NOT Proportional

**Mark is planning a birthday party at the local skating rink. The table shows the rates that are charged for parties at the skating rink. Is the number of guests proportional to the cost? If so, what is the constant of proportionality, and what does it mean in this situation?**

| Number of Guests ($x$) | Cost ($) ($y$) |
|---|---|
| 5 | 60 |
| 10 | 120 |
| 15 | 180 |
| 20 | 240 |




1. Graph the ordered pairs on a coordinate plane.
2. Is the graph a straight line?

   **YES** or **NO**
3. Does the graph go through the origin, (0, 0)?

   **YES** or **NO**
4. Is the cost proportional to the number of guests?

   **YES** or **NO**
5. What is the constant of proportionality, $\frac{y}{x}$?

   $\frac{y}{x} = \frac{\square}{\square} = \square$
6. The constant of proportionality describes how the quantities are related. The cost of each guest at the party is $\$\square$.

## On the Back!

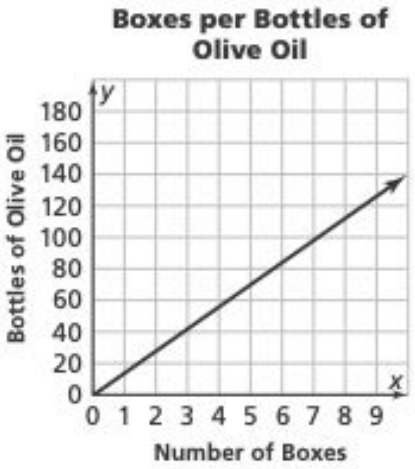
7. Draw an example of a graph of a proportional relationship. Identify the constant of proportionality.

Name _____

Build Mathematical Literacy
**2-5**

**Read the problem and connect it to the graph.**

A company ships bottles of olive oil to stores in boxes. The graph shows a proportional relationship between the number of boxes shipped and the number of bottles of olive oil shipped. About how many bottles are shipped in 8 boxes?




1. Underline the name of the quantity that is on the horizontal axis of the graph. Circle the name of the quantity that is on the vertical axis.

2. How can you tell that the graph represents a proportional relationship?

3. Find the point (0, 0) on the graph. How can you find what the *x*- and *y*-coordinates of this point represent?

4. What does the point (0, 0) mean?

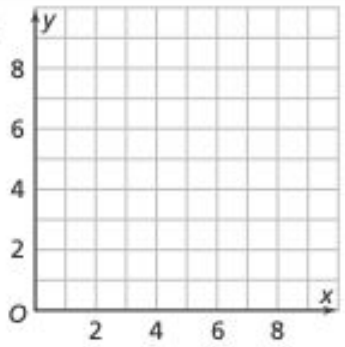
5. How can you use the graph to determine how many bottles are shipped in 8 boxes? Draw lines on the graph to help find the answer.

Name _____

Additional Vocabulary Support
**2-5**

**Choose the term from the list that best represents the item in each box.**

| | | |
|---|---|---|
| equivalent ratios | origin | coordinate plane |
| ordered pair | *x*-coordinate | constant of proportionality |
| ratio | unit rate | proportional relationship |

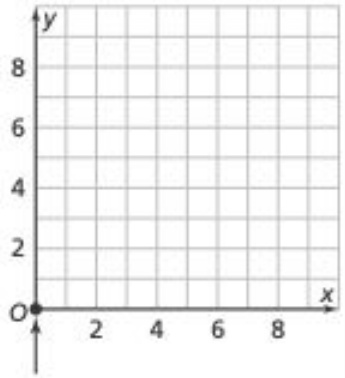
**1.** 


**2.** (5, 1)

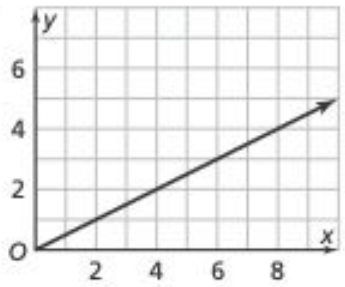
**3.** $\frac{5}{6}$

**4.** 40 miles per hour

**5.** $\frac{7}{15}$ and $\frac{21}{45}$

**6.** 


**7.** $y = 3.5x$

**8.** 


**9.** (7, 12)

Name _____

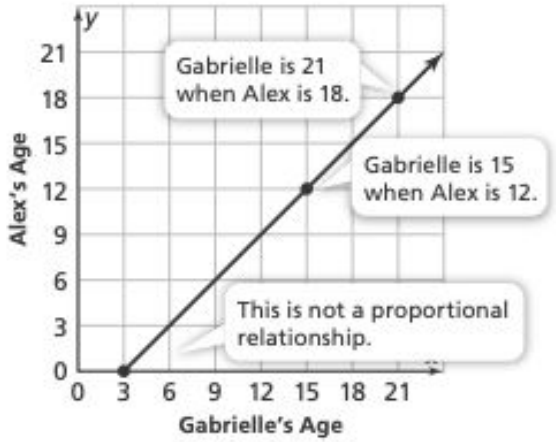
Reteach to Build Understanding
**2-6**

It is important to determine how quantities in a problem situation are related to determine whether you can use proportional reasoning.

**Gabrielle is 15 and Alex is 12. Do their ages form a proportional relationship?**

Graph a coordinate pair for their present ages on a coordinate plane and graph a coordinate pair for their ages in 6 years.

Draw a line through their ages and extend the line. The relationship is not proportional because the line does not pass through the origin.




**Sally collected 32 coins. The ratio of Sally's coins to Bill's coins is 4 : 7. If Sally and Bill each double the number of coins they have now, what is the ratio of Sally's coins to Bill's coins?**

1. Use equivalent ratios to find the number of coins Bill has. Let $b$ = the number of Bill's coins.

$$\frac{4}{\square} = \frac{32}{b}$$

$$\frac{4 \times 8}{\square \times \square} = \frac{32}{\square}$$

Bill has ☐ coins.

2. Find the ratio after they each double their number of coins.

Sally will have $2 \times 32 =$ ☐ coins. Bill will have $2 \times$ ☐ $=$ ☐ coins.

The ratio of the number of Sally's coins to the number of Bill's coins is now $\frac{\square}{\square}$.

3. How does this new ratio compare to the original ratio 4 : 7?

## On the Back!

4. A gift shop sells fruit baskets that each contain 4 apples and 3 oranges. If the shop owner orders 24 apples and 20 oranges, some fruit will be left over. How should the owner adjust the order so there is no fruit left over? Explain.

Name _____

Build Mathematical Literacy
**2-6**

**Read the problem below. Answer the questions to help you understand the problem.**

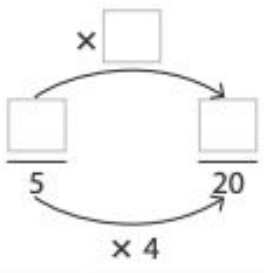
In Janelle's playlist, the ratio of pop songs to country songs is 6 : 5. There are 20 country songs. How many pop songs will she have if she doubles the number of each type of music on her playlist?

**1.** Choose the statement that will help you solve this problem. Explain your choice.

- ☐ The graph of a proportional relationship is a straight line through the origin.
- ☐ When two quantities are in a proportional relationship, all of the ratios that relate the quantities are equivalent.
- ☐ You can write a ratio involving fractions as a complex fraction.

**2.** If you multiply both terms of a ratio by the same nonzero number, does the ratio change? Explain your answer.

**3.** Use the information in the problem and proportional reasoning to complete the table. What other step is needed to solve the problem?



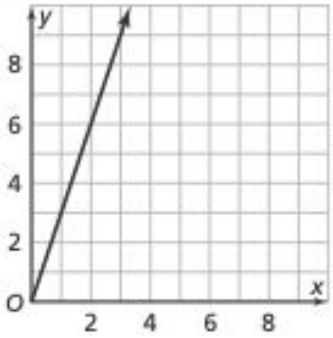
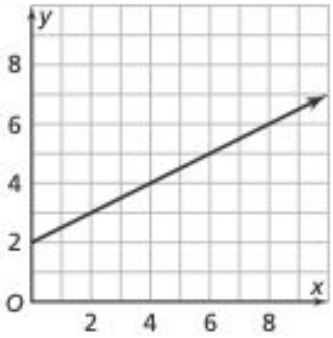
| Comparison | Equivalent Ratios |
|---|---|
| Pop songs<br>☐ | $\frac{\square}{5} \xrightarrow{\times \square} \frac{\square}{20}$<br>$\frac{\square}{5} \xrightarrow{\times 4} \frac{\square}{20}$ |

THE SCHOOL DISTRICT OF PHILADELPHIA

Name _____

Additional Vocabulary Support
**2-6**

**Determine whether each situation in the graphic organizer represents a proportional relationship. Write *proportional* or *not proportional*.**

| | | |
|---|---|---|
| **Graphs** |  |  |
| **Tables** | **x** \| **y**<br>4 \| 6<br>8 \| 12<br>12 \| 24<br>16 \| 30 | **x** \| **y**<br>2.5 \| 5<br>5 \| 10<br>7.5 \| 15<br>15 \| 30 |
| **Ratios** | $\frac{1}{3}$ $\frac{2}{5}$ $\frac{3}{8}$ | $\frac{20}{30}$ $\frac{40}{60}$ $\frac{60}{90}$ |
| **Words** | Diego drives 110 miles in 2 hours, 165 miles in 3 hours, and 220 miles in 4 hours. | Amy is 2 years older than Colin. |

# Answer Keys

Name _____

Topic **2**
Readiness Assessment

**1.** The teachers at a middle school voted for one of two locations for the school party. There were 30 votes for the skating rink and 13 votes for the bowling alley. What is the ratio of the number of votes for skating to the number of votes for bowling?

Ⓐ $\frac{30}{43}$ Ⓒ $\frac{13}{30}$

Ⓑ $\frac{13}{43}$ Ⓓ $\frac{30}{13}$

**2.** Which ratio below is equivalent to the ratio 7 : 350?

Ⓐ 17 : 950 Ⓒ 17 : 875

Ⓑ 17 : 900 Ⓓ 17 : 850

**3.** The list below shows the number of medals that one nation's team won at the Olympics. What is the ratio of gold medals to the total number of medals that the team won?

| | |
|---|---|
| **Gold** | 34 |
| **Silver** | 30 |
| **Bronze** | 39 |

Ⓐ 34 to 93 Ⓒ 103 to 34

Ⓑ 34 to 103 Ⓓ 34 to 69

**4.** Which two ratios are equivalent to 10 : 12?

Ⓐ 11 : 13 and 20 : 24

Ⓑ 10 : 12 and 11 : 13

Ⓒ 5 : 6 and 20 : 24

Ⓓ 5 : 6 and 11 : 13

**5.** Alondra is nearly 6 feet tall. Her normal stride is 24 inches long. She wants to walk 5 miles each day for exercise. The table below shows how many strides Alondra takes as she builds up to walking 5 miles. How many strides will Alondra take to walk 4 miles?

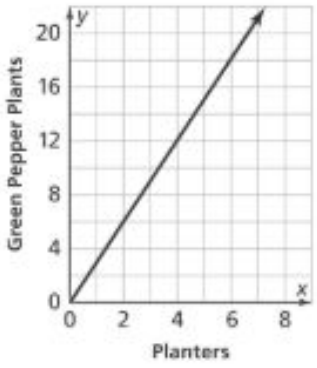
**Exercise Log**

| **Miles** | 1 | 2 | 4 | 5 |
|---|---|---|---|---|
| **Strides** | 2,640 | 5,280 | | 13,200 |

Ⓐ 7,920 Ⓒ 10,560

Ⓑ 9,240 Ⓓ 10,660

**6.** Mr. Drew grows green pepper plants in planters. The graph shows the relationship between the number of planters and the number of pepper plants. How many pepper plants are in 3 planters?




Ⓐ 18 Ⓒ 9

Ⓑ 12 Ⓓ 3



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

**7.** Julia can make a key chain in 1 minute 35 seconds. At this rate, which is closest to the amount of time she will need to make 8 key chains?

Ⓐ 1 minute
Ⓑ 2 minutes
Ⓒ 8 minutes
Ⓓ 12 minutes

**8.** Which number correctly completes the ratio table?

| | | | |
|---|---|---|---|
| 2 | 8 | 13 | 14 |
| 16 | | 104 | 112 |

Ⓐ 64
Ⓑ 48
Ⓒ 40
Ⓓ 32

**9.** The ratio table below shows the conversion between centigrams and milligrams. How many centigrams would be equal to 0.3 milligram?

| Centigrams | Milligrams |
|---|---|
| 1,000 | 10,000 |
| 100 | 1,000 |
| 10 | 100 |
| 1 | 10 |

Ⓐ 0.03
Ⓑ 0.3
Ⓒ 3
Ⓓ 30

**10.** A loading dock manager is unpacking a delivery truck that has 57 boxes of shoes and 26 boxes of socks. What is the ratio of boxes of socks to boxes of shoes?

Ⓐ 26 : 83
Ⓑ 26 : 57
Ⓒ 57 : 83
Ⓓ 57 : 26

**11.** Carlos is going on a boat tour. The boat will travel a total distance of 35 kilometers during the 7-hour tour. If the boat travels at a constant speed during the tour, what distance should the boat travel in 3 hours?

Ⓐ 5 km
Ⓑ 13 km
Ⓒ 15 km
Ⓓ 32 km

**12.** Greg has a table that is 3.75 meters in length. He wants to make a tablecloth that is 20 centimeters longer on each end than the table. What steps should Greg use to determine the correct number of centimeters to make the tablecloth?

| Metric Units of Length |
|---|
| 10 millimeters = 1 centimeter |
| 100 centimeters = 1 meter |
| 1,000 meters = 1 kilometer |

Ⓐ Use $(3.75 \times \frac{1}{100})$ and then add 40.
Ⓑ Use $(3.75 \times \frac{1}{100})$ and then add 20.
Ⓒ Use $(3.75 \times \frac{100}{1})$ and then add 20.
Ⓓ Use $(3.75 \times \frac{100}{1})$ and then add 40.


Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

GET READY! TOPIC 2

# Review What You Know!

## Vocabulary

**Choose the best term from the box to complete each definition.**

complex fraction
equivalent ratios
rate
ratio
terms

1. The quantities $x$ and $y$ in the ratio $\frac{x}{y}$ are called terms.
2. $\frac{2 \text{ dogs}}{3 \text{ cats}}$ and $\frac{10 \text{ dogs}}{15 \text{ cats}}$ are an example of equivalent ratios.
3. A(n) rate is a type of ratio that has both terms expressed in different units.
4. A(n) complex fraction has a fraction in its numerator, denominator, or both.

