Chapter 4: Ratios and Proportions, Percent, and Applications

Study Skills

4.1 Ratios and Proportions
4.2 Solving Proportions
4.3 Decimal Numbers and Percents
4.4 Fractions and Percents
4.5 Solving Percent Problems Using Proportions
4.6 Solving Percent Problems Using Equations
4.7 Applications: Discount, Sales Tax, Commission, and Percent Increase/Decrease
4.8 Applications: Profit, Simple Interest, and Compound Interest

Chapter 4 Projects

Math@Work

Foundations Skill Check for Chapter 5

Math@Work

Introduction

If you plan on going into nursing, you have a wide variety of areas to specialize in. Pediatric nurse, trauma nurse, medical-surgical nurse, and forensic nurse are just a few of the options you can choose from. Nurses not only need a strong ability to communicate with doctors and other coworkers, but they should also have a solid understanding of basic mathematics which is important in performing tasks such as administering medication and determining if a patient has a healthy blood pressure. No matter which field of nursing you choose to make your career in, math will be a part of your daily job to ensure that your patients receive proper medical care.

Suppose you choose to become a pediatric nurse in a hospital. Throughout your work day you’ll be faced with many questions that require math to find the answer. How often does an IV need to be replaced according to the doctor’s prescription? How much medication should be given to the patient to meet the prescribed dosage? Is the patient’s blood pressure and heart rate normal? Finding the answers to these questions (and many more) require several of the skills covered in this chapter and the previous chapter. At the end of the chapter, we’ll come back to this topic and explore how math is used as a pediatric nurse.
Study Skills

How to Read a Math Textbook

Reading a textbook is very different than reading a book for fun. You have to concentrate more on what you are reading because you will likely be tested on the content. Reading a math textbook requires a different approach than reading literature or history textbooks, because in addition to words, it contains a lot of symbols and formulas. Here are some tips to help you successfully read a math textbook.

1. **Don’t Skim**  
   When reading math textbooks you need to look at everything: titles, learning objectives, definitions, formulas, text in the margins, and any text that is highlighted, outlined, or in bold font. Also pay close attention to any tables, figures, charts, and graphs.

2. **Minimize Distractions**  
   Reading a math textbook requires much more concentration than a novel by your favorite author, so pick a study environment with few distractions and a time when you are most attentive.

3. **Start At The Beginning**  
   Don’t start in the middle of an assigned section. Math tends to build on previously learned concepts and you may have missed an earlier concept or formula that is crucial to understanding the rest of the material in the section.

4. **Highlight and Annotate**  
   Put your book to good use and don’t be afraid to add comments and highlighting. If you don’t understand something in the text, reread it a couple of times and if it is still not clear, note the text with a question mark or some other notation, so that you can ask your instructor about it.

5. **Go Through Each Step of the Examples**  
   Make sure you understand each step of an example and if not, mark it so you can ask about it in class. Sometimes math textbooks leave out intermediate steps to save space. Try filling these in yourself in the spaces or margins of the book. Also, try working the examples on your own.

6. **Take Notes of Important Definitions, Symbols or Notation, Properties, Formulas, Theorems, and Procedures**  
   Review these daily as you do your homework and before taking quizzes and tests. Practice rewriting definitions in your own words so that you understand them better.

7. **Use Available Resources**  
   Most books come with CD’s or have companion web sites to help you with understanding the content. These resources may contain videos that help explain more complex steps or concepts. Do some searching on the Internet for topics you don’t understand.

8. **Read the Material Before Class Whenever Possible**  
   Try to read the material from your book before the instructor lectures on it. After the lecture, reread the section again to help you retain the information as you look over your class notes.

9. **Many Terms Used in Everyday English Have a Different Meaning When Used in Mathematics**  
   Some examples include equivalent, similar, average, median, prime, and product. Two equations can be equivalent to one another without being equal. Similar triangles can be different sizes as long as their sides are in the same proportion. An average can be computed mathematically in several ways. It is important to note these differences in meaning in your notebook where you keep important definitions and formulas.

10. **Try Reading the Material Aloud**  
    Reading aloud makes you focus on every word in the sentence. Leaving out a word in a sentence or math problem could give it a totally different meaning, so be sure to read the text carefully and reread if necessary.
4.1 Ratios and Proportions

Objectives

Understand ratios.
Understand proportions.

Success Strategy

You may want to review and practice finding the least common denominator of two fractions before working through this section.

Understand Concepts

Go to Software  First, read through Learn in Lesson 4.1 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to ratios and proportions.

Definitions

A ratio is a comparison of two quantities by division. If the units are the same in the numerator and denominator or there are no units, we can write the ratio without them.

A rate is a ratio with different units in the numerator and denominator. The units should always be written when working with a rate.

A proportion is a statement that two ratios are equivalent.

1. Determine if the following are ratios, rates, or proportions.

   a. 5 to 9

   b. \( \frac{24 \text{ miles}}{1 \text{ hour}} \)

   c. \( \frac{4 \text{ gallons}}{\$14} = \frac{10 \text{ gallons}}{\$35} \)

   d. \( \frac{18 \text{ feet}}{24 \text{ feet}} \)

Read the following paragraph about proportions and work through the problems.

A proportion is considered to be true if the ratios on both sides are equivalent. Otherwise, the proportion is considered to be false. Suppose you have the proportion \( \frac{10}{15} = \frac{18}{25} \) and you want to compare the two ratios to determine if the proportion is true. Two methods which can be used to do this are explained in the following two problems.

2. First method: Since ratios can be thought of as fractions, one way to compare the two ratios is to find equivalent fractions for each by using the LCD (least common denominator) and then compare the numerators.

   a. What is the LCD for \( \frac{10}{15} \) and \( \frac{18}{25} \)?
b. Find the equivalent fractions in the proportion by using the LCD from part a.

c. Is the proportion \( \frac{10}{15} = \frac{18}{25} \) true or false?

3. Second method: Another way to determine if a proportion is true or false is to “clear the denominators.” To do this we need to multiply both ratios by a whole number which reduces both denominators to 1. While this number does not need to be the least common denominator, using the least common denominator will keep the numbers smaller and easier to work with.

a. What is the least common denominator of \( \frac{10}{15} \) and \( \frac{18}{25} \)?

b. If we multiply the ratio \( \frac{10}{15} \) by the answer to part a., we must multiply \( \frac{18}{25} \) by that same number or the resulting equation will not be equivalent. Rewrite the proportion \( \frac{10}{15} = \frac{18}{25} \) by multiplying each ratio by the LCD found in part a. Simplify your answer.

c. Is the proportion true or false? How does this answer compare to the answer for 3b?

Cross Products

The cross product of the two ratios in the proportion \( \frac{a}{b} = \frac{c}{d} \) is found by multiplying \( a \) by \( d \) and multiplying \( c \) by \( b \).

\[
\frac{a}{b} \times \frac{c}{d} \quad a \cdot d = b \cdot c
\]

If the cross products are equal, then the proportion is true.

Quick Tip

Finding the cross products is also known as cross multiplying.

Quick Tip

Remember that any whole number can be written as a fraction by placing it over a denominator of 1.