## Equivalent Ratios

**Complete each equivalent ratio.**

5. $\frac{4 \text{ boys}}{7 \text{ girls}} = \frac{8 \text{ boys}}{14 \text{ girls}}$
6. $\frac{16 \text{ tires}}{4 \text{ cars}} = \frac{4 \text{ tires}}{1 \text{ car}}$
7. $\frac{8 \text{ correct}}{10 \text{ total}} = \frac{40 \text{ correct}}{50 \text{ total}}$
8. $\frac{16 \text{ pearls}}{20 \text{ opals}} = \frac{8 \text{ pearls}}{10 \text{ opals}}$
9. $\frac{32 \text{ pencils}}{8 \text{ erasers}} = \frac{8 \text{ pencils}}{2 \text{ erasers}}$
10. $\frac{7 \text{ balls}}{9 \text{ bats}} = \frac{21 \text{ balls}}{27 \text{ bats}}$

## Rates

**Write each situation as a rate.**

11. John travels 150 miles in 3 hours.
    $\frac{150 \text{ miles}}{3 \text{ hours}}$ or $\frac{50 \text{ miles}}{1 \text{ hour}}$
12. Cameron ate 5 apples in 2 days.
    $\frac{5 \text{ apples}}{2 \text{ days}}$

## Equations

**Write an equation that represents the pattern in the table.**

13.

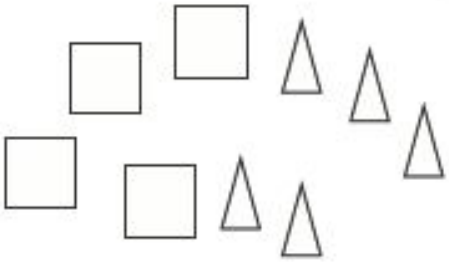
| $x$ | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|
| $y$ | 12 | 15 | 18 | 21 | 24 |

$y = 3x$

Name _____

Reteach to Build Understanding
**2-1**

A ratio is a relationship in which for every *x* units of one quantity there are *y* units of another quantity. There are three ways to write the ratio that relates the number of squares to the number of triangles.



$\frac{4}{5}$ 4 : 5 4 to 5

You can find equivalent ratios by multiplying or dividing both terms of a given ratio by the same nonzero number.

$\frac{8}{10} = \frac{24}{30}$ (×3) $\frac{8}{10} = \frac{4}{5}$ (÷2)

Alyssa's lemonade recipe calls for 9 lemons for every 2.5 gallons of water. Brian's recipe calls for 12 lemons for every 4 gallons of water. Whose lemonade will require more water if they each use 36 lemons?

1. Complete the tables of equivalent ratios to find out how much water each recipe requires if 36 lemons are used.

| Alyssa | |
|---|---|
| Number of Lemons | Gallons of Water |
| 9 | 2.5 |
| 18 | 5 |
| **27** | 7.5 |
| **36** | 10 |

×3 ×3

| Brian | |
|---|---|
| Number of Lemons | Gallons of Water |
| 12 | 4 |
| 24 | **8** |
| **36** | **12** |

2. How many gallons of water will Alyssa need? **10 gallons**
3. How many gallons of water will Brian need? **12 gallons**
4. Whose recipe requires more water? **Brian's**

**On the Back!**

5. Mayumi hikes 3 miles in 2 hours. Edwin hikes 4 miles in 3 hours. Who takes more time to complete a 12-mile hiking trail? How much more time?
**Edwin; 1 hour**


Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 

Name _____

Build Mathematical Literacy
**2-1**

**Read the word problem below. Then answer the questions to identify the steps for solving the problem.**

Miguel pays $42.99 per month at Be Fit Gym. Jina pays $215.94 every 6 months at Main Street Gym. Which gym is more expensive? How much more does membership at that gym cost each month?

1. Underline the two questions that you need to answer.
   **Check students' work.**
2. Circle the information you are given in the problem.
   **Check students' work.**
3. Can you compare the two dollar amounts exactly as they are given in the problem? Explain.
   **No; Miguel makes a monthly payment, but Jina pays every 6 months. The costs cannot be compared until the numbers of months are equivalent.**
4. What is the first step in solving the problem?
   **Find the unit rate for each gym membership.**
5. One student finds the number of months for $1 and another finds the number of dollars for 1 month. Which unit rate is more helpful in solving the problem?
   **Number of dollars for 1 month**
6. What two pieces of information must you include in order to give a complete solution for this problem?
   **Sample answer: A complete solution will include the name of the more expensive gym and the difference between the monthly costs of the two gym memberships.**

Name _____

Additional Vocabulary Support
**2-1**

Complete the vocabulary chart by filling in the missing information.

| Word or Phrase | Definition | Picture or Example |
|---|---|---|
| **ratio** | **Sample answer: A ratio is a relationship in which for every *x* units of one quantity there are *y* units of another quantity.** | 4 to 3, 4 : 3, or $\frac{4}{3}$ |
| **equivalent ratios** | Equivalent ratios are ratios that have different numbers but represent the same relationship. They can be found by multiplying or dividing both terms of a given ratio by the same nonzero number. | **Sample answer:** $\frac{4}{3} = \frac{4 \times 2}{3 \times 2} = \frac{8}{6}$, $\frac{6}{15} = \frac{6 \div 3}{15 \div 3} = \frac{2}{5}$ |
| **rate** | **Sample answer: A rate is a ratio that compares two quantities with different units of measure.** | $\frac{250 \text{ miles}}{5 \text{ hours}}$ $\frac{36 \text{ eggs}}{3 \text{ cartons}}$ |
| **unit rate** | A unit rate compares *x* units of one quantity to 1 unit of another quantity. | **Sample answer:** $\frac{50 \text{ miles}}{1 \text{ hour}}$, **or 50 miles per hour** |
| **unit price** | **Sample answer: A unit price is a unit rate that describes the price of 1 item.** | $0.45 per apple |



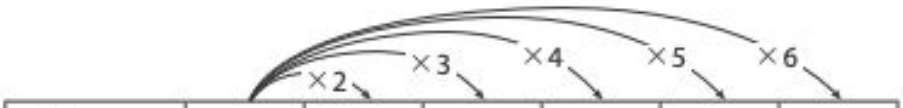
Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

Name _____

Reteach to Build Understanding
**2-2**

A train moves at a constant speed. The train travels 13 miles in $\frac{1}{6}$ hour. What is the train's speed in miles per hour?

**Step 1** Make a table of equivalent ratios.




| **Miles** | 13 | 26 | 39 | 52 | 65 | 78 |
|---|---|---|---|---|---|---|
| **Hours** | $\frac{1}{6}$ | $\frac{2}{6}$ | $\frac{3}{6}$ | $\frac{4}{6}$ | $\frac{5}{6}$ | $\frac{6}{6} = 1$ |

**Step 2** Identify the unit rate. The train travels $\frac{78 \text{ miles}}{1 \text{ hour}}$, or 78 miles per hour.

An elevator in a skyscraper rises 240 feet in $\frac{1}{5}$ minute. What is the elevator's rate in feet per minute?

**1.** Complete the table of equivalent ratios.

| **Feet** | 240 | **480** | **720** | **960** | **1,200** |
|---|---|---|---|---|---|
| **Minutes** | $\frac{1}{5}$ | $\frac{2}{5}$ | $\frac{3}{5}$ | $\frac{4}{5}$ | $\frac{5}{5} = 1$ |

**2.** Use the ratio $\frac{240}{\frac{1}{5}}$. What operation can you do on both terms to find an equivalent ratio that has 1 as the second term?

**Multiply by 5.**

**3.** What is the elevator's rate in feet per minute? **1,200 feet per minute**

**On the Back!**

**4.** Elijah drives 9 miles to his friend's house in $\frac{1}{6}$ hour. How fast does Elijah drive, in miles per hour? If he drives at this rate for 2 hours, how far does he drive? **54 miles per hour; 108 miles**

Name _____

Build Mathematical Literacy
**2-2**

**Review the Key Concept from the lesson. Then answer the questions to help you understand how to read a Key Concept.**

**KEY CONCEPT**

You can use what you know about equivalent ratios and operations with fractions to write a ratio of fractions as a unit rate.

Tia skateboards $\frac{2}{3}$ mile for every $\frac{1}{6}$ hour.

$$\frac{\frac{2}{3}}{\frac{1}{6}} = \frac{\frac{2}{3} \times \frac{6}{1}}{\frac{1}{6} \times \frac{6}{1}} = \frac{4}{1} = 4$$

| | | ×6 |
|---|---|---|
| **Miles** | $\frac{2}{3}$ | 4 |
| **Hours** | $\frac{1}{6}$ | 1 |
| | ×6 | |

She skateboards 4 miles per hour.

1. Circle the first ratio of fractions in the Key Concept box.
**Check students' work.**

2. How does the complex fraction show you how to write the ratio of fractions as a unit rate?
**Sample answer: The numerator $\left(\frac{2}{3}\right)$ and the denominator $\left(\frac{1}{6}\right)$ of the complex fraction are both multiplied by $\frac{6}{1}$. This makes an equivalent fraction in which the denominator is 1, and so it represents a unit rate.**

3. How are the calculations shown in the table like the calculations with the complex fraction?
**Sample answer: The table shows both terms of the ratio being multiplied by 6. This is the same as multiplying both terms by $\frac{6}{1}$ in the complex fraction.**

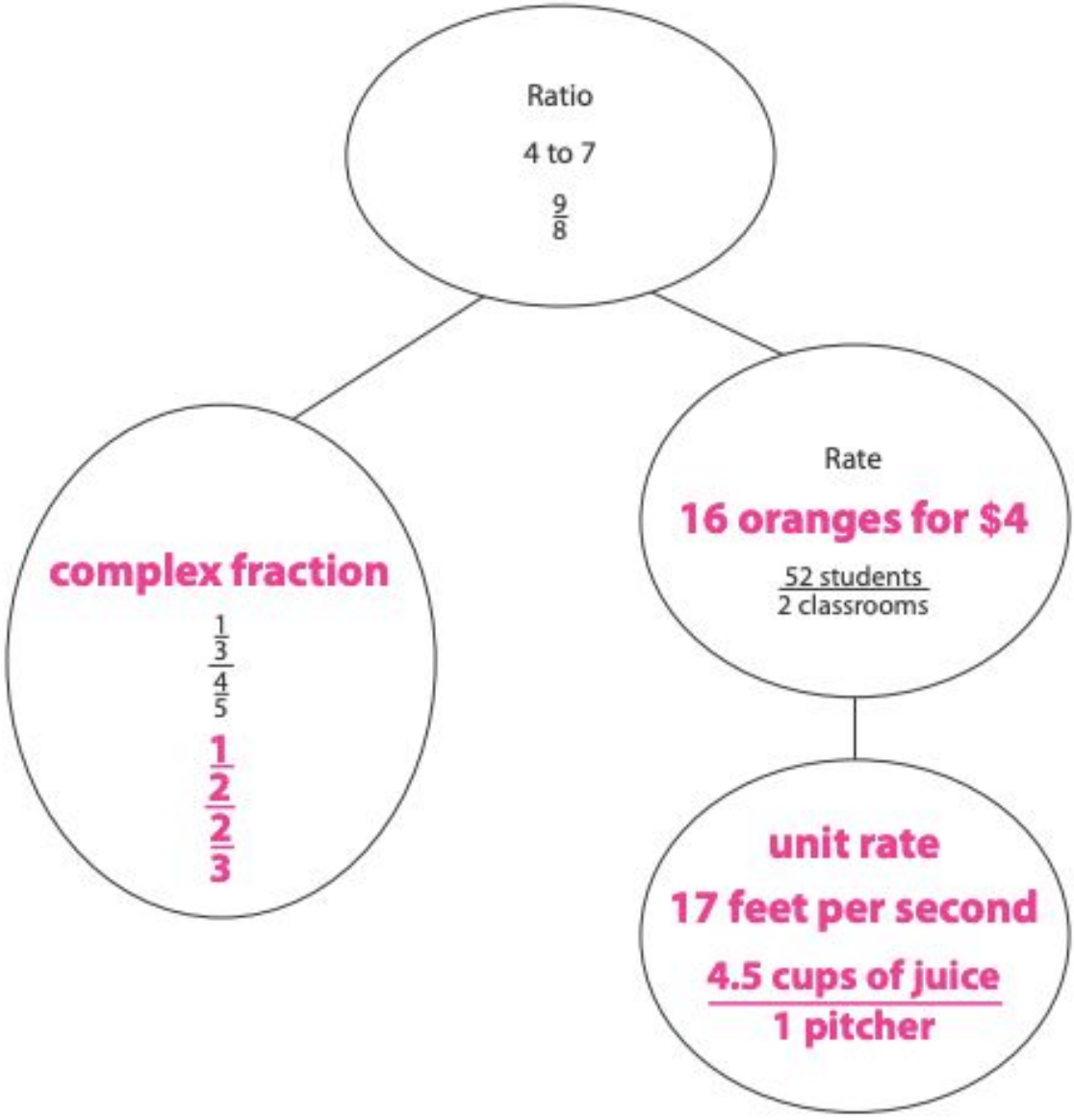
4. Does it matter whether you use a complex fraction or a table to find a unit rate? Explain.
**Sample answer: No; Whether you use a complex fraction or a table, you multiply both terms of the ratio by the same number to make an equivalent ratio in which the second term is 1.**

Name _____

Additional Vocabulary Support
**2-2**

**Each section of the graphic organizer contains a vocabulary term and two examples. Use each item from the list below to complete the graphic organizer.**

| | | |
|---|---|---|
| complex fraction | 16 oranges for \$4 | $\frac{4.5 \text{ cups of juice}}{1 \text{ pitcher}}$ |
| unit rate | $\frac{\frac{1}{2}}{\frac{2}{3}}$ | 17 feet per second |



Name _____

Reteach to Build Understanding
**2-3**

Two quantities have a proportional relationship if all of the ratios that relate the quantities are equivalent. This table shows a proportional relationship because all of the ratios $\frac{y}{x}$ are equivalent to 4.

| $x$ | 2 | 4 | 5 | 6 | 7 | 10 |
|---|---|---|---|---|---|---|
| $y$ | 8 | 16 | 20 | 24 | 28 | 40 |
| $\frac{y}{x}$ | $\frac{8}{2}=4$ | $\frac{16}{4}=4$ | $\frac{20}{5}=4$ | $\frac{24}{6}=4$ | $\frac{28}{7}=4$ | $\frac{40}{10}=4$ |

Sophie records the total number of cans of cat food she uses after different numbers of days. She wants to know if the number of cans of cat food she uses is proportional to the number of days.

After 3 days – 6 cans
After 4 days – 8 cans
After 9 days – 18 cans

**1.** Complete the table.

| **Number of Days ($x$)** | 3 | 4 | 9 |
|---|---|---|---|
| **Number of Cans ($y$)** | 6 | 8 | 18 |
| **$\frac{\text{Number of Cans } (y)}{\text{Number of Days } (x)}$** | $\frac{6}{3}=2$ | $\frac{8}{4}=2$ | $\frac{18}{9}=2$ |

**2.** Is the number of cans of cat food used proportional to the number of days? Explain.

**Yes; the ratio $\frac{y}{x}$ for each data pair is equivalent to 2.**

**3.** How many cans of cat food will Sophie use after 12 days? **24**

**On the Back!**

**4.** Is the relationship between the number of books and the number of shelves proportional? Explain.

| **Number of Shelves ($x$)** | **Number of Books ($y$)** |
|---|---|
| 3 | 135 |
| 5 | 225 |
| 6 | 270 |

**Yes; The ratio $\frac{y}{x}$ for each data pair is equivalent to 45.**

Name _____

Build Mathematical Literacy
**2-3**

**Read the problem below. Then answer the questions to understand the problem.**

The table below gives the prices of rose corsages at John's Flower Shop. Is there a proportional relationship between the number of roses in a corsage and the price of the corsage?

| Number of Roses | Price ($) |
|---|---|
| 1 | 5 |
| 2 | 10 |
| 3 | 15 |
| 4 | 20 |

1. Underline the question that you need to answer.
**Check students' work.**

2. What is a proportional relationship between two quantities?
**Sample answer: A relationship in which all the ratios that relate the quantities are equivalent.**

3. What information is given in the table?
**The table gives prices for rose corsages containing 1 to 4 roses.**

4. What do you need to do to answer the question?
**Sample answer: Determine whether all of the ratios that relate the price of a corsage to the number of roses in the corsage are equivalent.**

5. What ratios can you use to determine whether the relationship is proportional?
$\frac{5}{1}, \frac{10}{2}, \frac{15}{3}$, and $\frac{20}{4}$

Name _____

Additional Vocabulary Support
**2-3**

**Use each of these words once to complete the sentences.**

| | | | |
|---|---|---|---|
| **equivalent** | **equivalent ratios** | **proportional** | **proportional relationship** |

1. The fraction $\frac{1}{4}$ is **equivalent** to the decimal 0.25.

2. Each egg carton holds 12 eggs. The number of eggs is **proportional** to the number of egg cartons.

3. Because $\frac{45 \text{ dogs}}{15 \text{ cats}}$ and $\frac{15 \text{ dogs}}{5 \text{ cats}}$ are both equivalent to $\frac{3 \text{ dogs}}{1 \text{ cat}}$, the number of dogs and the number of cats are in a **proportional relationship**.

4. The ratios $\frac{4}{16}$ and $\frac{1}{4}$ are examples of **equivalent ratios**.

**In each table, shade the row that contains the information you can use to determine whether the relationship between the quantities is proportional. Then circle *proportional* or *not proportional*.**

5.

| **Time in Hours ($x$)** | 3 | 4 |
|---|---|---|
| **Distance in Miles ($y$)** | 180 | 240 |
| **$\frac{\text{Distance in Miles } (y)}{\text{Time in Hours } (x)}$** | 60 | 60 |

(Proportional) Not proportional

6.

| **Number of Tanks ($x$)** | 1 | 3 |
|---|---|---|
| **Number of Fish ($y$)** | 12 | 39 |
| **$\frac{\text{Number of Fish } (y)}{\text{Number of Tanks } (x)}$** | 12 | 13 |

Proportional (Not proportional)

THE SCHOOL DISTRICT OF PHILADELPHIA

Name _____

Reteach to Build Understanding
**2-4**

Jack uses 1.5 cups of water for every 2 cups of raspberries to make a raspberry syrup. What is an equation that relates the amount of water to the amount of raspberries in the syrup?

**Step 1** Are the quantities proportional?

| **Cups of Raspberries ($x$)** | 2 | 4 | 6 |
|---|---|---|---|
| **Cups of Water ($y$)** | 1.5 | 3 | 4.5 |
| $\frac{y}{x}$ | $\frac{1.5}{2} = 0.75$ | $\frac{3}{4} = 0.75$ | $\frac{4.5}{6} = 0.75$ |

The quantities are proportional. The constant of proportionality is 0.75.

**Step 2** Write an equation in the form $y = kx$, where $k$ is the constant of proportionality, to relate proportional quantities $x$ and $y$.

Use $k = 0.75$. $y = kx$

$y = 0.75x$

The equation $y = 0.75x$ relates the amount of water to the amount of raspberries.

**1.** Complete the table to determine whether the quantities $x$ and $y$ are proportional.

| $x$ | 2 | 5 | 7 |
|---|---|---|---|
| $y$ | 4.5 | 11.25 | 15.75 |
| $\frac{y}{x}$ | $\frac{4.5}{2} =$ **2.25** | $\frac{11.25}{5} =$ **2.25** | $\frac{15.75}{7} =$ **2.25** |

**2.** What is the constant of proportionality that relates the quantities $x$ and $y$?

$\frac{y}{x} =$ **2.25**

**3.** Write an equation that relates the quantities.

$y = kx$

$y =$ **2.25** $x$

**On the Back!**

**4.** The table shows how the quantities $x$ and $y$ are related. Are the quantities proportional? Write an equation to represent the relationship.

| $x$ | 5 | 7 | 9 |
|---|---|---|---|
| $y$ | 6.5 | 9.1 | 11.7 |

**Yes; $y = 1.3x$**

Name _____

Build Mathematical Literacy
**2-4**

**Read the problem. Then answer the questions to help you write an equation.**

The Drama Club members sell magazine subscriptions to raise money. The total amount raised increases by $5 for every 10 subscriptions sold. Write an equation to represent this situation.

1. Circle the words that describe the quantities involved in the problem.

   **Check students' work.**

2. Underline the sentence in the problem that describes how the quantities are related. Then complete the table. Include a title for the quantity in the first column.

   **Check students' work.**

| Number of Subscriptions Sold | Total Amount Raised ($) |
|---|---|
| 10 | 5 |
| 20 | 10 |
| 30 | 15 |

3. How does the table help you see the relationship between the two quantities?

   **Sample answer: The table shows that the amount raised, in dollars, is half the number of subscriptions sold.**

4. Circle the equation below that represents the relationship in the problem. Tell what $x$ and $y$ represent and explain your choice.

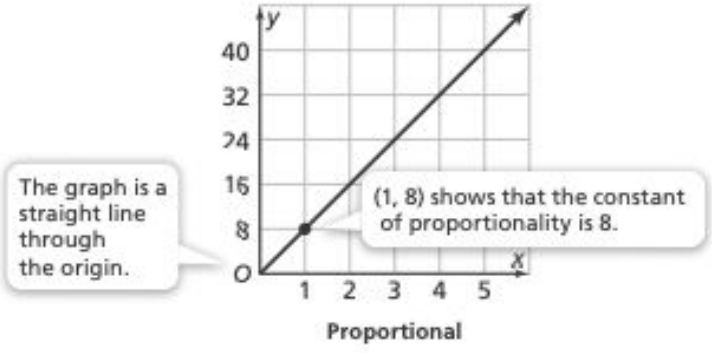
   $y = 0.5x$ $\qquad$ $y = 5x$ $\qquad$ $y = 10x$

   **Let $x$ represent the number of subscriptions sold. Let $y$ represent the total amount raised. The amount raised is always half the number of subscriptions sold, so the constant of proportionality, $\frac{y}{x}$, is 0.5.**

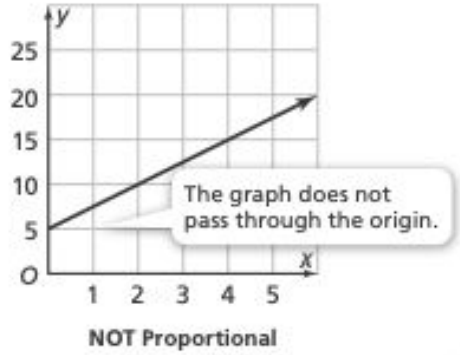
Name _____

Reteach to Build Understanding
**2-5**

The graph of a proportional relationship is a straight line through the origin, (0, 0).




Proportional

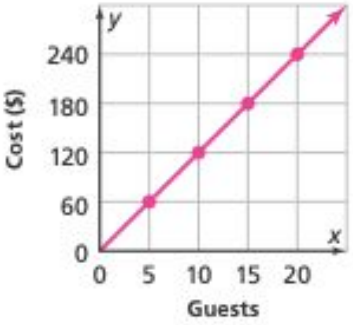



NOT Proportional

**Mark is planning a birthday party at the local skating rink. The table shows the rates that are charged for parties at the skating rink. Is the number of guests proportional to the cost? If so, what is the constant of proportionality, and what does it mean in this situation?**

| Number of Guests ($x$) | Cost ($) ($y$) |
|---|---|
| 5 | 60 |
| 10 | 120 |
| 15 | 180 |
| 20 | 240 |

1. Graph the ordered pairs on a coordinate plane.




2. Is the graph a straight line?

   **YES** or **NO**

3. Does the graph go through the origin, (0, 0)?

   **YES** or **NO**

4. Is the cost proportional to the number of guests?

   **YES** or **NO**

5. What is the constant of proportionality, $\frac{y}{x}$?

   $\frac{y}{x} = \frac{60}{5} = 12$

6. The constant of proportionality describes how the quantities are related. The cost of each guest at the party is $12.

**On the Back!** **Check students' work.**

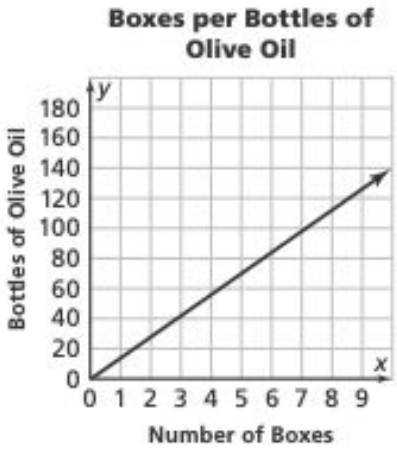
7. Draw an example of a graph of a proportional relationship. Identify the constant of proportionality.

Name _____

Build Mathematical Literacy
**2-5**

**Read the problem and connect it to the graph.**

A company ships bottles of olive oil to stores in boxes. The graph shows a proportional relationship between the number of boxes shipped and the number of bottles of olive oil shipped. About how many bottles are shipped in 8 boxes?




1. Underline the name of the quantity that is on the horizontal axis of the graph. Circle the name of the quantity that is on the vertical axis.
   **Check students' work.**

2. How can you tell that the graph represents a proportional relationship?
   **The graph is a straight line through the origin.**

3. Find the point (0, 0) on the graph. How can you find what the *x*- and *y*-coordinates of this point represent?
   **Read the labels on the axes; *x* represents a number of boxes, and *y* represents a number of bottles.**

4. What does the point (0, 0) mean?
   **The company ships 0 bottles when it ships 0 boxes.**

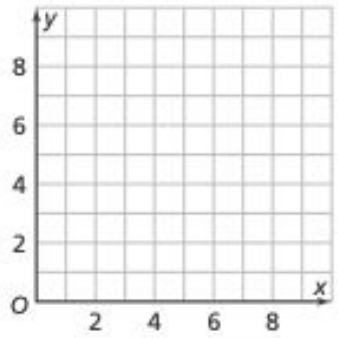
5. How can you use the graph to determine how many bottles are shipped in 8 boxes? Draw lines on the graph to help find the answer.
   **Sample answer: Draw a vertical line from 8 on the *x*-axis. From the point where this line intersects the graph, draw a horizontal line to the *y*-axis. The number at the point where this line intersects the *y*-axis is the number of bottles. Check students' work.**

Name _____

Additional Vocabulary Support
**2-5**

**Choose the term from the list that best represents the item in each box.**

| | | |
|---|---|---|
| equivalent ratios | origin | coordinate plane |
| ordered pair | *x*-coordinate | constant of proportionality |
| ratio | unit rate | proportional relationship |

**1.** 


**coordinate plane**

**2.** (5, 1)

**ordered pair**

**3.** $\frac{5}{6}$

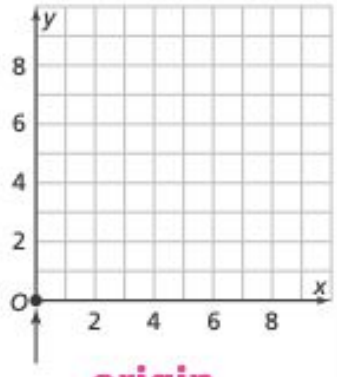
**ratio**

**4.** 40 miles per hour

**unit rate**

**5.** $\frac{7}{15}$ and $\frac{21}{45}$

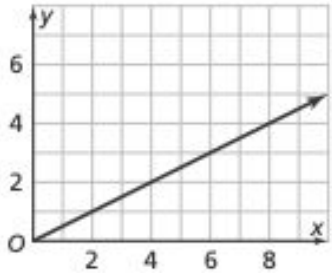
**equivalent ratios**

**6.** 


**origin**

**7.** $y = 3.5x$

**constant of proportionality**

**8.** 


**proportional relationship**

**9.** (7, 12)

***x*-coordinate**

Name _____

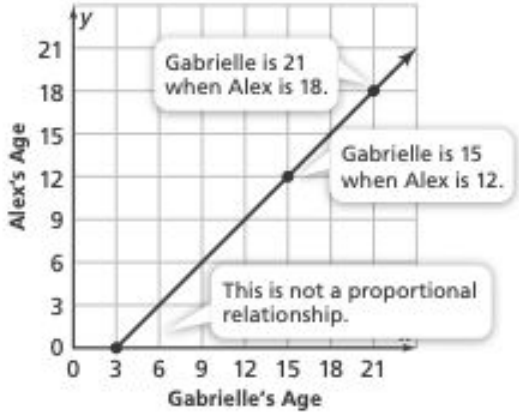
Reteach to Build Understanding
**2-6**

It is important to determine how quantities in a problem situation are related to determine whether you can use proportional reasoning.

**Gabrielle is 15 and Alex is 12. Do their ages form a proportional relationship?**

Graph a coordinate pair for their present ages on a coordinate plane and graph a coordinate pair for their ages in 6 years.

Draw a line through their ages and extend the line. The relationship is not proportional because the line does not pass through the origin.




**Sally collected 32 coins. The ratio of Sally's coins to Bill's coins is 4 : 7. If Sally and Bill each double the number of coins they have now, what is the ratio of Sally's coins to Bill's coins?**

1. Use equivalent ratios to find the number of coins Bill has. Let $b$ = the number of Bill's coins.

$$\frac{4}{7} = \frac{32}{b}$$

$$\frac{4 \times 8}{7 \times 8} = \frac{32}{56}$$

Bill has **56** coins.

2. Find the ratio after they each double their number of coins.

Sally will have $2 \times 32 =$ **64** coins. Bill will have $2 \times$ **56** $=$ **112** coins.

The ratio of the number of Sally's coins to the number of Bill's coins is now $\frac{64}{112}$.

3. How does this new ratio compare to the original ratio 4 : 7?

**The ratios are equivalent.**

**On the Back!**

4. A gift shop sells fruit baskets that each contain 4 apples and 3 oranges. If the shop owner orders 24 apples and 20 oranges, some fruit will be left over. How should the owner adjust the order so there is no fruit left over? Explain.

**Sample answer: Order only 18 oranges; A table of equivalent ratios shows that, when all 24 apples are used, only 18 oranges are needed, and 2 of the 20 oranges are left over.**



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved.