4. The cross products of a proportion are used to compare the two ratios in the proportion to see if they are equivalent. Finding the cross products is actually a shortcut of the second method described in Problem 3. Perform cross multiplication to verify the proportion \( \frac{10}{15} = \frac{18}{25} \) is true. Do you get the same results as you did for part d. of Problem 3?
5. The comparison values you get from both methods will usually be different (compare the values from Problem 2 part b. with Problem 3 part d.), but both approaches are valid to use.

   a. What do both methods have in common?

   b. Which method do you prefer? Explain why you prefer this method.

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### Skill Check

**Go to Software** Work through Practice in Lesson 4.1 of the software before attempting the following exercises.

Write each comparison as a ratio or rate reduced to lowest terms.

6. 75 miles to 3 gallons of gas

7. $1.25 per 25 ounces

Determine if each proportion is true or false.

8. \( \frac{25}{6} = \frac{50}{8} \)

9. \( \frac{3}{4} = \frac{15}{20} \)

10. \( \frac{4}{5} = \frac{2.4}{3} \)

11. \( \frac{1}{2} = \frac{1}{3} \)

### Apply Skills

Work through the problems in this section to apply the skills you have learned related to ratios and proportions.

12. Lachlan is comparing nutrition labels to see if two products have equivalent ratios of calories per serving size. The first product has 110 calories per 80 gram serving. The second product has 82.5 calories per 60 gram serving.

   a. Set up a proportion using the given information.

   b. Do the two products have the equivalent calorie per serving ratios?

### Quick Tip

Usually the phrase “per serving” means “per 1 serving.”
c. Another way to compare two ratios is to convert them to unit rates, which is an equivalent ratio with a denominator of 1. You can convert a ratio to a unit rate by dividing the denominator into the numerator. Convert the ratios on either side of the equal sign in part a. to a unit rate.

d. Do the two products have the same number of calories per 1 gram serving based on your results from part c.?

13. When making concrete, the ratio of sand to cement should be 5 parts sand to 2 parts cement. A batch of concrete is made with the ratio of 30 parts sand per 14 parts cement.
   a. Set up a proportion using the given information.
   b. Was the batch of concrete made with the correct ratio of sand to cement? If not, find the correct ratio for the given amount of sand.

14. A doctor orders an IV for a patient to run at 125 mL per hour. A nurse sets the IV to run at a rate of 1000 mL per 8 hours.
   a. Set up a proportion using the given information.
   b. Did the nurse set the IV at the correct rate? If not, find the correct ratio for the given number of milliliters.

15. A student teacher is given a guideline that a test should have an average of 6 points per problem. The student teacher makes a test worth 78 points that has 13 problems.
   a. Set up a proportion using the given information.
   b. Did the student teacher make the test according to the guideline? If not, find the correct ratio for the given number of points.
4.2 Solving Proportions

Objectives

- Solve proportions.
- Use proportions to solve problems.

Success Strategy

Be sure to pay attention to the units when setting up proportions.

Understand Concepts

Go to Software

First, read through Learn in Lesson 4.2 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to solving proportions.

Solving a Proportion

1. Find the cross products. (Cross products are also known as cross multiplying).
2. Divide both sides of the equation by the coefficient of the variable.

The first step in solving proportions in word problems is to set up the proportion. When setting up proportions to solve for an unknown variable, there are multiple setups to choose from. Consider the situation where a baker is scaling a cookie recipe. The recipe uses 4 cups of flour and makes 36 cookies. The baker wants to determine how many cups of flour are needed to make 60 cookies.

1. We first need to analyze the problem to determine how to set up the proportion.
   a. What is the unknown value in this problem?
   b. What are the units used in this problem?

2. One way to set up a proportion is to have matching units in the numerators, matching units in the denominator, and the variable in the numerator. In this form, it is important to have one ratio be the original quantities and the other ratio to be the scaled quantities. For our baking problem, the proportion in this form would be

\[
\frac{4 \text{ cups}}{36 \text{ cookies}} = \frac{x \text{ cups}}{60 \text{ cookies}}
\]

   a. Are the original values on the right or left?
   b. Are the scaled values on the right or left?

Quick Tip

The word scale is often used when working with proportions. A scaled value has been adjusted to fit a certain need. Things can be scaled in relation to size or amount. For instance, residential plans are commonly drawn on a quarter-scale, which means that one inch on the scale drawing is equivalent to four feet of the final version.

Quick Tip

The answer remains the same regardless if the scaled values are placed on the right or left side of the equation.
c. How many cups of flour are needed to make 60 cookies?

3. Another way to set up this problem is to take the \textit{reciprocal} of both sides of the proportion from Problem 2. This will result in the variable being in the denominator.

   a. Write the reciprocal of each side of the proportion from Problem 2.

   b. The units have switched from the top to the bottom and vice versa. Does this change the solution to the proportion?

4. Another way to set up a proportion is to have the matching units of measurement in each ratio with the variable in the numerator. In this form, it is important to have the original quantities together in either the numerator or the denominator. For this problem, we will keep them in the denominator. For our baking problem, the proportion in this form would be

   \[
   \frac{x \text{ cups}}{4 \text{ cups}} = \frac{60 \text{ cookies}}{36 \text{ cookies}}
   \]

   a. Are the original values on the top or bottom?

   b. Are the scaled values in the numerators or the denominators?

   c. Do you still get the same solution for \( x \)?

   d. Can you think of another way to set up this proportion that gives you the same answer? Describe your method and solve the proportion to make sure you get the same answer. (\textbf{Hint:} See Problem 3.)
Nursing Notation

In nursing, the following two notations are commonly used to set up and solve proportions when preparing medications for patients.

\[ \frac{a}{b} = \frac{c}{d} \quad \text{and} \quad a:b::c:d \]

The values \( b \) and \( c \) are known as the **means** and \( a \) and \( d \) are known as **extremes**.

In both notations, the \( a : b \) represents a ratio where \( a \) is the numerator and \( b \) is the denominator. Similarly, \( c : d \) is a ratio where \( c \) is the numerator and \( d \) is the denominator.

5. The two notations represent the same proportion. What does the symbol “::” stand for?

6. One way to read “\( a : b :: c : d \)” is “\( a \) is to \( b \) as \( c \) is to \( d \)”. Write in words how would you read “10 mg : 1 mL :: 12.5 mg : 1.25 mL”?

Quick Tip

To help you remember which values are the means and which are the extremes, remember that **mean** refers to “the middle value,” so the numbers in the middle are the means.

Solving Proportions Using Nursing Notation

1. Change the notation into standard proportion notation and then solve.
   
   For example, \( 1 : 2 :: 3 : x \) would be \( \frac{1}{2} = \frac{3}{x} \). Solve for \( x \).

2. Keep the notation the same, and multiply the means together and the extremes together to get the result of \( a \cdot d = b \cdot c \).
   
   For example, \( 1 : 2 :: 3 : x \) would cross multiply to become \( 1 \cdot x = 2 \cdot 3 \). Solve for \( x \).

7. Verify that both methods in the instruction box give the same results for \( 8 : 15 :: 12 : x \).

Quick Tip

If you are a nursing student, you may want to practice solving proportions using both notations (the standard notation and the medical notation).

Quick Tip

Multiplying together the means and the extremes is a similar process finding the cross products of a proportion.
Skill Check

Go to Software Work through Practice in Lesson 4.2 of the software before attempting the following exercises.