Name _____

Build Mathematical Literacy
**2-6**

**Read the problem below. Answer the questions to help you understand the problem.**

In Janelle's playlist, the ratio of pop songs to country songs is 6 : 5. There are 20 country songs. How many pop songs will she have if she doubles the number of each type of music on her playlist?

**1.** Choose the statement that will help you solve this problem. Explain your choice.

- [ ] The graph of a proportional relationship is a straight line through the origin.
- [x] When two quantities are in a proportional relationship, all of the ratios that relate the quantities are equivalent.
- [ ] You can write a ratio involving fractions as a complex fraction.

**Sample answer: The problem can be solved using a ratio and a constant multiple of the terms, so I can use proportional reasoning.**

**2.** If you multiply both terms of a ratio by the same nonzero number, does the ratio change? Explain your answer.

**No; The ratio does not change when both terms are multiplied by the same nonzero number because all of the ratios remain equivalent to the original ratio.**

**3.** Use the information in the problem and proportional reasoning to complete the table. What other step is needed to solve the problem?

| Comparison | Equivalent Ratios |
|---|---|
| $\frac{\text{Pop songs}}{\text{Country songs}}$ | $\frac{6}{5} \xrightarrow{\times 4} \frac{24}{20}$ |

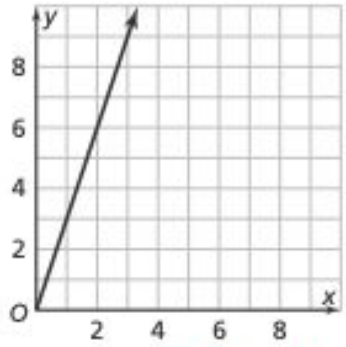
**The number of pop songs that are in the playlist now must be multiplied by 2.**

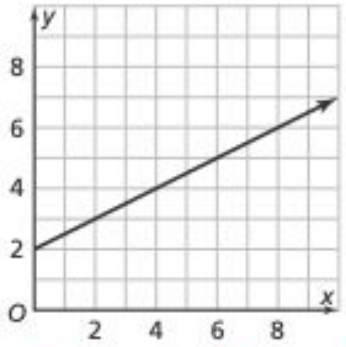
THE SCHOOL DISTRICT OF PHILADELPHIA

Name _____

Additional Vocabulary Support
**2-6**

**Determine whether each situation in the graphic organizer represents a proportional relationship. Write *proportional* or *not proportional*.**

<table>
<tr>
<td>Graphs</td>
<td> 

<br>proportional</td>
<td> 

<br>not proportional</td>
</tr>
<tr>
<td>Tables</td>
<td>
<table>
<tr><th>x</th><th>y</th></tr>
<tr><td>4</td><td>6</td></tr>
<tr><td>8</td><td>12</td></tr>
<tr><td>12</td><td>24</td></tr>
<tr><td>16</td><td>30</td></tr>
</table>
not proportional</td>
<td>
<table>
<tr><th>x</th><th>y</th></tr>
<tr><td>2.5</td><td>5</td></tr>
<tr><td>5</td><td>10</td></tr>
<tr><td>7.5</td><td>15</td></tr>
<tr><td>15</td><td>30</td></tr>
</table>
proportional</td>
</tr>
<tr>
<td>Ratios</td>
<td>$\frac{1}{3}$ $\frac{2}{5}$ $\frac{3}{8}$<br>not proportional</td>
<td>$\frac{20}{30}$ $\frac{40}{60}$ $\frac{60}{90}$<br>proportional</td>
</tr>
<tr>
<td>Words</td>
<td>Diego drives 110 miles in 2 hours, 165 miles in 3 hours, and 220 miles in 4 hours.<br>proportional</td>
<td>Amy is 2 years older than Colin.<br>not proportional</td>
</tr>
</table>

THE SCHOOL DISTRICT OF PHILADELPHIA

**Grade:** 7 **Subject:** Math (worksheets taken from enVision Mathematics, Grade 7)

**Topic:** Generate Equivalent Expressions

**What Your Student is Learning:**

- **Understand how variables are used to represent unknown values in problems.**
- **Recognize when two expressions are equivalent and use properties of operations to write equivalent expressions (and show how quantities are related in real-life applications).**
- **Combine like integer and rational terms (fraction/decimal/negative/positive numbers).**
- **Use the Distributive property to expand expressions and understand expanding an expression is the reverse of factoring.**
- **Use properties of operations to add/subtract expressions and use addition of expressions to model real-life applications.**

**Background and Context for Parents:**

## Recognize and Represent Expressions

- **Understanding Algebra** In Lesson 4-1, students write and evaluate algebraic expressions that represent real-life situations. In Lesson 4-2, students apply properties of operations (including the Distributive Property) to write equivalent expressions. They also examine expressions and recognize when they are equivalent.
- **Simplify Expressions** In Lesson 4-3, students use the Associative and Commutative Properties to reorder and group like terms. Students use models to combine like terms and simplify expressions represented by the models.

**STEP 1** Write the expression by grouping like terms together.

Use the Commutative and Associative Properties to reorder and group like terms.

$-2c + 3c - 5 - 4c + 7$

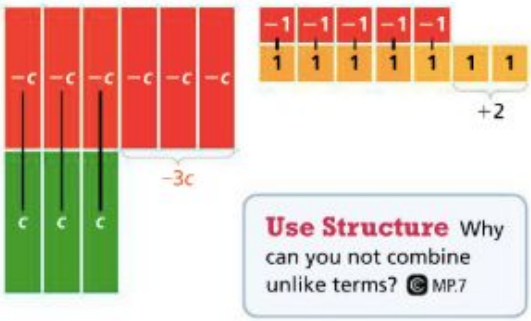
$= -2c + 3c - 4c - 5 + 7$

$= -2c - 4c + 3c - 5 + 7$

$= (-2c - 4c + 3c) + (-5 + 7)$

**STEP 2** Combine like terms.

$(-2c - 4c + 3c) + (-5 + 7)$




**Use Structure** Why can you not combine unlike terms? MP.7

## Use Properties

- **Expand Expressions** In Lesson 4-4, students use the Distributive Property to expand expressions. Students deepen their understanding of the Distributive Property as the complexity of the expressions increases to include more than one variable and rational coefficient.
- **Factor Expressions** In Lesson 4-5, students build on their knowledge of common factors to factor algebraic expressions. Students comprehend the inverse relationship between expanding and factoring. Students use area models in conjunction with common factors and the Distributive Property to factor expressions.

Use an area model to represent the area of the mural, $3x + 12$.

So, one possible set of dimensions of the mural with an area of $3x + 12$ could be 3 meters in length and $x + 4$ meters in height.

## Simplify Expressions

- **Adding Expressions** In Lesson 4-6, students apply the Commutative and Associative Properties to add expressions with rational coefficients. The problems increase in complexity by including more than one variable and by requiring regrouping. This lesson helps launch the students into the next lesson on subtraction of expressions.

$(2.40m - 125) + (1.80b - 92.40)$
$= 2.40m + 1.80b + (-125 - 92.40)$
$= 2.40m + 1.80b - 217.4$

Use the Commutative and Associative Properties.

The expression $2.40m + 1.80b - 217.4$ represents the profit from selling muffins and bagels.

- **Subtracting Expressions** In Lesson 4-7, students build on their prior knowledge of integer subtraction to subtract expressions. Students continue to apply the Commutative and Associative Properties to simplify the expressions. They also use the Distributive Property to re-write certain subtraction expressions as addition of the inverse.

Use properties of operations to subtract the expressions.

(area of pool + tiles) − (area of pool)

$= 18(2x + 18) - 14(2x + 14)$
$= 36x + 324 - 28x - 196$
$= 36x - 28x + 324 - 196$
$= 8x + 128$

First, use the Distributive Property.

Then, use the Commutative Property.

The area of the tiled border is $8x + 128$ ft$^2$.

## Conceptual Understanding

- **Analyze Equivalent Expressions** Students generate equivalent expressions to provide different perspectives on a problem. They make tables of values to compare and identify equivalent expressions.

$3(x - 5)$

| $x$ | Value of Expression |
|---|---|
| 1 | |
| 2 | |
| 3 | |

$3x - 15$

| $x$ | Value of Expression |
|---|---|
| 1 | |
| 2 | |
| 3 | |

- **Simplify Expressions** Students understand the pattern and relationship between subtracting integers and subtracting expressions. They will apply the concept of adding the opposite and use the Distributive Property to simplify expressions.

- **Understand Properties of Operations** Students develop a deeper understanding of the properties of operations when manipulating expressions. They will make the connection between the Distributive Property and GCF by factoring different types of expressions.

**Ways to support your student:**

- Read the problem outloud to them.
- Remember, physical representation and visuals help this abstract concept more concrete. Ask students: “Could you use objects or draw something to represent this?”
- Before giving your student the answer to their question or specific help, ask them “What have you tried so far?, What do you know?, What might be a next step?
- After your student has solved it, and before you tell them it’s correct or not, have them explain to you how they got their solution and if they think their answer makes sense.

**Online Resources for Students:**

- https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-variables-expressions - (only the first 3 topics: Combining Like Terms, The distributive property & equivalent expressions, and Interpreting Linear Expressions)
- https://calculationnation.nctm.org/Games/Game.aspx?GameId=C9C9C9C9-624D-4CDD-B761-7E0B364404E1 - Use the guest pass if it prompts you to login to “Ker-Splash” game

Name _____

Topic 4
Readiness Assessment

**1.** Use the order of operations to evaluate $5 + 4 \times 2$.

Ⓐ 11 Ⓒ 18
Ⓑ 13 Ⓓ 22

**2.** How would you express the area of the rectangle using the Distributive Property?

Ⓐ $5(x + 3)$ Ⓒ $3(x + 5)$
Ⓑ $x(3 + 5)$ Ⓓ $3x + 5$

**3.** Jessie bought $f$ bags of potting soil for \$2.00 each. Write an expression to show how much Jessie paid.

Ⓐ $2f$ Ⓒ $2f + 2$
Ⓑ $f + 2$ Ⓓ $f - 2$

**4.** Which expression is equivalent to three times the sum of six and five?

Ⓐ $3 \times 6 + 5$
Ⓑ $3 \times 5 + 6$
Ⓒ $3(6 + 5)$
Ⓓ $3 + (5 \times 6)$

**5.** Sam buys one bag of flour for \$2.50, three packages of shredded cheese for \$3.00 each, and two packages of mushrooms for \$3.50 each. How much does Sam pay in all?

Ⓐ \$9.00 Ⓒ \$15.50
Ⓑ \$15.00 Ⓓ \$18.50

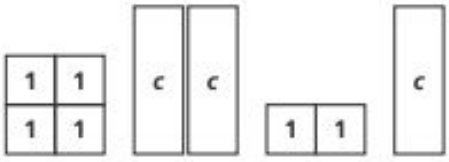
**6.** Israel planted 4 tomato seeds in his garden. Then he planted $s$ flower seeds. Which expression represents the number of seeds Israel planted?

Ⓐ $4s$ Ⓒ $4 - s$
Ⓑ $4 + s$ Ⓓ $4 + 4s$

**7.** Allie bought some DVDs for \$14.99 each. Which expression below represents Allie's cost for $d$ DVDs?

Ⓐ $14.99 + d$
Ⓑ $14.99 + 14.99d$
Ⓒ $14.99 \div d$
Ⓓ $14.99d$

**8.** How would you simplify the expression represented by the diagram below?

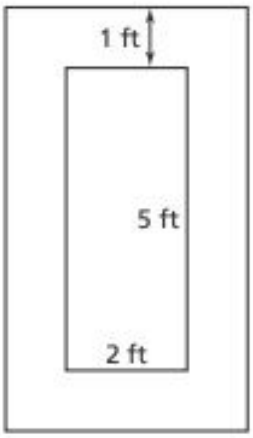



Ⓐ $2 + c$ Ⓒ $6 + 3c$
Ⓑ $9c$ Ⓓ $6 \times 3c$

**9.** Asa has 4 colored pencils. His friend purchases three times as many. If Asa's friend buys two more 4-packs, which expression shows the total amount of pencils that Asa and his friend have?

Ⓐ $4 + (3 \times 4) + (2 \times 4)$
Ⓑ $(4 + 3) \times (4 - 3) + (2 \times 4)$
Ⓒ $4 + 3 + (4 + 4)$
Ⓓ $4 + (3 + 4) + (3 + 4)$

**10.** Dré wants to add 1 foot of grass all around his doghouse for a dog run. If the doghouse is 2 feet by 5 feet, what would the area of the grassy region be?




Ⓐ 10 square feet
Ⓑ 18 square feet
Ⓒ 28 square feet
Ⓓ 32 square feet

---

**11.** Alia buys three erasers that cost $0.50 each, two notebooks that cost $5.00 each, and six pencils that cost $0.75 each. Which expression shows how much money Alia spent on supplies?

Ⓐ $0.50 + 5 + 0.75$
Ⓑ $0.50 + 0.50 + 0.50 + 5 + 6(0.75)$
Ⓒ $3(0.50) + 2(5) + 6(0.75)$
Ⓓ $3(50) + 2(5) + (75)$

---

**12.** Evaluate $w + 2w + 1$ when $w$ equals 8.

Ⓐ 17
Ⓑ 24
Ⓒ 25
Ⓓ 32

**13.** Emilie rides her bike $x$ miles before she gets a flat tire. She walks $\frac{1}{3}$ mile to a bus stop and then takes a bus for $2\frac{1}{2}$ miles. Which expression shows how many miles Emilie travels in all?

Ⓐ $x + 2\frac{2}{5}$
Ⓑ $x + 2\frac{5}{6}$
Ⓒ $2\frac{2}{5}x$
Ⓓ $2\frac{5}{6}x$

---

**14.** Ryanne is 14. Her brother's age is three more than half her age. How old is her brother?

Ⓐ 7
Ⓑ 8.5
Ⓒ 10
Ⓓ 31

---

**15.** Which expression is equivalent to twice $b$ plus the sum of 2 and $b$?

Ⓐ $2 + 3b$
Ⓑ $2 + b$
Ⓒ $3b$
Ⓓ $5b$

---

**16.** Which expression is equivalent to $2(3x - 8)$?

Ⓐ $(3x - 8) + (3x + 8)$
Ⓑ $6x - 8$
Ⓒ $6x - 16$
Ⓓ $-10x$

GET READY! 4

# Review What You Know!

## Vocabulary

**Choose the best term from the box to complete each definition.**

evaluate
expression
factor
order of operations
substitute
term

1. When you _____ an expression, you replace each variable with a given value.
2. To evaluate $a + 3$ when $a = 7$, you can _____ 7 for $a$ in the expression.
3. The set of rules used to determine the order in which operations are performed is called the _____.
4. Each part of an expression that is separated by a plus or minus sign is a(n) _____.
5. A(n) _____ is a mathematical phrase that can contain numbers, variables, and operation symbols.
6. When two numbers are multiplied to get a product, each number is called a(n) _____.