Solve each proportion.

8. \( \frac{3}{5} = \frac{x}{25} \)

9. \( \frac{y}{7} = \frac{21}{49} \)

10. \( \frac{10}{25} = \frac{25}{x} \)

11. \( \frac{15}{25} = \frac{72}{y} \)

Apply Skills

Work through the problems in this section to apply the skills you have learned related to solving proportions. Try using different formats for setting up the proportion from Problems 2-4 to determine which one you like best.

12. A nurse is told that a patient’s IV is to run at a rate of 75 mL per hour. If the nurse uses a 250 mL bag of IV solution, how long will it be until the nurse needs to replace it?

a. Set up a proportion with the given information.

b. Solve the proportion.

c. Interpret your answer from part b.
13. A civil engineer is making a scale model of a water pump to test before building the full-sized version. One inch on the model represents ten inches on the actual water pump. If the full-sized water pump is designed to be 82 inches long, what is the length of the scale model?

   a. Set up a proportion with the given information.

   b. Solve the proportion.

   c. Interpret your answer from part b.

14. In the United States one new person is infected with HIV every ten and a half minutes. How long will it take for fifty new people to become infected with HIV?
   Source: http://www.cdc.gov/hiv/statistics/basics/

   a. Set up a proportion with the given information.

   b. Solve the proportion.

   c. Interpret your answer from part b.
15. A certain type of chain saw runs on a mixture of 128 ounces of gasoline for every 4 ounces of oil. If you want to use 5 ounces of oil to make the fuel mixture, how many ounces of gasoline are required?

a. Set up a proportion with the given information.

b. Solve the proportion.

c. Interpret your answer from part b.

16. A machinist can make 6 parts every 5 minutes. How long will it take to make 100 parts for a customer? Round your answer to the nearest tenth.

a. Set up a proportion with the given information.

b. Solve the proportion.

c. Interpret your answer from part b.
4.3 Decimal Numbers and Percents

Objectives

Understand that percent means hundredths.
Change decimal numbers to percents.
Change percents to decimal numbers.

Success Strategy

Being able to convert between decimals and percents is an important skill in real life situations.
Extra practice in the software would be beneficial in improving this skill.

Go to Software

First, read through Learn in Lesson 4.3 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to decimal numbers and percents.

1. The % symbol is a recent form to represent \( \frac{1}{100} \) when talking about percents in writing.
   The % symbol slowly developed over several hundred years from its original form. Use the key words “percent symbol history” to answer the following questions.
   a. When was a symbol for percent first used?
   b. Before a symbol was created, what words were used when writing about percents? What do these words mean?

Writing a Decimal Number as a Percent

1. Move the decimal two places to the right.
2. Attach the percent sign.

\[
\begin{align*}
0.25 & \rightarrow 0.25 \rightarrow 25\%
\end{align*}
\]

Writing a Percent as a Decimal Number

1. Remove the percent sign.
2. Move the decimal two places to the left.

\[
\begin{align*}
56\% & \rightarrow .56 \rightarrow 0.56
\end{align*}
\]

Multiplying and dividing by powers of 10 and how those actions related to the placement of the decimal point in a number was introduced in Sections 3.3 and 3.4. Use this information for the next problem.

2. Instead of moving the decimal point two places to the right, what is another way to write the rule for changing a decimal number into a percent?
3. Instead of moving the decimal point two places to the left, what is another way to write the rule for changing a percent into a decimal number?

4. Money is useful for connecting the fraction form, decimal form, and percent form of some common values since it is something we are familiar with and use often. Fill in this table with each form of the coin value.

<table>
<thead>
<tr>
<th>Coin Name</th>
<th>Unreduced Fraction</th>
<th>Decimal Number Equivalent</th>
<th>Percent Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penny</td>
<td>(\frac{1}{100})</td>
<td>0.01</td>
<td>1%</td>
</tr>
<tr>
<td>Nickel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dime</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quarter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half-dollar</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**True or False:** Determine whether each statement is true or false. Rewrite any false statement so that it is true. (There may be more than one correct new statement.)

5. The coins listed in the table are less than 100% of a dollar.

6. The coins listed in the table have a decimal form less than 0.01.

7. A dollar coin is 100% of a dollar.

Lesson Link

In Section 3.5, we discussed that coins represent a fraction of a dollar where 100 cents is equal to one dollar.
Skill Check

Go to Software Work through Practice in Lesson 4.3 of the software before attempting the following exercises.

Change each fraction to a percent.

8. \( \frac{26}{100} \)

9. \( \frac{13.9}{100} \)

Change each decimal number to a percent.

10. 0.06

11. 0.153

Change each percent to a decimal number.

12. 85%

13. 1.4%

14. Fill in the missing values in the table. Reduce all fractions to lowest terms.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( \frac{3}{8} )</td>
</tr>
<tr>
<td>( \frac{9}{16} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Apply Skills

Work through the problems in this section to apply the skills you have learned related to decimal numbers and percents.

15. The table below shows the distribution of employed citizens in the United States in 2007 based on the age ranges given along the horizontal axis. Source: http://www.cdc.gov/

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Percent Distribution of Employed US Citizens 16 and Older in 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>16–19</td>
<td>4.0</td>
</tr>
<tr>
<td>20–24</td>
<td>9.6</td>
</tr>
<tr>
<td>25–34</td>
<td>21.6</td>
</tr>
<tr>
<td>35–44</td>
<td>23.5</td>
</tr>
<tr>
<td>45–54</td>
<td>23.7</td>
</tr>
<tr>
<td>55–64</td>
<td>13.8</td>
</tr>
<tr>
<td>65 and Older</td>
<td>3.8</td>
</tr>
</tbody>
</table>

a. What is the total sum (as a percent) of all the age groups?

b. What percent of workers are below the age of 45?

c. What percent of workers are age 25 or older?

d. What trend do you notice in the data with relation to age?

e. What is the difference between the largest percent and the smallest?

f. How does the lowest age category compare to the highest?
4.4 Fractions and Percents

Objectives

Change fractions and mixed numbers to percents.
Change percents to fractions and mixed numbers.

Success Strategy

Changing fractions to percents requires the use of long division. You may find it helpful to review long division in Section 1.4 before working through this section.

Writing a Fraction as a Percent

1. Find the decimal number equivalent of the fraction.
2. Move the decimal two places to the right.
3. Attach the percent sign.

Writing a Percent as a Fraction

1. Write the percent as a fraction over 100 and remove the percent symbol.
2. Reduce if possible.

Read the following paragraph about solving word problems and work through the problems.

When solving word problems where the solution is a percent, finding the answers will typically involve writing the percent as a fraction and using quantitative reasoning skills. You need to determine which value in the question represents the whole, or total, amount (denominator) and which value represents a part of the whole or total (numerator). The following problems will guide you through the process.

1. Tim needs to earn 120 credit hours to earn a Baccalaureate degree and currently has 96 credit hours. What percent of the credit hour requirement has Tim completed?
   a. What is the total amount of credit hours needed?
   b. How many credit hours has Tim earned?
   c. Write the portion of total credit hours that Tim has earned as a fraction.
   d. Answer the question asked by changing the fraction from part c. into a percent.

Lesson Link

Reducing a fraction to lowest terms was introduced in Section 2.1.

Quick Tip

You may not see percents written as fractions in real world situations very often, but there are times when this format is useful. In Section 4.5 you will learn how to use the fractional form of a percent to solve percent problems by using a proportion.
2. Christine’s doctor recommends that she takes 1000 micrograms of calcium per day. She takes a vitamin which contains 400 micrograms of calcium and she knows that today she has taken 350 micrograms from her food. What percent of the recommended value of calcium has Christine taken?

a. What is the total amount of calcium Christine needs to take a day?

b. How many micrograms of calcium has Christine taken so far today?

c. Write the portion of the recommended amount of calcium that Christine has taken today as a fraction?

d. Answer the question asked by changing the fraction from part c. into a percent.

Read through the following paragraph about writing percents as fractions then solve the problems.
When writing a percent as a fraction, you will often need to reduce the fraction. When reducing fractions where both the numerator and denominator end in a zero, the zero can be removed. This is the result of dividing a 10 out of the numerator and denominator and the fact that \( \frac{10}{10} = 1 \).

For example, \( \frac{50}{70} = \frac{5}{7} \).

3. State how many zeros can be removed when reducing each fraction.

a. \( \frac{40}{70} \)

b. \( \frac{40}{700} \)

c. \( \frac{100}{70} \)

d. \( \frac{25,000}{50,000} \)

**True or False:** Determine whether each statement is true or false. Rewrite any false statement so that it is true. (There may be more than one correct new statement.)

4. \( \frac{1}{4} \) is equivalent to \( \frac{1}{4} \)%.
5. 0.005 is equivalent to $\frac{1}{2}\%$.

6. 25% and $\frac{1}{4}$ have the same decimal number equivalent.

Read the following paragraph about percents and probability and then work through the following problems.

In media advertising, the likelihood, or chance, that something happens is commonly given as a ratio. This ratio can be written as a fraction or a percent. When commercials report that “4 out of 5 dentists” recommend a certain type of toothpaste, what they mean is $\frac{4}{5}$ of all dentists (or 80% of all dentists) recommend this toothpaste.

7. Interpret the following statements using complete sentences by converting the given ratio into a fraction and a percent. (You will have two sentences for each statement.)

   a. 3 out of 4 choosy moms prefer Jif brand peanut butter.

   b. 81 out of 1000 babies are born with a low birth weight. Source: http://www.cdc.gov

   c. 5 out of 100 adults with a post graduate degree are smokers. Source: http://www.cdc.gov/

Go to Software Work through Practice in Lesson 4.4 of the software before attempting the following exercises.

Change each fraction or mixed number to a percent. Round to the nearest hundredth if necessary.

8. $\frac{1}{25}$
9. $\frac{5}{6}$
10. $\frac{3}{8}$

Change each percent to a fraction or mixed number. Reduce if possible.

11. 72%
12. 125%
13. 62.5%
Apply Skills  

Work through the problems in this section to apply the skills you have learned related to fractions and percents.

14. Write the percent in each statement as a fraction and reduce when possible.
   a. A Nutri-Grain cereal bar gives you 20% of your daily value of calcium.

   b. Thirty-two percent of the student population at a college are first year students.

   c. In June of 2013, 7.6% of US citizens that were able to work were unemployed. Source: http://data.bls.gov/timeseries/LNS14000000

15. Margot made a purchase that costs $50 and was charged $3.50 in sales tax. What is the sales tax rate as a percent of the cost?

16. A Big Mac from McDonald’s is estimated to have 970 mg of sodium. The maximum recommended daily value of sodium for adults in the United States is 2300 mg. What percent of the maximum daily value of sodium does the Big Mac provide?

17. Americans consume an average of 3436 mg of sodium per day. The recommended adequate intake level of sodium is 1500 mg. What percent of the adequate sodium intake level does the average American consume per day?

18. In 2011, 15 out of every 100 people in the United States were living in poverty. In the same year, 48 out of every 100 people in the US, above the age of 15, owned a smartphone. Source: US Census Bureau
   a. What percent of the US population was living in poverty in 2011?

   b. What percent of the US population over the age of 15 owned a smartphone in 2011?
4.5 Solving Percent Problems Using Proportions

Objectives

Understand the proportion \( \frac{P}{100} = \frac{A}{B} \).

Use the proportion \( \frac{P}{100} = \frac{A}{B} \) to solve percent problems.

Success Strategy

There are two different methods for solving percent problems. One way is to use the proportion, which is taught in this section. The next section will show a different method. Be sure to practice both methods to determine which one you prefer.

Understand Concepts

Go to Software First, read through Learn in Lesson 4.5 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to solving percent problems by using the proportion \( \frac{P}{100} = \frac{A}{B} \).

The Percent Proportion

The proportion \( \frac{P}{100} = \frac{A}{B} \) can be used when solving percent problems.

\[ P = \text{Percent} \]
\[ A = \text{Amount} \]
\[ B = \text{Base} \]

1. Write a short paragraph to compare the parts of the ratio \( \frac{A}{B} \) in the percent proportion to the parts of a fraction. Be sure to include how they are similar and how they are different.

Quick Tip

The amount may sometimes be larger than the base. This happens when the percent is greater than 100.

Quick Tip

Remember that the unknown value in the proportion will be represented by a variable.

When setting up a proportion to solve a percent problem, it is important to read the problem statement carefully. Before setting up the proportion, you should determine which values in the proportion are known and which value is the unknown.

2. Review Pólya’s problem solving steps which are located in the study skill section at the beginning of the workbook. Write your own version of the problem solving steps to solve a percent problem using the percent proportion.

   Step 1 is:

   Step 2 is:

   Step 3 is:

   Step 4 is:
Being able to identify the important information in a word problem is a valuable skill that takes time to develop. There are three pieces to a percent proportion: the amount \( A \), the base \( B \), and the percent \( P \). Two of the pieces are typically given to you in the problem statement. The other piece will be the unknown, which is the value that needs to be solved for.

For the following problems, determine the pieces of the percent proportion. If a value is unknown based on the problem statement, write "unknown" as your answer. You do not need to solve the problem.

3. 45% of what number is 36?
   a. What is the percent?
   b. What is the amount?
   c. What is the base?
   d. Write the percent proportion.

4. During the past year, Franklin spent 32% of his income on his mortgage and home repairs. If he earned $38,750 during the year, how much money did he spend on his mortgage and home repairs?
   a. What is the percent?
   b. What is the amount?
   c. What is the base?
   d. Write the percent proportion.

5. Tilda purchased a pair of jeans which cost $48. The cost of tax on her purchase was $4.08. What percent of the purchase price was the tax rate?
   a. What is the percent?
   b. What is the amount?
   c. What is the base?
   d. Write the percent proportion.

Skill Check

Go to Software Work through Practice in Lesson 4.5 of the software before attempting the following exercises.

Use the proportion \( \frac{P}{100} = \frac{A}{B} \) to solve for the unknown quantity.

6. Find 60% of 25.
7. What is 12% of 20?
The following problems focus on two important parts of solving percent problems using the proportion \( \frac{P}{100} = \frac{A}{B} \).

The first part is setting up the proportion based on the information provided. The second part is understanding what the answer means and putting it into words. Outside of a math course, problems which need math to solve them will often involve this type of translation into mathematical notation and back into words.