## Order of Operations

**Evaluate each expression using the order of operations.**

7. $3(18 - 7) + 2$
8. $(13 + 2) \div (9 - 4)$
9. $24 \div 4 \cdot 2 - 2$

## Equivalent Expressions

**Evaluate each expression when $a = -4$ and $b = 3$.**

10. $ab$
11. $2a + 3b$
12. $2(a - b)$

13. Explain the difference between evaluating $3 \cdot 7 - 4 \div 2$ and evaluating $3(7 - 4) \div 2$.

Name _____

Reteach to Build Understanding
**4-1**

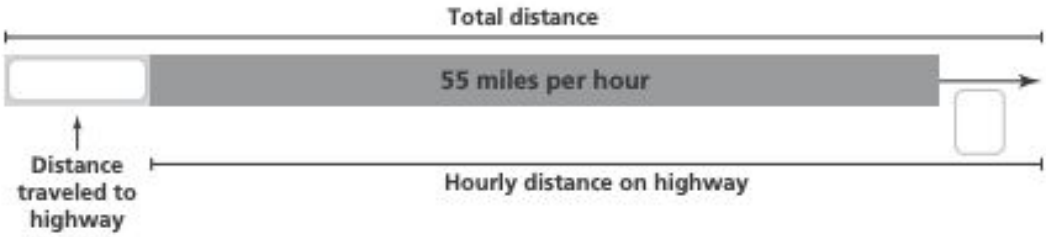
Amber is saving money to buy a bicycle. She saves $60 her grandfather gave her, and plans to save an additional $5 each week. How much will Amber save after *w* weeks?

Use a bar diagram to represent the amount Amber will save after *w* weeks.

Amber will save $60 + 5w$ dollars after *w* weeks.

Reggie drives 10 miles from the airport to the highway. Once on the highway, he drives at a speed of 55 miles per hour. What is Reggie's total distance from the airport *h* hours after reaching the highway?

**1.** Complete the bar diagram.




**2.** Write an expression that represents the distance that Reggie travels on the highway in *h* hours.

**3.** Write an expression that represents Reggie's total distance from the airport *h* hours after reaching the highway.

## On the Back!

**4.** Chrissy had 4 gallons of gas in her tank when she arrived at the gas station. She pumped gas into her car at a rate of $\frac{3}{10}$ gallon per second. How many gallons of gas were in the tank after *s* seconds?

Name _____

Build Mathematical Literacy
**4-1**

**Read the word problem below. Then answer the questions to help you understand the problem.**

Ben wants to buy a binder and some pencils from the school store. Binders cost $2.25 each and pencils cost $0.75 each. How much will it cost Ben to buy 1 binder and *p* pencils?

1. Underline the question you need to answer.

2. Circle the information about the price of binders.

3. What operation will Ben use to find his total cost at the school store? Explain.

4. Circle the expression that represents the total cost of the pencils Ben will buy.

| | |
|---|---|
| $2.50*p* | $2.50 + $0.75*p* |
| $7.75 − $0.75*p* | $0.75*p* |

5. What type of answer will this problem have? Explain.

Name _____

Additional Vocabulary Support
**4-1**

**Use each of these words once to complete the sentences.**

| | | |
|---|---|---|
| **coefficient** | **expression** | **simplify** |
| **substitute** | **variable** | **constant** |

Find the value of $2 - 3x$ when $x = 7$.

1. $2 - 3x$ is a(n) _____.

2. The term $3x$ contains both a(n) _____ and a(n) _____.

3. The term 2 is a(n) _____ term.

4. First, _____ 3 for $x$ in the expression.
   The expression is now $2 - 3(7)$.

5. To solve the problem, _____ $2 - 3(7)$.
   The expression $2 - 3x$ is equivalent to $2 - 3(7) = 2 - 21 = -19$ when $x = 7$.

**Tell whether each of the following is an *expression* or *not an expression*.**

6. 15

   expression not an expression

7. $x + 5 = 8$

   expression not an expression

8. $5x - 3y + 0.25$

   expression not an expression

Name _____

Reteach to Build Understanding
**4-2**

You can use properties to show that the expressions $3x - 3$ and $-3 + 3x$ are equivalent.

$3x - 3 = 3x + (-3)$ Additive Inverse
$= -3 + 3x$ Commutative Property

Equivalent expressions have the same value for all values of the variable.

| $x$ | $3x - 3$ | $-3 + 3x$ |
|---|---|---|
| 1 | $3(1) - 3 = 0$ | $-3 + 3(1) = 0$ |
| 2 | $3(2) - 3 = 3$ | $-3 + 3(2) = 3$ |
| 3 | $3(3) - 3 = 6$ | $-3 + 3(3) = 6$ |
| 4 | $3(4) - 3 = 9$ | $-3 + 3(4) = 9$ |

A cup of tea costs \$3 at a local cafe. Alan and his wife, Patty, have a coupon for \$1 off their order. Alan says the expression $3t - 1$ represents the cost for $t$ cups of tea. Patty says the expression $3t + (-1)$ represents the cost. Are their expressions equivalent? Explain.

1. Use the additive inverse to write an equivalent expression for $3t - 1$.

2. Complete the tables.

**Alan's Expression**

| $t$ | $3t - 1$ | Total Cost |
|---|---|---|
| 1 | $3(1) - 1$ | 2 |
| 2 | $3(\square) - 1$ | ☐ |
| 3 | $3(\square) - 1$ | ☐ |
| 4 | $3(\square) - 1$ | ☐ |

**Patty's Expression**

| t | $3t + (-1)$ | Total Cost |
|---|---|---|
| 1 | $3(\square) + (-1)$ | ☐ |
| 2 | $3(\square) + (-1)$ | ☐ |
| 3 | $3(\square) + (-1)$ | ☐ |
| 4 | $3(\square) + (-1)$ | ☐ |

3. Are Alan's and Patty's expressions equivalent? Explain.

## On the Back!

4. Karina bought 8 bagels and used a gift certificate for \$4. Her total cost is represented by the expression $8b - 4$, where $b$ is the cost of a bagel. What is an equivalent expression?

Build Mathematical Literacy
**4-2**

Name _____

**Read the word problem below. Then answer the questions to help you understand the problem.**

Lucy works at a restaurant. One day, she earns $16 per hour when she cooks for $x$ hours and $14 per hour when she cleans for $y$ hours after she finishes cooking. Then she eats lunch at the restaurant, which results in $3.50 being subtracted from her pay. The expression $(16x + 14y) - 3.50$ represents her earnings on this particular day. Use the Commutative and Associative Properties to write two equivalent expressions.

1. Circle the expression shown in the problem.

2. Underline the properties you will use.

3. If you write one expression as your answer, have you correctly solved this problem? Explain.

4. Describe the Commutative Property using words. Write an equation that shows the Commutative Property.

5. Describe the Associative Property using words. Write an equation that shows the Associative Property.

Name _____

Additional Vocabulary Support
**4-2**

**Choose the term from the list that the equation in each box illustrates. You will use each term more than once.**

| | | |
|---|---|---|
| **Associative Property** | **additive inverse** | **Commutative Property** |

| | | |
|---|---|---|
| **1.** $5 + 9 = 9 + 5$ | **2.** $x - 7 = x + (-7)$ | **3.** $(2a + 1) + 4 = 2a + (1 + 4)$ |
| **4.** $\frac{1}{4}x + (-4) = \frac{1}{4}x - 4$ | **5.** $(-2 + x) + (-5y) = (-2) + (x + (-5y))$ | **6.** $(x + 2y) + 3 = (2y + x) + 3$ |
| **7.** $(x + (-1)) + 2x = (x - 1) + 2x$ | **8.** $3x + (-y) + 1 = 3x + (-y + 1)$ | **9.** $(-4) + 7x + (-2y) = (-4) + (-2y) + 7x$ |

Name _____

Reteach to Build Understanding
**4-3**

Simplify the expression $9 - 2x - 7 + 4x$.

**Step 1** Use the Commutative Property to reorder the terms so that like terms are together. $9 + 4x - 7 - 2x = 9 - 7 + 4x - 2x$

**Step 2** Use the Associative Property to group like terms. $= (9 - 7) + (4x - 2x)$

**Step 3** Simplify by combining like terms. $= 2 + 2x$

Eloise's math tutor used algebra tiles to model $3n + 4 - n + 5$. What is the simplified form of this expression?

1. Eloise rearranged the tiles as shown below. What property did she use? Write an expression that represents Eloise's arrangement of the tiles.

2. Rewrite your expression from Exercise 1 by grouping like terms.

3. What is the simplified form of the expression?

## On the Back!

4. What is the simplified form of the expression $7r - 8r + 13 - 2r + 5$?

Name _____

Build Mathematical Literacy
**4-3**

**Read the problem below. Then answer the questions to identify the steps for solving the problem.**

Simplify the expression $7a + 3 + (-2b) + 5 + (-9a) + 11b$.

1. What does it mean to simplify an expression?

2. Underline the expression in the problem.

3. Complete the table to identify and organize the like terms and constant terms in the expression.

| Like terms containing *a* | Like terms containing *b* | Constant terms |
|---|---|---|
| | | |
| | | |

4. What operation will you perform on the terms in the table? Will this operation be performed on terms in the same row or the same column?

5. How will you know when you have completely solved the problem?

Name _____

Additional Vocabulary Support
**4-3**

**Use the list below to complete the sentences.**

| | | |
|---|---|---|
| **constants** | **variables** | **simplify** |

1. You can combine like terms to _____ an expression.

2. All _____ are like terms and can be combined.

3. Terms with the same _____ are considered like terms.

**For each of the following, tell whether the terms shown are *like terms* or *unlike terms*.**

4. $-5x, -5, 0.5x$

like terms unlike terms

5. $63, 19.2, -1$

like terms unlike terms

6. $16a, -a, \frac{1}{10}a$

like terms unlike terms

7. $5z, 5x, 5y$

like terms unlike terms

Name _____

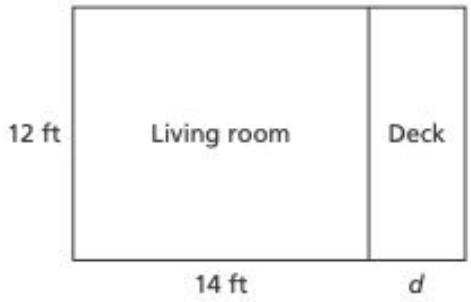
Reteach to Build Understanding
**4-4**

You can use the Distributive Property to expand expressions.

$3(7x + 5) = (3)(7x) + (3)(5)$ Use the Distributive Property.
$= 21x + 15$ Simplify.

The expanded form of $3(7x + 5)$ is $21x + 15$.

The Bains' house has a deck next to the living room. What is the total combined area of the living room and deck?




1. The deck and living room combine to form a rectangle. What is the rectangle's width?

2. Write an expression to represent the combined length of the rectangle.

3. Write an expression to represent the combined area of the living room and deck.

4. Use the Distributive Property to expand the product and then simplify. What expression represents the total combined area of the living room and deck?

## On the Back!

5. The deli's lunch special offers customers half off the total cost of a sandwich of their choice and a bag of pretzels. The original price of the pretzels is $1.50. Let $s$ represent the original cost of a selected customer's sandwich. What is the total cost of the customer's order?

Name _____

Build Mathematical Literacy
**4-4**

**Read the word problem below. Then answer the questions to help you understand the problem.**

Kira earns $12 per hour at her job. She also earns $10 each day walking her neighbor's dog. She has decided to save one-fourth of all of the money she earns for college. The expression $\frac{1}{4}(12x + 10)$ represents the amount of money Kira saves for college in a day that she works $x$ hours. Use the Distributive Property to write an equivalent expression.

1. Highlight the sentence that tells what you need to do to solve the problem.

2. Circle the expression given in the problem.

3. Underline the words that explain the real-world meaning of the expression. Is it necessary to translate the words you underlined into a mathematical expression in order to solve the problem? Explain.

4. Explain how you can check if you have written an equivalent expression.

Name _____

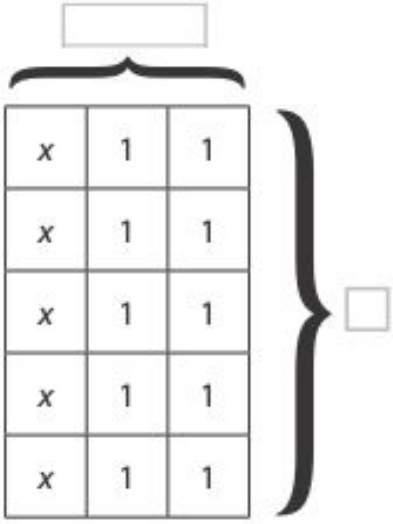
Reteach to Build Understanding
**4-5**

Factor the expression $6x + 9$.

$6x + 9 = (3 \cdot 2x) + (3 \cdot 3)$ The Greatest Common Factor (GCF) of $6x$ and 9 is 3.

$= 3(2x + 3)$ Distributive Property

A room that is 5 meters long has an area of $5x + 10$ square meters. What expression represents the width of the room?




1. What is the GCF of $5x$ and 10?

2. Fill in the box to rewrite the expression $5x + 10$ using the GCF.

   $5x + 10 = (\square \cdot x) + (5 \cdot \square)$

3. Use the Distributive Property rewrite the expression from Exercise 2 in factored form.

4. What expression represents the width of the room?

5. Label the length and width of the room on the area model.

## On the Back!

6. Cameron combined peanuts, cashews, and walnuts to make a trail mix. The expression $16p + 24c + 32w$ represents the total number of nuts in the mix. Cameron wants to divide the trail mix into equal servings, but he does not know how many. Use factoring to write expressions that will help Cameron divide the trail mix into 4 servings or 8 servings.

Name _____

Build Mathematical Literacy
**4-5**

**Read the problem below. Then answer the questions to identify the steps for solving the problem.**

Hector factored the expression $22x + 33y$ as $11(2x + 3y)$. Is Hector correct? If he is, show that his answer is correct. If not, factor the expression correctly.

1. Circle the question you are asked to answer.

2. After you determine the answer to the first question, how many more steps do you need to complete to finish the problem? Underline the step(s).

3. What property is needed to check Hector's answer?

4. Which of the following might help you answer the first question? Select all that apply.

   - ☐ List all factors of 22 and 33.
   - ☐ Add $22x$ and $33y$.
   - ☐ Expand $11(2x + 3y)$ using the Distributive Property.
   - ☐ List all factors of 11.

5. How can you tell if Hector has answered this problem completely?

Name _____

Additional Vocabulary Support
**4-5**

**Use the list below to complete the sentences.**

| | | |
|---|---|---|
| **greatest common factor** | **product of two terms** | **factors** |
| **coefficient** | **Distributive Property** | **GCF** |

The area of a rectangular room is given by the expression $20x - 32$. Factor the expression to find one set of possible dimensions of the room.

1. To factor this expression, look at the _____ of the variable term and the constant term.

2. List the _____ of 20 and 32.

   _____ of 20: 1, 2, 4, 5, 10, 20

   _____ of 32: 1, 2, 4, 8, 16, 32

3. Circle the greatest factor that appears in both lists. This number is the _____, which is also called the _____.

4. Use the _____ to rewrite the expression.

   $20x - 32 = 4(5x - 8)$

5. After factoring, the expression is written as a _____.

Name _____

Reteach to Build Understanding
**4-6**

Raul and Bobby are brothers who are saving to buy a new video game console. Bobby contributed $25 and plans to save $10 per week. Raul contributed $20 and plans to save $15 per week. What expression represents the total amount Bobby and Raul will have in $w$ weeks?

| | |
|---|---|
| $25 + 10w$ | Write an expression for Bobby's savings. |
| $20 + 15w$ | Write an expression for Raul's savings. |
| $(25 + 10w) + (20 + 15w)$ | Add the expressions. |
| $(25 + 20) + (10w + 15w)$ | Use the Commutative and Associative Properties. |
| $45 + 25w$ | Combine like terms. |

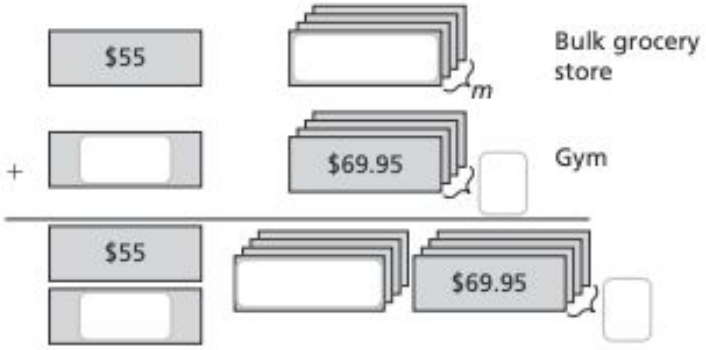
The expression $45 + 25w$ represents the total amount they will have in $w$ weeks.

For membership to a bulk grocery store, there is a $55 initial fee and monthly dues are $12.50. A gym membership costs $69.95 a month, plus a one-time sign up fee of $90. What expression represents the total cost of both memberships for $m$ months?

1. Complete the diagram.

2. What expression represents the total monthly cost of the bulk grocery store membership?

3. What expression represents the total monthly cost of the gym membership?




4. Write the sum of the expressions from Exercises 2 and 3.

5. Use the Commutative and Associative Properties to rewrite your expression with like terms grouped together. Then combine like terms to write an expression that represents the total cost of both memberships for $m$ months.

## On the Back!

6. For adults, a bowling alley charges $3.75 for shoe rental and $5 per game. For children, the cost is $2.50 for shoe rental and $4 per game. What expression represents the total cost for one adult and one child to bowl $g$ games?

Name _____

Build Mathematical Literacy
**4-6**

**Read the word problem below. Then answer the questions to help you understand the problem.**

An online bookstore sells all paperback books for $x$ dollars each. Aidan bought 7 paperback books and spent $3.95 on shipping. Nina bought 11 paperback books and spent $5.25 on shipping. What expression represents the total amount that Aidan and Nina spent?

1. Underline the question that you need to answer.

2. What does it mean when a problem asks for an expression?

3. Circle the part of the problem that represents the cost of a book.

4. How can you find the cost of Nina's books?

   - ☐ The problem states that Nina's books cost $11.
   - ☐ Add 11 and $x$.
   - ☐ Multiply 11 and $x$.
   - ☐ Add 11 and 5.25.

5. After simplifying, how many terms do you expect in your final answer? Explain.

Name _____

Reteach to Build Understanding
**4-7**

A meal delivery service called Healthy Foods charges an initial fee of $29.95 plus $25 each month. Good Eats provides the same service for an initial fee of $10 plus $20 a month. Write an expression that represents the amount Miranda will save over $m$ months if she signs up for Good Eats instead of Healthy Foods.

| | |
|---|---|
| $(29.95 + 25m) - (10 + 20m)$ | Subtract expressions for the cost of each membership. |
| $= 29.95 + 25m - 10 - 20m$ | Distributive Property |
| $= (25m - 20m) + (29.95 - 10)$ | Commutative and Associative Properties |
| $= 5m + 19.95$ | Combine like terms. |

Miranda will save $5m + 19.95$ dollars if she signs up for Good Eats instead of Healthy Foods.

Last week, Byron bought 5 containers of yogurt and spent $12.88 on other groceries. This week Cassandra bought 3 containers of the same yogurt and spent $11.50 on other groceries. How much more money did Byron spend than Cassandra?

1. Let $c$ represent the cost of one container of yogurt. Write expressions to represent the amount spent by Byron and the amount spent by Cassandra.

2. Write an expression to represent the difference by subtracting the amount that Cassandra spent from the amount that Byron spent. Then complete the steps to simplify the expression.

   $(\quad) - (\quad)$
   $= 5c + 12.88 - \square - \square$
   $= (5c - \square) + (\square - 11.50)$
   $= \square c + \square$

3. What expression represents how much more money Byron spent than Cassandra?

## On the Back!

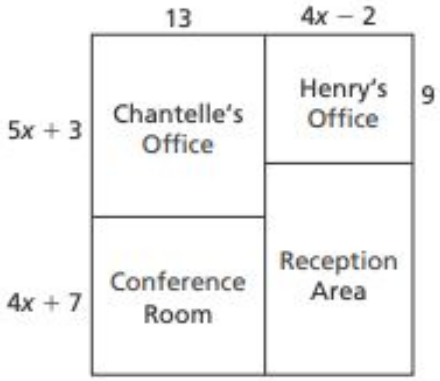
4. Yesterday Gunnar ran 4 times around the track plus an additional 450 feet. Today he ran 3 times around the track plus an additional 375 feet. What expression represents how much farther Gunnar ran yesterday than today?

Name _____

Build Mathematical Literacy
**4-7**

**Read the problem below. Answer the questions to help understand the steps needed to solve the problem.**

Chantelle and Henry work for the same company and share a reception area and a conference room as shown below. How much greater is the area of Chantelle's office than the area of Henry's office?




1. How many operations will you use to answer the question? Name each operation and underline the word or words in the problem that tell you this.

2. In the diagram, highlight the given side lengths of the two offices that you need to compare. Cross out any information in the problem and diagram that is not necessary to solve the problem.

3. Complete the table to organize the information you will need to solve the problem.

| | **Chantelle's Office** | **Henry's Office** |
|---|---|---|
| **Length** | 13 units | ____ units |
| **Width** | ____ units | 9 units |
| **Area** | 13 (____) square units | 9 (____) square units |

4. Once you have found the areas of Chantelle's and Henry's offices, will you have completed the problem? Explain.

Name _____

Reteach to Build Understanding
**4-8**

The price of a pair of jeans has been reduced by 40%. Let $p$ represent the original price.

The equivalent expressions $p - 0.4p$ and $0.6p$ represent the sale price of the jeans.

The expression $p - 0.4p$ means that 40% was subtracted from the original price, $p$.

The expression $0.6p$ means that 40% off the original price, $p$, is equivalent to 60% of the original price.

Antoine is moving to a new house. His new room will be 50% larger than his old room. What equivalent expressions can you use to represent the size of Antoine's new room?

1. Let $r$ represent the size of Antoine's old room. What expression represents how much larger his new room is than his old room?

2. Draw a bar diagram to represent Antoine's new room.

3. What addition expression represents the size of Antoine's new room? How can you write an equivalent expression?

## On the Back!

4. For her summer vacation, Emily reduced the weight of her luggage by 30% from its weight, $s$, on her winter vacation. Write two equivalent expressions to represent the weight of Emily's luggage on her summer vacation.

Name _____

Build Mathematical Literacy
**4-8**

**Read the problem below. Answer the questions to help you understand the steps for solving the problem.**

Mr. Kelley uses an expression to represent the perimeter of a square. How can the expression be rewritten to highlight the length of a side of the square?

$P = 8x + 20$

1. Underline the expression representing the perimeter of the square. Circle the words in the problem that explain what this expression represents.

2. Which of the following best describes the correct solution to this problem?

   - ☐ An explanation written in words
   - ☐ An algebraic expression that represents the perimeter of the square
   - ☐ An algebraic expression that represents the side length of the square
   - ☐ The actual side length of the square given as a number

3. How can you rewrite an expression with no like terms?

4. What is the relationship between the perimeter of a square and its side length? Select all correct answers.

   - ☐ Perimeter = (side length) + (side length) + (side length) + (side length)
   - ☐ Perimeter = (side length) × (side length)
   - ☐ Perimeter = 4 × (side length)
   - ☐ Perimeter = (side length) ÷ 4

Name _____

Additional Vocabulary Support
**4-8**

**Use the list below to fill in an example for each property or technique.**

| | | |
|---|---|---|
| $5 + x = x + 5$ | $3x + 6 = 3(x + 2)$ | $x - 4 = x + (-4)$ |
| $3a + 2 + a = 4a + 2$ | $(2x + 7) + 3 = 2x + (7 + 3)$ | |

| Property or Technique | Example |
|---|---|
| Distributive Property | |
| Associative Property | |
| Commutative Property | |
| Combine like terms. | |
| Write an additive inverse. | |

**For each of the following, tell whether the expressions are *equivalent expressions* or *not equivalent expressions*.**

**1.** $16b + 7a - c$ and $7a + (-c) + 16b$

equivalent expressions not equivalent expressions

**2.** $5y + (-4)$ and $4 + (-5y)$

equivalent expressions not equivalent expressions

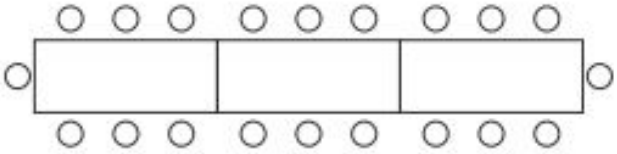
**3.** $x + x + 3 - y + 2x - 1 + 6y$ and $4x + 5y + 2$

equivalent expressions not equivalent expressions

Name _____

Enrichment
**4-8**

A conference center has rectangular tables that seat three people at each long side and one person at each end. Tables can be placed end-to-end to seat larger groups, as shown in the diagram.



1. Why does the expression $6x + 2$ represent the number of people who can sit at $x$ tables placed end-to-end? Explain.

2. An individual table can seat 8 people, but people cannot sit at the ends of the middle tables or the inside ends of the end tables when the tables are placed end to end. An event planner thinks the expression $8x - 2(x - 2) - 2(1)$ can also be used to represent the number of people that can be seated. Is the event planner's expression equivalent to $6x + 2$? Show your work.

3. Write another expression that is equivalent to $6x + 2$. How does your expression represent the number of people who can sit at $x$ tables placed end-to-end?

4. If the tables were placed side-by-side so that the long sides were next to each other instead of the short sides, what expression represents the number of people who can sit at $x$ tables? Explain.

# Answer Keys

Name _____

Topic 4
Readiness Assessment

**1.** Use the order of operations to evaluate $5 + 4 \times 2$.

Ⓐ 11 Ⓒ 18
Ⓑ 13 Ⓓ 22

**2.** How would you express the area of the rectangle using the Distributive Property?

Ⓐ $5(x + 3)$ Ⓒ $3(x + 5)$
Ⓑ $x(3 + 5)$ Ⓓ $3x + 5$

**3.** Jessie bought $f$ bags of potting soil for $2.00 each. Write an expression to show how much Jessie paid.

Ⓐ $2f$ Ⓒ $2f + 2$
Ⓑ $f + 2$ Ⓓ $f - 2$

**4.** Which expression is equivalent to three times the sum of six and five?

Ⓐ $3 \times 6 + 5$
Ⓑ $3 \times 5 + 6$
Ⓒ $3(6 + 5)$
Ⓓ $3 + (5 \times 6)$

**5.** Sam buys one bag of flour for $2.50, three packages of shredded cheese for $3.00 each, and two packages of mushrooms for $3.50 each. How much does Sam pay in all?

Ⓐ $9.00 Ⓒ $15.50
Ⓑ $15.00 Ⓓ $18.50

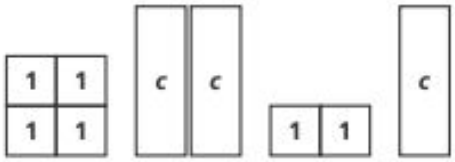
**6.** Israel planted 4 tomato seeds in his garden. Then he planted $s$ flower seeds. Which expression represents the number of seeds Israel planted?

Ⓐ $4s$ Ⓒ $4 - s$
Ⓑ $4 + s$ Ⓓ $4 + 4s$

**7.** Allie bought some DVDs for $14.99 each. Which expression below represents Allie's cost for $d$ DVDs?

Ⓐ $14.99 + d$
Ⓑ $14.99 + 14.99d$
Ⓒ $14.99 \div d$
Ⓓ $14.99d$

**8.** How would you simplify the expression represented by the diagram below?

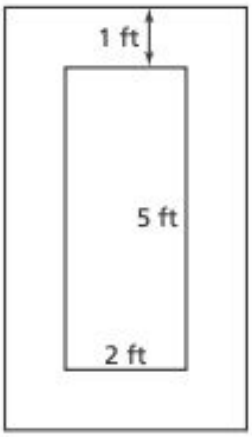



Ⓐ $2 + c$ Ⓒ $6 + 3c$
Ⓑ $9c$ Ⓓ $6 \times 3c$

**9.** Asa has 4 colored pencils. His friend purchases three times as many. If Asa's friend buys two more 4-packs, which expression shows the total amount of pencils that Asa and his friend have?

Ⓐ $4 + (3 \times 4) + (2 \times 4)$
Ⓑ $(4 + 3) \times (4 - 3) + (2 \times 4)$
Ⓒ $4 + 3 + (4 + 4)$
Ⓓ $4 + (3 + 4) + (3 + 4)$

**10.** Dré wants to add 1 foot of grass all around his doghouse for a dog run. If the doghouse is 2 feet by 5 feet, what would the area of the grassy region be?




Ⓐ 10 square feet
Ⓑ 18 square feet
Ⓒ 28 square feet
Ⓓ 32 square feet

---

**11.** Alia buys three erasers that cost $0.50 each, two notebooks that cost $5.00 each, and six pencils that cost $0.75 each. Which expression shows how much money Alia spent on supplies?

Ⓐ $0.50 + 5 + 0.75$
Ⓑ $0.50 + 0.50 + 0.50 + 5 + 6(0.75)$
Ⓒ $3(0.50) + 2(5) + 6(0.75)$
Ⓓ $3(50) + 2(5) + (75)$

---

**12.** Evaluate $w + 2w + 1$ when $w$ equals 8.

Ⓐ 17
Ⓑ 24
Ⓒ 25
Ⓓ 32

**13.** Emilie rides her bike $x$ miles before she gets a flat tire. She walks $\frac{1}{3}$ mile to a bus stop and then takes a bus for $2\frac{1}{2}$ miles. Which expression shows how many miles Emilie travels in all?