10. In 2011, 70.7% of babies in the state of Washington were vaccinated against Hepatitis B within 3 days of birth. If 86,929 babies were born in Washington in 2011, how many were vaccinated against Hepatitis B within 3 days of their birth? Sources: http://www.doh.wa.gov/Portals/1/Documents/Pubs/422-099-VitalStatistics2011Highlights.pdf and http://www.cdc.gov/vaccines/stats-surv/nis/data/tables_2011.htm

   a. Set up the proportion.

   b. Solve for the unknown variable. Round your answer to the nearest whole number.

   c. What does this answer mean? (Write a complete sentence.)

11. A family has a monthly income of $3700 and they spend $925 per month on housing costs. What percent of their monthly income goes towards housing costs?

   a. Set up the proportion.

   b. Solve for the unknown variable.

   c. What does this answer mean? (Write a complete sentence.)
12. The average semester tuition at a state college is $5650. The college board decides to raise tuition by 7%. How much will tuition increase?

a. Set up the proportion.

b. Solve for the unknown variable.

c. What does this answer mean? (Write a complete sentence.)

d. What will the tuition be per semester after the tuition increase?

e. How much will a 4-year degree cost if this is the only tuition increase during those 4 years? (Hint: there are two semesters per school year.)

13. In the United States, approximately 7% of the population are military veterans. If there are approximately 22,000,000 veterans in the United States, what is the population of the United States (rounded to the nearest whole number)? Source: US Census Bureau

a. Set up the proportion.

b. Solve for the unknown variable. Round your answer to the nearest whole number.

c. What does this answer mean? (Write a complete sentence.)
4.6 Solving Percent Problems Using Equations

Objectives

Understand the equation \( R \cdot B = A \).

Use the equation \( R \cdot B = A \) to solve percent problems.

Success Strategy

The previous section introduced a method for solving percent problems using a proportion. In this section, you will learn another method that uses an equation. Be sure to practice both methods to determine which one you prefer.

Go to Software

First, read through Learn in Lesson 4.6 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to solving percent problems by using the equation \( R \cdot B = A \).

The Percent Equation

The equation \( R \cdot B = A \) can be used when solving percent problems.

\( R \) = Rate, written as a decimal number

\( A \) = Amount

\( B \) = Base

1. The previous section introduced the proportion \( \frac{P}{100} = \frac{A}{B} \) for solving percent problems. The following exercises will investigate how this proportion relates to the equation \( R \cdot B = A \).

   a. What are the similarities and differences between the variables used in the proportion and those used in the equation?

   b. \( \frac{P}{100} \) is the fraction form of the percent and \( R \) is the decimal form of the percent. This means that \( \frac{P}{100} = R \). Substitute (or replace) \( \frac{P}{100} \) with \( R \) in the proportion \( \frac{P}{100} = \frac{A}{B} \).

   c. Rewrite the equation from part b. for \( A \) by cross multiplying and writing \( R \) as \( \frac{R}{1} \).

   d. Which property of multiplication says that \( R \cdot B = A \) and \( B \cdot R = A \) are equivalent equations?

   e. Since we can rearrange the proportion \( \frac{P}{100} = \frac{A}{B} \) to look like the equation \( R \cdot B = A \), what does this tell you about the two equations?
2. Use the information from Problem 1 to answer the following exercises.
   a. Rewrite the proportion \( \frac{65}{100} = \frac{A}{40} \) as an equation.

   b. Use both the proportion and the equation to solve for \( A \). Do you get the same value after using both methods?

   c. Which method do you prefer for solving percent problems, the proportion or the equation? Explain your answer.

For the following problems, determine the pieces of the percent equation. If a value is unknown based on the problem statement, write "unknown" as your answer.

3. What percent of 42 is 8?
   a. What is the rate?
   b. What is the amount?
   c. What is the base?
   d. Write the percent equation.

4. At a hospital, 8% of emergency room visits are for non-urgent care needs. During one day they had 24 non-urgent care patients. How many patients did the emergency room have that day?
   a. What is the rate?
   b. What is the amount?
   c. What is the base?
   d. Write the percent equation.

5. Watermelons are approximately 91% water by weight. A medium size seedless watermelon weighs 14 pounds. What is the weight of the water content in the watermelon?
   a. What is the rate?
   b. What is the amount?
   c. What is the base?
   d. Write the percent equation.
Skill Check

Go to Software  Work through Practice in Lesson 4.6 of the software before attempting the following exercises.

Use the equation $R \cdot B = A$ to solve for the unknown quantity.

6. 20% of 80 is what number?

7. What percent of 24 is 6?

8. 46 is what percent of 115?


Quick Tip

The word *of* is often used to indicate multiplication.

Apply Skills

The following problems focus on two important parts of solving percent problems by using the equation $R \cdot B = A$. The first part is setting up the equation based on the information provided. The second part is understanding what the answer means and putting it into words. Outside of a math course, problems which need math to solve them will often involve this type of translation into mathematical notation and back into words.

10. At the beginning of the year, Nevaeh invests $1400 in a fund that is expected to grow at a rate of 7.3% per year. How much interest should she expect to earn by the end of the year?

   a. Set up the equation.

   b. Solve for the unknown variable.

   c. What does the answer to part b mean? (Write a complete sentence.)
11. In a survey of 150,000 adults, 6300 people admitted to falling asleep while driving during the previous 30 days. What percent of the people surveyed fell asleep while driving during the previous 30 days?  
Source: http://www.cdc.gov/mmwr/pdf/wk/mm6151.pdf

a. Set up the equation.

b. Solve for the unknown variable.

c. What does the answer to part b. mean? (Write a complete sentence.)

12. A salaried worker makes $35,000 per year. During the yearly review, he is given a 4.5% increase in pay. How much of a pay increase did he receive?

a. Set up the equation.

b. Solve for the unknown variable.

c. What does the answer to part b. mean? (Write a complete sentence.)

d. If the worker is paid two times each month, how much will each paycheck increase after the raise?
4.7 Applications: Discount, Sales Tax, Commission, and Percent Increase/Decrease

Objectives

Learn Pólya’s four-step process for problem solving.
Understand how to calculate a discount.
Understand how to calculate sales tax.
Understand how to calculate commission.
Understand how to calculate percent increase and percent decrease.

Success Strategy

This section introduces an expanded version of Pólya’s problem-solving steps. This approach works for all types of problems, not only math problems. It would benefit you to make a copy of these steps and keep it handy when you need to solve a problem.

Understand Concepts

Go to Software First, read through Learn in Lesson 4.7 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to applications of percent problems.

The application problems presented in this section can be solved by either the proportion or the equation covered in the previous two sections. The same method should be followed to identify the pieces of the equation that are given to you and the unknown value, write the equation, and then solve for the unknown.

Finding the Discounted Price

There are two methods for finding the discounted price of an item.

1. Find the amount of the discount and subtract that from the original price.
2. Subtract the discount percent from 100% to find the percent of sale price you will pay. Then, multiply that percent by the original price to find the discounted price.

Quick Tip

The discount and the discounted price are not the same thing. The discount is the amount taken off of the original price. The discounted price is the price paid after the discount.

For the next two problems, use both methods of finding the discounted price of an item to find the answer.

1. You receive a coupon for 35% off of any item at a local store. You decide to buy something that originally costs $26. What is the discounted price of the item after you use the coupon?

2. You have a coupon code for an online store which gives you 15% off of any order over $50. You spend $65 and use the coupon. How much will your order cost after applying the coupon?
3. Which method do you prefer to find the discounted price? Explain your reasoning.

4. The sales tax percent is a combination of both state tax and county tax in most states. Use the key words “sales tax” along with your county’s or state’s name to answer the following questions.
   a. What is the combined county and state sales tax rate where you live?
   b. Which county in your state has the highest sales tax rate?
   c. If you make a purchase for $250 at a local store, how much will you pay in sales tax?

5. Income tax is an amount of money deducted from your paycheck and given to the federal and state governments. It is calculated in a similar way as sales tax. The main difference is that the tax amount is deducted from your paycheck and is based on a percentage of your earnings.

   Go to www.forbes.com and enter “federal tax bracket” into the search bar. Find the current year’s federal tax bracket information and use that to answer the following questions. (For the following questions, “single” means “unmarried.”)
   a. If a single person makes $45,000 per year. What percent of his/her income goes towards federal income tax? How much will he/she pay?
   b. A married couple earns $85,000 per year. What percent of their income goes towards the federal income tax? How much will they pay?
   c. A single person earns $85,000 per year. What percentage of his/her income goes to federal income tax? How does this compare to the taxes paid by the married couple earning the same amount per year from part b.?
   d. What percent of your income goes toward federal income tax?
Percent Increase and Percent Decrease

Percent increase or percent decrease is the percent that the value of an item changes over time. To find the percent increase or percent decrease:

1. Find the difference in values. For percent increase, subtract the first value from the second value. For percent decrease, subtract the second value from the first value.
2. Determine what percent the difference is of the original value.

Use the steps given in the blue box to solve the following problems about percent increase and percent decrease.

6. After Maria’s annual review, her pay was increased to $9.25 per hour. Before her raise she made $8.75 per hour. What was the percent increase in her pay? Round your answer to the nearest tenth, when necessary.

7. Kobe got a new job and it now takes him 15 minutes to drive to work. The commute time to his previous job was 25 minutes. What was the percent decrease in Kobe’s commute time?

Skill Check

Work through Practice in Lesson 4.7 of the software before attempting the following exercises.

Solve each word problem using either the percent proportion or equation.

8. 50% of what number is $12.35?  
9. What percent of 270 is 94.5?

10. 25% of 338 is what number?  
11. \( \frac{8}{100} = \frac{x}{12,000} \)
12. People who run a business often have to review quarterly profits for their business to make adjustments to sales plans or item production. The line graph shows the profit per quarter at a small business. Round your answers to the nearest tenth when necessary.

**a.** Which quarter had the most profit?

**b.** Between which two quarters did sales decrease the most?

**c.** What was the percent decrease from part b.?

**d.** Between which two quarters did sales increase the most?

**e.** What was the percent increase from part d.?
13. Levi is a full-time sales associate at a computer store. He earns a weekly salary of $220 and earns 15% commission on all of his sales.

   a. During one week, Levi sold $8500 in merchandise. Sales tax in the county where Levi works is 8.5%. What was the total sales tax paid on all of the sales Levi made?

   b. What would his paycheck for the week be before taxes? (Hint: Levi’s total earnings is equal to salary plus commission.)

   c. Levi’s combined federal and state income tax is 23%. How much will his paycheck be after taxes?

   d. During the next week, one of Levi’s customers returns $1250 in merchandise. When commission based purchases are returned, the value of commission is taken from the salesperson’s next paycheck. How much will be deducted from Levi’s next paycheck (before taxes)?

14. At an electronics superstore, a 46-inch flat screen TV has a retail price of $575. Round your answers to the nearest cent when necessary.

   a. During a holiday sale, management decides to offer a 25% discount on the TV. What is the discounted price of the TV?

   b. The superstore also offers a credit card where the customer can save an additional 5% on their entire purchase (after all other discounts) by charging the sale to the store card. If a customer uses the store credit card to buy the discounted TV, what would the final discounted price of the TV be?

   c. The superstore is located in a county with a 6.5% sales tax. What would be the final sales price of the TV for a customer who uses the store credit card?
Reference Values and Percent Change

In determining the percent change, it is important to identify the reference value. The reference value is usually the starting value or original amount of a quantity before the change occurred. Many times the data is in chronological or time order, so the reference value is easy to determine. Look at the following example.

The batting average of Freddie Freeman, the Atlanta Braves first baseman, was 0.259 for the 2012 season. In 2013 his batting average was 0.319. Calculate the percent increase in his batting average from 2012 to 2013.

In this problem we are trying to determine the percent increase of Freddie Freeman’s batting average from 2012 to 2013, so the reference value will be his batting average from the earlier time period of 2012, or 0.259. Also, the key word increase and the fact that 0.259 < 0.319 tells you that the starting value or reference point is his 2012 batting average.

In calculating percent changes with regard to sales and company profits, the reference point may not be so obvious and may depend on what information is desired. Look at this example.

Last year, a local company that manufactures denim clothing had annual costs of $235,000 and sales of $567,000. Calculate the percent profit made by the company.

For this problem it is easy to determine the amount of profit. You take sales – cost which gives you $332,000. The difficult part is in determining what the denominator needs to be for calculating percent profit. Should the denominator be the amount of cost or the amount of sales? Most companies actually calculate both as a measure of company profitability, but in a typical problem it will most likely be specified as to which one you should use as the reference value. You can see that depending on the reference value, the percent profit can be vastly different:

As percent of sales: \[ \text{amount of profit} \div \text{sales} \cdot 100 = \left( \frac{332,000}{567,000} \right) \cdot 100 = 58.5\% \]

As percent of cost: \[ \text{amount of profit} \div \text{cost} \cdot 100 = \left( \frac{332,000}{235,000} \right) \cdot 100 = 141.3\% \]

In determining the reference value when calculating a percent, be sure to read the problem very carefully. If the reference value isn’t explicitly stated in the problem, look for key words and phrases like “increase,” “decrease,” “changed from,” or “changed to,” to help you identify the starting value or original amount.  

http://espn.go.com/mlb/player/stats/_/id/30193/freddie-freeman
4.8 Applications: Profit, Simple Interest, and Compound Interest

Objectives
Understand percent of profit.
Calculate simple interest.
Calculate compound interest.

Success Strategy
Keep your list of problem-solving steps from the previous section handy when working through this section. Also, read each interest problem carefully so that you are determining the correct type of interest—simple vs. compound interest.

Understanding Concepts

Go to Software First, read through Learn in Lesson 4.8 of the software. Then, work through the problems in this section to expand your understanding of the concepts related to applications of percent problems.

Percent of Profit
The amount of profit earned when an item is sold is the difference between the selling price and the cost of the item.

Percent of profit can be calculated in two ways:
1. **Based on cost:** Divide the amount of profit by the cost of the item.
   \[
   \frac{\text{profit}}{\text{cost}} = \% \text{ of profit based on cost}
   \]
2. **Based on selling price:** Divide the amount of profit by the selling price of the item.
   \[
   \frac{\text{profit}}{\text{selling price}} = \% \text{ of profit based on selling price}
   \]

1. In the proportion \( \frac{P}{100} = \frac{A}{B} \), which variable would be used for
   a. the profit?
   b. the cost or selling price?
   c. the percent of profit?