Ⓐ $x + 2\frac{2}{5}$
Ⓑ $x + 2\frac{5}{6}$
Ⓒ $2\frac{2}{5}x$
Ⓓ $2\frac{5}{6}x$

---

**14.** Ryanne is 14. Her brother's age is three more than half her age. How old is her brother?

Ⓐ 7
Ⓑ 8.5
Ⓒ 10
Ⓓ 31

---

**15.** Which expression is equivalent to twice $b$ plus the sum of 2 and $b$?

Ⓐ $2 + 3b$
Ⓑ $2 + b$
Ⓒ $3b$
Ⓓ $5b$

---

**16.** Which expression is equivalent to $2(3x - 8)$?

Ⓐ $(3x - 8) + (3x + 8)$
Ⓑ $6x - 8$
Ⓒ $6x - 16$
Ⓓ $-10x$

GET READY! TOPIC 4

# Review What You Know!

## Vocabulary

**Choose the best term from the box to complete each definition.**

evaluate
expression
factor
order of operations
substitute
term

1. When you ___evaluate___ an expression, you replace each variable with a given value.
2. To evaluate $a + 3$ when $a = 7$, you can ___substitute___ 7 for $a$ in the expression.
3. The set of rules used to determine the order in which operations are performed is called the ___order of operations___.
4. Each part of an expression that is separated by a plus or minus sign is a(n) ___term___.
5. A(n) ___expression___ is a mathematical phrase that can contain numbers, variables, and operation symbols.
6. When two numbers are multiplied to get a product, each number is called a(n) ___factor___.

## Order of Operations

**Evaluate each expression using the order of operations.**

7. $3(18 - 7) + 2$
   35
8. $(13 + 2) \div (9 - 4)$
   3
9. $24 \div 4 \cdot 2 - 2$
   10

## Equivalent Expressions

**Evaluate each expression when $a = -4$ and $b = 3$.**

10. $ab$
    $-12$
11. $2a + 3b$
    1
12. $2(a - b)$
    $-14$

13. Explain the difference between evaluating $3 \cdot 7 - 4 \div 2$ and evaluating $3(7 - 4) \div 2$.
    Sample answer: Evaluate $3 \cdot 7 - 4 \div 2$ by first multiplying ($3 \cdot 7 = 21$), then dividing ($4 \div 2 = 2$), and finally subtracting ($21 - 2 = 19$). Evaluate $3(7 - 4) \div 2$ by first working inside the parentheses, ($7 - 4 = 3$), then multiplying and dividing from left to right: ($3 \cdot 3 \div 2 = 9 \div 2 = 4.5$).

Name _____

Reteach to Build Understanding
**4-1**

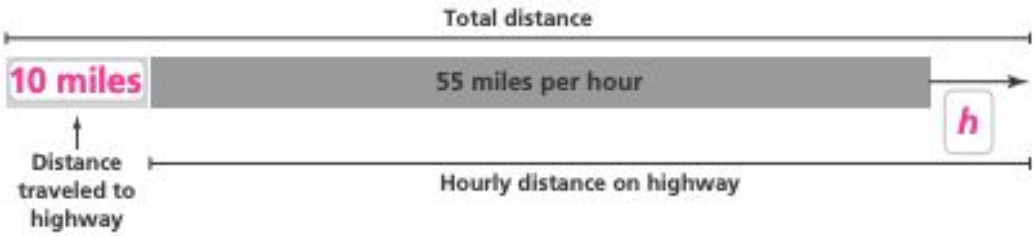
Amber is saving money to buy a bicycle. She saves $60 her grandfather gave her, and plans to save an additional $5 each week. How much will Amber save after *w* weeks?

Use a bar diagram to represent the amount Amber will save after *w* weeks.

Amber will save 60 + 5*w* dollars after *w* weeks.

Reggie drives 10 miles from the airport to the highway. Once on the highway, he drives at a speed of 55 miles per hour. What is Reggie's total distance from the airport *h* hours after reaching the highway?

**1.** Complete the bar diagram.




**2.** Write an expression that represents the distance that Reggie travels on the highway in *h* hours.

**55*h***

**3.** Write an expression that represents Reggie's total distance from the airport *h* hours after reaching the highway.

**10 + 55*h***

## On the Back!

**4.** Chrissy had 4 gallons of gas in her tank when she arrived at the gas station. She pumped gas into her car at a rate of $\frac{3}{10}$ gallon per second. How many gallons of gas were in the tank after *s* seconds?

**$4 + \frac{3}{10}s$**

Name _____

Build Mathematical Literacy
**4-1**

**Read the word problem below. Then answer the questions to help you understand the problem.**

Ben wants to buy a binder and some pencils from the school store. Binders cost $2.25 each and pencils cost $0.75 each. How much will it cost Ben to buy 1 binder and $p$ pencils?

1. Underline the question you need to answer.
   **Check students' work.**
2. Circle the information about the price of binders.
   **Check students' work.**
3. What operation will Ben use to find his total cost at the school store? Explain.
   **Addition; Sample answer: Ben will add the price of one binder to the price of $p$ pencils to find his total cost.**
4. Circle the expression that represents the total cost of the pencils Ben will buy.

   $2.50$p$ | $2.50 + $0.75$p$

   $7.75 − $0.75$p$ | (**$0.75$p$**)

5. What type of answer will this problem have? Explain.
   **Algebraic expression; Sample answer: The number of pencils Ben will buy at the store is unknown. After Ben decides how many pencils he needs, he can use the expression to find his total cost.**

Name _____

Additional Vocabulary Support
**4-1**

**Use each of these words once to complete the sentences.**

| | | |
|---|---|---|
| **coefficient** | **expression** | **simplify** |
| **substitute** | **variable** | **constant** |

Find the value of $2 - 3x$ when $x = 7$.

1. $2 - 3x$ is a(n) **expression**.

2. The term $3x$ contains both a(n) **variable** and a(n) **coefficient**.

3. The term 2 is a(n) **constant** term.

4. First, **substitute** 3 for $x$ in the expression.
The expression is now $2 - 3(7)$.

5. To solve the problem, **simplify** $2 - 3(7)$.
The expression $2 - 3x$ is equivalent to $2 - 3(7) = 2 - 21 = -19$ when $x = 7$.

**Tell whether each of the following is an *expression* or *not an expression*.**

6. 15

(expression) not an expression

7. $x + 5 = 8$

expression (not an expression)

8. $5x - 3y + 0.25$

(expression) not an expression

Name _____

Reteach to Build Understanding
**4-2**

You can use properties to show that the expressions $3x - 3$ and $-3 + 3x$ are equivalent.

$3x - 3 = 3x + (-3)$ Additive Inverse
$= -3 + 3x$ Commutative Property

Equivalent expressions have the same value for all values of the variable.

| $x$ | $3x - 3$ | $-3 + 3x$ |
|---|---|---|
| 1 | $3(1) - 3 = 0$ | $-3 + 3(1) = 0$ |
| 2 | $3(2) - 3 = 3$ | $-3 + 3(2) = 3$ |
| 3 | $3(3) - 3 = 6$ | $-3 + 3(3) = 6$ |
| 4 | $3(4) - 3 = 9$ | $-3 + 3(4) = 9$ |

A cup of tea costs \$3 at a local cafe. Alan and his wife, Patty, have a coupon for \$1 off their order. Alan says the expression $3t - 1$ represents the cost for $t$ cups of tea. Patty says the expression $3t + (-1)$ represents the cost. Are their expressions equivalent? Explain.

1. Use the additive inverse to write an equivalent expression for $3t - 1$.
   **$3t + (-1)$**
2. Complete the tables.

**Alan's Expression**

| $t$ | $3t - 1$ | Total Cost |
|---|---|---|
| 1 | $3(1) - 1$ | 2 |
| 2 | $3(\boxed{2}) - 1$ | 5 |
| 3 | $3(\boxed{3}) - 1$ | 8 |
| 4 | $3(\boxed{4}) - 1$ | 11 |

**Patty's Expression**

| t | $3t + (-1)$ | Total Cost |
|---|---|---|
| 1 | $3(\boxed{1}) + (-1)$ | 2 |
| 2 | $3(\boxed{2}) + (-1)$ | 5 |
| 3 | $3(\boxed{3}) + (-1)$ | 8 |
| 4 | $3(\boxed{4}) + (-1)$ | 11 |

3. Are Alan's and Patty's expressions equivalent? Explain. **Yes; Subtracting 1 is equivalent to adding $-1$.**

**On the Back!**

4. Karina bought 8 bagels and used a gift certificate for \$4. Her total cost is represented by the expression $8b - 4$, where $b$ is the cost of a bagel. What is an equivalent expression?
   **Sample answer: $-4 + 8b$**



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

Name _____

Build Mathematical Literacy
**4-2**

**Read the word problem below. Then answer the questions to help you understand the problem.**

Lucy works at a restaurant. One day, she earns $16 per hour when she cooks for $x$ hours and $14 per hour when she cleans for $y$ hours after she finishes cooking. Then she eats lunch at the restaurant, which results in $3.50 being subtracted from her pay. The expression $(16x + 14y) - 3.50$ represents her earnings on this particular day. Use the Commutative and Associative Properties to write two equivalent expressions.

1. Circle the expression shown in the problem.
   **Check students' work.**
2. Underline the properties you will use.
   **Check students' work.**
3. If you write one expression as your answer, have you correctly solved this problem? Explain.
   **No; The correct solution will be two equivalent expressions.**
4. Describe the Commutative Property using words. Write an equation that shows the Commutative Property.
   **Sample answer: The Commutative Property says you can add numbers in any order or that you can multiply numbers in any order. $2 + 5 = 5 + 2$ and $3 \times 4 = 4 \times 3$**
5. Describe the Associative Property using words. Write an equation that shows the Associative Property.
   **Sample answer: The Associative Property says that you can change the grouping of numbers without changing the sum or that you can change the grouping of factors without changing the product. $(3 + 4) + 5 = 3 + (4 + 5)$ or $(5 \times 6) \times 7 = 5 \times (6 \times 7)$**

Name _____

Additional Vocabulary Support
**4-2**

**Choose the term from the list that the equation in each box illustrates. You will use each term more than once.**

| Associative Property | additive inverse | Commutative Property |
|---|---|---|

| | | |
|---|---|---|
| **1.** $5 + 9 = 9 + 5$<br>**Commutative Property** | **2.** $x - 7 = x + (-7)$<br>**additive inverse** | **3.** $(2a + 1) + 4 = 2a + (1 + 4)$<br>**Associative Property** |
| **4.** $\frac{1}{4}x + (-4) = \frac{1}{4}x - 4$<br>**additive inverse** | **5.** $(-2 + x) + (-5y) = (-2) + (x + (-5y))$<br>**Associative Property** | **6.** $(x + 2y) + 3 = (2y + x) + 3$<br>**Commutative Property** |
| **7.** $(x + (-1)) + 2x = (x - 1) + 2x$<br>**additive inverse** | **8.** $3x + (-y) + 1 = 3x + (-y + 1)$<br>**Associative Property** | **9.** $(-4) + 7x + (-2y) = (-4) + (-2y) + 7x$<br>**Commutative Property** |

Name _____

Reteach to Build Understanding
**4-3**

Simplify the expression $9 - 2x - 7 + 4x$.

**Step 1** Use the Commutative Property to reorder the terms so that like terms are together. $9 + 4x - 7 - 2x = 9 - 7 + 4x - 2x$

**Step 2** Use the Associative Property to group like terms. $= (9 - 7) + (4x - 2x)$

**Step 3** Simplify by combining like terms. $= 2 + 2x$

Eloise's math tutor used algebra tiles to model $3n + 4 - n + 5$. What is the simplified form of this expression?

1. Eloise rearranged the tiles as shown below. What property did she use? Write an expression that represents Eloise's arrangement of the tiles.

**The Commutative Property; $3n - n + 4 + 5$**

2. Rewrite your expression from Exercise 1 by grouping like terms.
**$(3n - n) + (4 + 5)$**

3. What is the simplified form of the expression?
**$2n + 9$**

**On the Back!**

4. What is the simplified form of the expression $7r - 8r + 13 - 2r + 5$?
**$-3r + 18$**

Name _____

Build Mathematical Literacy
**4-3**

**Read the problem below. Then answer the questions to identify the steps for solving the problem.**

Simplify the expression $7a + 3 + (-2b) + 5 + (-9a) + 11b$.

1. What does it mean to simplify an expression?
**Sample answer: Combine all like terms.**

2. Underline the expression in the problem.
**Check students' work.**

3. Complete the table to identify and organize the like terms and constant terms in the expression.

| Like terms containing *a* | Like terms containing *b* | Constant terms |
|---|---|---|
| $7a$ | $-2b$ | 3 |
| $-9a$ | $11b$ | 5 |

4. What operation will you perform on the terms in the table? Will this operation be performed on terms in the same row or the same column?
**Addition; Same column**

5. How will you know when you have completely solved the problem?
**Sample answer: The simplified expression will not contain any like terms.**

Name _____

Additional Vocabulary Support
**4-3**

**Use the list below to complete the sentences.**

| constants | variables | simplify |
|---|---|---|

1. You can combine like terms to ___simplify___ an expression.

2. All ___constants___ are like terms and can be combined.

3. Terms with the same ___variables___ are considered like terms.

**For each of the following, tell whether the terms shown are *like terms* or *unlike terms*.**

4. $-5x, -5, 0.5x$

   like terms  (unlike terms)

5. $63, 19.2, -1$

   (like terms)  unlike terms

6. $16a, -a, \frac{1}{10}a$

   (like terms)  unlike terms

7. $5z, 5x, 5y$

   like terms  (unlike terms)

Name _____

Build Mathematical Literacy
**4-4**

**Read the word problem below. Then answer the questions to help you understand the problem.**

Kira earns $12 per hour at her job. She also earns $10 each day walking her neighbor's dog. She has decided to save one-fourth of all of the money she earns for college. The expression $\frac{1}{4}(12x + 10)$ represents the amount of money Kira saves for college in a day that she works $x$ hours. Use the Distributive Property to write an equivalent expression.

1. Highlight the sentence that tells what you need to do to solve the problem.
   **Check students' work.**
2. Circle the expression given in the problem.
   **Check students' work.**
3. Underline the words that explain the real-world meaning of the expression. Is it necessary to translate the words you underlined into a mathematical expression in order to solve the problem? Explain.
   **Check students' work; No; Sample answer: Because the expression is given in the problem, you do not need to translate the words into a mathematical expression.**
4. Explain how you can check if you have written an equivalent expression.
   **Sample answer: I can substitute *x*-values in each expression. If the expressions are equal for the same *x*-values, the expressions are likely equivalent.**

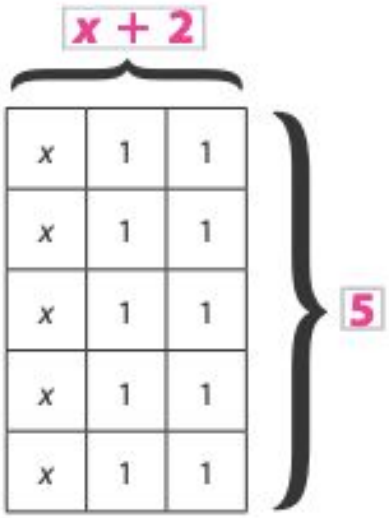
Name _____

Reteach to Build Understanding
**4-5**

Factor the expression $6x + 9$.