2. In the equation \( R \cdot B = A \), which variable would be used for
   a. the profit?
   b. the cost or selling price?
   c. the percent of profit?
3. Interest is a part of most people’s financial life. Interest can be earned in our favor, which means that we gain money from the interest. Interest can also be earned from us, which means that we owe money due to interest. Identify if interest is earned in your favor (paid to you) or earned from you (paid by you) for the following types of accounts.

   a. Savings accounts
   b. Credit cards
   c. Mortgages
   d. Certified Deposits
   e. Student loans

**Quick Tip**
In 2007 the Credit Card Accountability Responsibility and Disclosure Act was passed to help ensure that consumers are informed of important details related to any credit accounts they open. There are many sources online to learn more about this law.

**Quick Tip**
A certified deposit (CD) is a low-risk investment with fixed terms of years or months during which the money cannot be accessed.

**Quick Tip**
The interest rate period and time must be in the same units.

**Quick Tip**
Most accounts today use compound interest instead of simple interest.

---

**Interest Formulas**

**Simple interest** is calculated with the formula \( I = P \cdot r \cdot t \), where

- \( I \) = interest earned or paid
- \( P \) = principal (or starting amount)
- \( t \) = time, in years
- \( r \) = interest rate

**Compound interest** uses the same formula but \( t = \frac{1}{n} \), where \( n \) is equal to the number of times per year the account is compounded. To find compound interest, follow these steps:

1. Use the simple interest formula with \( t = \frac{1}{n} \),
2. Add the interest earned to the principal amount,
3. Repeat steps 1 and 2 as many times as the interest is to be compounded.

---

4. Use the above information in the Interest Formulas box to answer the following questions.

   a. How many times do you use the equation \( I = P \cdot r \cdot t \) when calculating simple interest?
   
   b. How many times do you use the equation \( I = P \cdot r \cdot t \) when calculating compound interest?
5. An account is opened with an initial deposit of $1000 and earns 9% annual interest.
   
   a. Calculate the simple interest on the account for a year.

   b. Suppose it is a compound interest account which is compounded quarterly (4 times per year). Calculate the interest earned on the account after a year.

   c. Which account earned more interest during the year, the simple interest account or the compound interest account?

   d. Why do you think the account from part c. earned more interest?

6. When calculating interest with compound interest accounts, it is important to know the key words for different values of $n$ in $t = \frac{1}{n}$. Fill in the missing information in the following table.

<table>
<thead>
<tr>
<th>Key Word</th>
<th>Times Per Year (Value of $n$)</th>
<th>Value of $t = \frac{1}{n}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-annually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quarterly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Skill Check  

Go to Software Work through Practice in Lesson 4.8 of the software before attempting the following exercises.

Substitute the given values into $I = P \cdot r \cdot t$ and then simplify to find the interest earned.

7. $P = $1000, $r = 5\%$, $t = 3$ years
8. \( P = \$2000, r = 4\%, t = 5 \text{ years} \)

9. \( P = \$5000, t = 2 \text{ years}, r = 2\% \)

10. \( P = \$10,000, r = 6\%, t = 4 \text{ years} \)

---

**Apply Skills**

Work through the problems in this section to apply the skills you have learned related to applications of percent problems.

11. Barbara’s Bombtastic Bakery sells custom decorated 8-inch round cakes for $18.50 each. The cost of materials to make and package the cake (not including labor costs for baking and decorating) is $4.50.

   a. What is the amount of profit earned on each cake?

   b. What is the percent of profit based on cost?

   c. What is the percent of profit based on sale price? Round your answer to the nearest hundredth.

12. A furniture store has an in-store credit deal where you can have 0% interest on your purchase if you pay it off within 6 months. If the balance is not paid off within 6 months, you must pay for 6 months of simple interest on the original purchase price at an annual rate of 15%.

   a. If you purchased $1400 in furniture and did not pay off the balance within 6 months, how much interest will be added to your account?

   b. If you made equal monthly payments, how much would you need to pay each month to pay off the furniture in 6 months so you will not have to pay interest?
13. You have a savings account which earns 4% annual interest compounded quarterly. You make an initial one-time deposit of $1000 into the savings account.

   a. Fill in the table to calculate the interest after each compounding period for a year. Round your answer to the nearest hundredth when necessary.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Starting Principle</th>
<th>Interest Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. How much interest was earned on the savings account during that 1 year?

   c. What percent of the initial deposit is the amount of interest earned? This value is called the effective interest rate for the account.

14. According to the Federal Reserve, in July 2013 Americans owed $849.8 billion in credit card debt. If the average annual credit card interest rate is 15%, how much interest is earned on this debt in one month? Round your answer to the nearest hundredth.
Chapter 4 Projects

Project A: Take Me Out to the Ball Game!

An activity to demonstrate the use of percents and percent increase/decrease in real life

The Atlanta Braves baseball team has been one of the most popular baseball teams for fans not only from Georgia, but throughout the Carolinas, and the southeastern United States. The Braves franchise started playing at the Atlanta-Fulton County Stadium in 1966 and this continued to be their home field for 30 years. In 1996, the Centennial Olympic Stadium that was built for the 1996 Summer Olympics was converted to a new ballpark for the Atlanta Braves. The ballpark was named Turner Field and was opened for play in 1997.

Round all percentages to the nearest whole percent.

1. The Atlanta-Fulton County Stadium had a seating capacity of 52,769 fans. Turner Field has a seating capacity of 50,096. Source: http://atlanta.braves.mlb.com/atl/ballpark/history.jsp
   a. Determine the amount of decrease in seating capacity between Turner Field and the original Braves stadium.
   b. Determine the percent decrease in seating capacity at Turner Field (based on the original stadium).

2. The Centennial Olympic Stadium had approximately 85,000 seats. Some of the seating was removed in order to convert it to the Turner Field ballpark. Rounding the number of seats in Turner Field to the nearest thousand, what is the approximate percent decrease in seating capacity from the original Olympic stadium?

3. When Turner Field opened in 1997, the average attendance at a Braves game was 42,771. In 2012 the average attendance was 29,878. What is the percent decrease in attendance from 1997 to 2012? Source: espn.go.com

4. In 2013 the average attendance at a Braves game was 31,465. What is the percent increase in average attendance per game from 2012 to 2013?
5. In July of 2013, Chipper Jones, a popular Braves third baseman, retired. He started his career with the Braves in 1993 at the age of 21. Source: espn.go.com

a. In 2001, Chipper had 189 hits in 572 at-bats. Calculate Chipper’s batting average for the season by dividing the number of hits by the number of at-bats. Round to 3 decimal places.

b. In 2008, Chipper had 160 hits in 439 at-bats. Calculate Chipper’s batting average for the season by dividing the number of hits by the number of at-bats. Round to 3 decimal places.

c. Calculate the percent change in Chipper’s batting average from 2001 to 2008.

d. Does this represent a percent increase or decrease?