$6x + 9 = (3 \cdot 2x) + (3 \cdot 3)$ The Greatest Common Factor (GCF) of $6x$ and 9 is 3.
$= 3(2x + 3)$ Distributive Property

A room that is 5 meters long has an area of $5x + 10$ square meters. What expression represents the width of the room?




1. What is the GCF of $5x$ and 10?
   **5**

2. Fill in the box to rewrite the expression $5x + 10$ using the GCF.
   $5x + 10 = (\boxed{5} \cdot x) + (5 \cdot \boxed{2})$

3. Use the Distributive Property rewrite the expression from Exercise 2 in factored form.
   **$5(x + 2)$**

4. What expression represents the width of the room?
   **$x + 2$**

5. Label the length and width of the room on the area model.
   **Check students' work.**

**On the Back!**

6. Cameron combined peanuts, cashews, and walnuts to make a trail mix. The expression $16p + 24c + 32w$ represents the total number of nuts in the mix. Cameron wants to divide the trail mix into equal servings, but he does not know how many. Use factoring to write expressions that will help Cameron divide the trail mix into 4 servings or 8 servings.
   **$16p + 24c + 32w = 4(4p + 6c + 8w) = 8(2p + 3c + 4w)$**





Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7

Name _____

Build Mathematical Literacy
**4-5**

**Read the problem below. Then answer the questions to identify the steps for solving the problem.**

Hector factored the expression $22x + 33y$ as $11(2x + 3y)$. Is Hector correct? If he is, show that his answer is correct. If not, factor the expression correctly.

1. Circle the question you are asked to answer.
   **Check students' work.**
2. After you determine the answer to the first question, how many more steps do you need to complete to finish the problem? Underline the step(s).
   **1; Check students' work.**
3. What property is needed to check Hector's answer?
   **Distributive Property**

4. Which of the following might help you answer the first question? Select all that apply.

   - [X] List all factors of 22 and 33.
   - [ ] Add $22x$ and $33y$.
   - [X] Expand $11(2x + 3y)$ using the Distributive Property.
   - [ ] List all factors of 11.

5. How can you tell if Hector has answered this problem completely?
   **Sample answer: The factorization is correct if the product of the factors is equivalent to the original expression.**

Name _____

Additional Vocabulary Support
**4-5**

**Use the list below to complete the sentences.**

| | | |
|---|---|---|
| **greatest common factor** | **product of two terms** | **factors** |
| **coefficient** | **Distributive Property** | **GCF** |

The area of a rectangular room is given by the expression $20x - 32$. Factor the expression to find one set of possible dimensions of the room.

1. To factor this expression, look at the **coefficient** of the variable term and the constant term.

2. List the **factors** of 20 and 32.

   **Factors** of 20: 1, 2, (4), 5, 10, 20

   **Factors** of 32: 1, 2, (4), 8, 16, 32

3. Circle the greatest factor that appears in both lists. This number is the **greatest common factor**, which is also called the **GCF**.

4. Use the **Distributive Property** to rewrite the expression.

   $20x - 32 = 4(5x - 8)$

5. After factoring, the expression is written as a **product of two terms**.

Name _____

Reteach to Build Understanding
**4-6**

Raul and Bobby are brothers who are saving to buy a new video game console. Bobby contributed $25 and plans to save $10 per week. Raul contributed $20 and plans to save $15 per week. What expression represents the total amount Bobby and Raul will have in *w* weeks?

| | |
|---|---|
| $25 + 10w$ | Write an expression for Bobby's savings. |
| $20 + 15w$ | Write an expression for Raul's savings. |
| $(25 + 10w) + (20 + 15w)$ | Add the expressions. |
| $(25 + 20) + (10w + 15w)$ | Use the Commutative and Associative Properties. |
| $45 + 25w$ | Combine like terms. |

The expression $45 + 25w$ represents the total amount they will have in *w* weeks.

For membership to a bulk grocery store, there is a $55 initial fee and monthly dues are $12.50. A gym membership costs $69.95 a month, plus a one-time sign up fee of $90. What expression represents the total cost of both memberships for *m* months?

1. Complete the diagram.

2. What expression represents the total monthly cost of the bulk grocery store membership?
   **55 + 12.50m**
3. What expression represents the total monthly cost of the gym membership?
   **90 + 69.95m**
4. Write the sum of the expressions from Exercises 2 and 3.
   **(55 + 12.50m) + (90 + 69.95m)**
5. Use the Commutative and Associative Properties to rewrite your expression with like terms grouped together. Then combine like terms to write an expression that represents the total cost of both memberships for *m* months.
   **(55 + 90) + (12.50m + 69.95m); 145 + 82.45m**

**On the Back!**

6. For adults, a bowling alley charges $3.75 for shoe rental and $5 per game. For children, the cost is $2.50 for shoe rental and $4 per game. What expression represents the total cost for one adult and one child to bowl *g* games?
   **6.25 + 9g**

Name _____

Build Mathematical Literacy
**4-6**

**Read the word problem below. Then answer the questions to help you understand the problem.**

An online bookstore sells all paperback books for $x$ dollars each. Aidan bought 7 paperback books and spent $3.95 on shipping. Nina bought 11 paperback books and spent $5.25 on shipping. What expression represents the total amount that Aidan and Nina spent?

1. Underline the question that you need to answer.
   **Check students' work.**
2. What does it mean when a problem asks for an expression?
   **Sample answer: An expression can include numbers and/or variables. I may not be able to give a specific numerical amount as an answer.**
3. Circle the part of the problem that represents the cost of a book.
   **Check students' work.**
4. How can you find the cost of Nina's books?

   - ☐ The problem states that Nina's books cost $11.
   - ☐ Add 11 and $x$.
   - ☒ Multiply 11 and $x$.
   - ☐ Add 11 and 5.25.

5. After simplifying, how many terms do you expect in your final answer? Explain.
   **2; Sample answer: For Aidan and Nina, there is a variable term for the cost of the books and a constant term for the cost of shipping. After writing an expression for each person, combine like terms. The final answer will have a variable term and a constant term.**

Name _____

Reteach to Build Understanding
**4-7**

A meal delivery service called Healthy Foods charges an initial fee of $29.95 plus $25 each month. Good Eats provides the same service for an initial fee of $10 plus $20 a month. Write an expression that represents the amount Miranda will save over $m$ months if she signs up for Good Eats instead of Healthy Foods.

| | |
|---|---|
| $(29.95 + 25m) - (10 + 20m)$ | Subtract expressions for the cost of each membership. |
| $= 29.95 + 25m - 10 - 20m$ | Distributive Property |
| $= (25m - 20m) + (29.95 - 10)$ | Commutative and Associative Properties |
| $= 5m + 19.95$ | Combine like terms. |

Miranda will save $5m + 19.95$ dollars if she signs up for Good Eats instead of Healthy Foods.

Last week, Byron bought 5 containers of yogurt and spent $12.88 on other groceries. This week Cassandra bought 3 containers of the same yogurt and spent $11.50 on other groceries. How much more money did Byron spend than Cassandra?

1. Let $c$ represent the cost of one container of yogurt. Write expressions to represent the amount spent by Byron and the amount spent by Cassandra.
   **$5c + 12.88$; $3c + 11.50$**
2. Write an expression to represent the difference by subtracting the amount that Cassandra spent from the amount that Byron spent. Then complete the steps to simplify the expression.
   $(\boxed{5c + 12.88}) - (\boxed{3c + 11.50})$
   $= 5c + 12.88 - \boxed{3c} - \boxed{11.50}$
   $= (5c - \boxed{3c}) + (\boxed{12.88} - 11.50)$
   $= \boxed{2}c + \boxed{1.38}$
3. What expression represents how much more money Byron spent than Cassandra?
   **$2c + 1.38$**

**On the Back!**

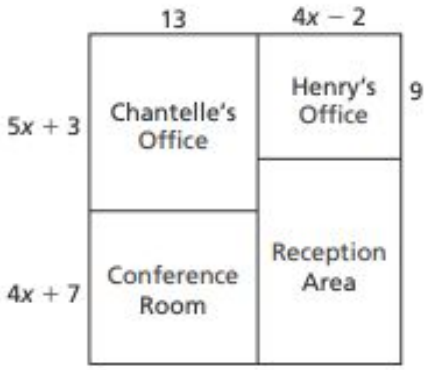
4. Yesterday Gunnar ran 4 times around the track plus an additional 450 feet. Today he ran 3 times around the track plus an additional 375 feet. What expression represents how much farther Gunnar ran yesterday than today?
   **$t + 75$**

Name _____

Build Mathematical Literacy
**4-7**

**Read the problem below. Answer the questions to help understand the steps needed to solve the problem.**

Chantelle and Henry work for the same company and share a reception area and a conference room as shown below. How much greater is the area of Chantelle's office than the area of Henry's office?




1. How many operations will you use to answer the question? Name each operation and underline the word or words in the problem that tell you this.

   **Multiplication and subtraction; Check students' work.**

2. In the diagram, highlight the given side lengths of the two offices that you need to compare. Cross out any information in the problem and diagram that is not necessary to solve the problem.

   **Check students' work.**

3. Complete the table to organize the information you will need to solve the problem.

| | Chantelle's Office | Henry's Office |
|---|---|---|
| **Length** | 13 units | $4x - 2$ units |
| **Width** | $5x + 3$ units | 9 units |
| **Area** | 13 ($5x + 3$) square units | 9 ($4x - 2$) square units |

4. Once you have found the areas of Chantelle's and Henry's offices, will you have completed the problem? Explain.

   **No; Sample answer: The areas must be subtracted to find the difference.**

Name _____

Reteach to Build Understanding
**4-8**

The price of a pair of jeans has been reduced by 40%. Let $p$ represent the original price.

The equivalent expressions $p - 0.4p$ and $0.6p$ represent the sale price of the jeans.

The expression $p - 0.4p$ means that 40% was subtracted from the original price, $p$.

The expression $0.6p$ means that 40% off the original price, $p$, is equivalent to 60% of the original price.

Antoine is moving to a new house. His new room will be 50% larger than his old room. What equivalent expressions can you use to represent the size of Antoine's new room?

1. Let $r$ represent the size of Antoine's old room. What expression represents how much larger his new room is than his old room?
   **$0.5r$**

2. Draw a bar diagram to represent Antoine's new room.

3. What addition expression represents the size of Antoine's new room? How can you write an equivalent expression?
   **$r + 0.5r$; Combine like terms to write $1.5r$.**

**On the Back!**

4. For her summer vacation, Emily reduced the weight of her luggage by 30% from its weight, $s$, on her winter vacation. Write two equivalent expressions to represent the weight of Emily's luggage on her summer vacation.
   **$s - 0.3s$, $0.7s$**

Name _____

Build Mathematical Literacy
**4-8**

**Read the problem below. Answer the questions to help you understand the steps for solving the problem.**

Mr. Kelley uses an expression to represent the perimeter of a square. How can the expression be rewritten to highlight the length of a side of the square?

$P = 8x + 20$

1. Underline the expression representing the perimeter of the square. Circle the words in the problem that explain what this expression represents.

**Check students' work.**

2. Which of the following best describes the correct solution to this problem?

- [ ] An explanation written in words
- [x] An algebraic expression that represents the perimeter of the square
- [ ] An algebraic expression that represents the side length of the square
- [ ] The actual side length of the square given as a number

3. How can you rewrite an expression with no like terms?

**Sample answer: Find the GCF and rewrite using the Distributive Property.**

4. What is the relationship between the perimeter of a square and its side length? Select all correct answers.

- [x] Perimeter = (side length) + (side length) + (side length) + (side length)
- [ ] Perimeter = (side length) × (side length)
- [x] Perimeter = 4 × (side length)
- [ ] Perimeter = (side length) ÷ 4

Name _____

Additional Vocabulary Support
**4-8**

**Use the list below to fill in an example for each property or technique.**

| | | |
|---|---|---|
| $5 + x = x + 5$ | $3x + 6 = 3(x + 2)$ | $x - 4 = x + (-4)$ |
| $3a + 2 + a = 4a + 2$ | $(2x + 7) + 3 = 2x + (7 + 3)$ | |

| Property or Technique | Example |
|---|---|
| Distributive Property | $3x + 6 = 3(x + 2)$ |
| Associative Property | $(2x + 7) + 3 = 2x + (7 + 3)$ |
| Commutative Property | $5 + x = x + 5$ |
| Combine like terms. | $3a + 2 + a = 4a + 2$ |
| Write an additive inverse. | $x - 4 = x + (-4)$ |

**For each of the following, tell whether the expressions are *equivalent expressions* or *not equivalent expressions*.**

**1.** $16b + 7a - c$ and $7a + (-c) + 16b$

(equivalent expressions) not equivalent expressions

**2.** $5y + (-4)$ and $4 + (-5y)$

equivalent expressions (not equivalent expressions)

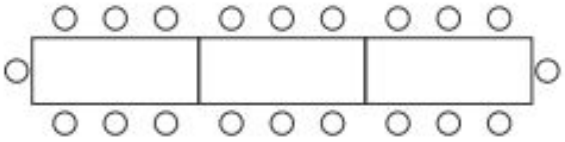
**3.** $x + x + 3 - y + 2x - 1 + 6y$ and $4x + 5y + 2$

(equivalent expressions) not equivalent expressions

Name _____

Enrichment
**4-8**

A conference center has rectangular tables that seat three people at each long side and one person at each end. Tables can be placed end-to-end to seat larger groups, as shown in the diagram.



1. Why does the expression $6x + 2$ represent the number of people who can sit at $x$ tables placed end-to-end? Explain.

**Sample answer: There are 3 people per long side, or 6 people per table: $6x$. The end tables each seat one person at the end for 2 more people.**

2. An individual table can seat 8 people, but people cannot sit at the ends of the middle tables or the inside ends of the end tables when the tables are placed end to end. An event planner thinks the expression $8x - 2(x - 2) - 2(1)$ can also be used to represent the number of people that can be seated. Is the event planner's expression equivalent to $6x + 2$? Show your work.

**Yes; $8x - 2(x - 2) - 2(1) = 8x - 2x + 4 - 2 = 6x + 2$**

3. Write another expression that is equivalent to $6x + 2$. How does your expression represent the number of people who can sit at $x$ tables placed end-to-end?

**Sample answer: $7x - 1(x - 2)$; Each table can seat 7 people at most, but the middle $(x - 2)$ tables each seat one fewer person.**

4. If the tables were placed side-by-side so that the long sides were next to each other instead of the short sides, what expression represents the number of people who can sit at $x$ tables? Explain.

**$2x + 6$; Sample answer: Each middle table seats 2 people, one at each short side, for a total of $2x$ people. The first and last tables each seat an additional 3 people on one long side, for a total of 6 more people.**



Copyright © Pearson Education, Inc., or its affiliates. All Rights Reserved. 7