6. In 2001, Chipper had 102 RBI’s (runs batted in). In 2008, Chipper had only 75 RBI’s.

a. Calculate the percent change in RBI’s from 2001 to 2008.

b. Does this represent a percent increase or decrease?
Project B: Getting a Different Perspective on Things!

An activity to demonstrate the use of ratios and rates in real life

The table below contains population estimates taken from the World Population Prospects: The 2010 Revision (United Nations, 2011) for eight countries and the world overall.

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Population Estimate</th>
<th>Area in km²</th>
<th>Area in mi²</th>
<th>Density/mi² (to nearest tenth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>34,994,000</td>
<td>9,984,670</td>
<td>3,855,103</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>1,359,368,000</td>
<td>9,640,821</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>81,804,000</td>
<td>357,022</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>1,275,138,000</td>
<td>3,287,240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>126,345,000</td>
<td>377,873</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>4,508,000</td>
<td>270,534</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>5,301,000</td>
<td>710.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>318,498,000</td>
<td>9,826,675</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World (land only)</td>
<td>7,130,014,000</td>
<td>148,940,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is extremely hard to put these numbers in perspective since they are so large. One way to do this is to look at the ratio of the number of people per unit of area which is called population density. Since the units of the numerator and denominator of this expression are different, this ratio is called a rate. The units should always be specified on values representing rates for clarity.

In the table above, the population estimates are in the second column and the area in km² of the corresponding country or region is in column 3.

1. Since the use of metric equivalents is not common in the United States, let’s first convert the area in square kilometers in column 2 to area in square miles by using the relationship $1 \text{ km}^2 = 0.6213712 \text{ mi}^2$ and noting that the units are squared. For example, for Canada you could set up the proportion

$$\frac{x \text{ mi}^2}{9,984,670 \text{ km}^2} = \left( \frac{0.6213712 \text{ mi}}{1 \text{ km}} \right)^2$$

Solving this proportion for $x$ using cross products yields $x = 3,855,103$ when rounded to the nearest whole number.

Using a similar proportion to the one above, convert the measurements in column 3 to mi² and place the values in column 4, rounding to the nearest whole number. (The reason for the large number of decimal places in the conversion factor is to increase the accuracy of our calculations because our area values are so large.)
2. Now compute the population density per square mile for each country by dividing the population estimate in column 2 by the corresponding area in column 4. Round your answer to the nearest tenth and place the result in the last column.

3. Which country has the largest number of people per square mile?

4. Which country has the smallest number of people per square mile?

5. How does the United States compare to other countries in the table?

6. How does the population density of the United States and Canada compare to that of the World (based on the total land mass area which excludes areas covered by water)? Does this surprise you? Explain why or why not.

7. Was it easier to put the population numbers in perspective once they were converted to people per square mile, a population density? Why or why not?

8. Look at the numbers for countries like Singapore, India, and Japan. Using the internet, do some research to determine two consequences resulting from over population in an area.
**Pediatric Nurse**

As a pediatric nurse working in a hospital setting, you will be responsible for taking care of several patients during your work day. You will need to administer medications, set IVs, and check each patient’s vital signs (such as temperature and blood pressure). While doctors prescribe the medications that nurses need to administer, it is important for nurses to double check the dosage amounts. Administering the incorrect amount of medication can be detrimental to the patient’s health.

During your morning nursing round, you check in on three new male patients and obtain the following information.

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
<th>Patient C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>10</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td><strong>Weight (pounds)</strong></td>
<td>81</td>
<td>68.5</td>
<td>112</td>
</tr>
<tr>
<td><strong>Blood Pressure</strong></td>
<td>97/58</td>
<td>100/59</td>
<td>116/73</td>
</tr>
<tr>
<td><strong>Temperature (°F)</strong></td>
<td>99.7</td>
<td>97.3</td>
<td>101.4</td>
</tr>
<tr>
<td><strong>Medication</strong></td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
</tbody>
</table>

The following table shows the lower ranges for abnormal blood pressure (BP) for boys. If either the numerator or denominator of the blood pressure ratio is greater than or equal to the values in the chart, this can indicate a stage of hypertension.

<table>
<thead>
<tr>
<th>Blood Pressure Ranges for Boys by Age</th>
<th>Medication Directions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systolic BP / Diastolic BP</strong></td>
<td><strong>Medication</strong></td>
</tr>
<tr>
<td>Age 9</td>
<td>A</td>
</tr>
<tr>
<td>Age 10</td>
<td>B</td>
</tr>
<tr>
<td>Age 11</td>
<td></td>
</tr>
<tr>
<td>Age 12</td>
<td></td>
</tr>
</tbody>
</table>


1. Do any of the patients have a blood pressure which may indicate they have hypertension?
2. Use proportions to determine the amount of medication that should be administered to each patient.
3. The average body temperature is 98.6 degrees. You are supposed to alert the doctor on duty if any of the patients have a temperature 2.5 degrees higher than average. Would you alert a doctor for any of the patients?
4. Which skills covered in this chapter and the previous chapters were necessary to help you make your decisions?
Foundations Skill Check for Chapter 5

This page lists several skills covered previously in the book and software that are needed to learn new skills in Chapter 5. To make sure you are prepared to learn these new skills, take the self-test below and determine if any specific skills need to be reviewed.

Each skill includes an easy (e.), medium (m.), and hard (h.) version. You should be able to complete each problem type at each skill level. If you are unable to complete the problems at the easy or medium level, go back to the given lesson in the software and review until you feel confident in your ability. If you are unable to complete the hard problem for a skill, or are able to complete it but with minor errors, a review of the skill may not be necessary. You can wait until the skill is needed in the chapter to decide whether or not you should work through a quick review.

1.6 Simplify each expression using the order of operations.

   e. $6 + 14 ÷ 2$  \hspace{1cm} m. $3 \cdot (14 - 2 \cdot 6)^2$  \hspace{1cm} h. $3 + 15 + 3 \cdot 5 - 16 \cdot 2 + 4$

2.6 Simplify each expression using the order of operations.

   e. $\frac{3 + 7 \cdot 2}{4 + 8 \cdot 3}$  \hspace{1cm} m. $\frac{12}{25} + \frac{1}{5} \cdot \frac{1}{3} + 2 \cdot \frac{1}{5}$  \hspace{1cm} h. $3 \left( \frac{2}{5} - \frac{1}{5} \cdot \frac{4}{5} \right)^2 \cdot \frac{4}{25} \cdot \frac{1}{2}$

3.4 Simplify each expression using the order of operations.

   e. $12.5 + 3 ÷ 2$  \hspace{1cm} m. $6.25 + 1.5 ÷ 2 \cdot 4$  \hspace{1cm} h. $(2.5 - 1)^2 + 3 - 1.1^2$

3.5 Simplify each expression using the order of operations.

   e. $\frac{4}{5} \cdot 0.5 + \frac{1}{2} \cdot 7$  \hspace{1cm} m. $3.14 \cdot \left( \frac{8}{2} \right)^2$  \hspace{1cm} h. $\frac{1}{2} \cdot 1.5 \cdot (2.5 + 1)$

4.2 Solve each proportion.

   e. $\frac{3}{4} = \frac{9}{x}$  \hspace{1cm} m. $\frac{5}{6} = \frac{y}{9}$  \hspace{1cm} h. $\frac{18}{x} = \frac{42}{56}$