B E F O R E

In previous chapters you’ve . . .

• Written ratios
• Solved equations with decimals
• Written fractions as decimals
• Solved proportions

N o w

In Chapter 7 you’ll study . . .

• Finding the percent of a number
• Solving percent problems
• Finding the percent of change in a quantity
• Finding markups, discounts, sales tax, and tips
• Calculating interest earned and account balances

W H Y ?

So you can solve real-world problems about . . .

• astronomy, p. 332
• solar cars, p. 338
• roller coasters, p. 343
• community service, p. 348
• lakes, p. 355
• laptops, p. 360
• savings accounts, p. 364
Shopping While shopping, you see a sign that says “All items 25% off original price.” The number 25% is an example of a percent. In this chapter, you will use percents to find the prices of items on sale.

What do you think? Suppose you see a sign that says “Take \(\frac{1}{3}\) off the price of every item in the store.” You want to buy a hat whose original price is $18. What is the sale price of the hat?
Chapter Prerequisite Skills

PREREQUISITE SKILLS QUIZ

Preparing for Success To prepare for success in this chapter, test your knowledge of these concepts and skills. You may want to look at the pages referred to in blue for additional review.

1. Vocabulary Write the ratio 4 to 12 in two other ways.

Write the fraction as a decimal or the decimal as a fraction. (p. 219)

2. \(\frac{5}{8}\)  
3. \(\frac{3}{25}\)  
4. 0.35  
5. 0.175

Solve the proportion. (pp. 275, 280)

6. \(\frac{3}{4} = \frac{y}{16}\)  
7. \(\frac{30}{48} = \frac{10}{h}\)  
8. \(\frac{7.5}{x} = \frac{5}{8}\)  
9. \(\frac{r}{6} = \frac{10.5}{9}\)

NOTETAKING STRATEGIES

CONCEPT GRID You can use a concept grid to take notes. A concept grid usually includes a definition, characteristics, examples, and nonexamples.

<table>
<thead>
<tr>
<th>Definition:</th>
<th>Characteristics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two figures are similar if they have the same shape but not necessarily the same size.</td>
<td>Corresponding angles are congruent. The ratios of lengths of corresponding sides are equal.</td>
</tr>
</tbody>
</table>

Example: [Diagram of similar figures]

Nonexample: [Diagram of non-configured shapes]

In Lesson 7.7, making a concept grid can help you understand compound interest.
Percents and Fractions

BEFORE
You multiplied fractions and whole numbers.

Now
You’ll use a fraction to find the percent of a number.

WHY?
So you can compare tennis players’ serves, as in Ex. 7.

Music
In marching band competitions, each band is judged on its musical performance, marching, and visual effect. At many competitions, a marching band is rated on a 100 point scale. A band that earns 85 points has earned 85 percent of the total possible points.

The word percent means “per hundred.” A percent is a ratio whose denominator is 100. The symbol for percent is %.

Writing Percents

Words In the area model shown, 85 of the 100 squares are shaded. You can say that 85 percent of the squares are shaded.

Numbers \( \frac{85}{100} = 85\% \)

Algebra \( \frac{p}{100} = p\% \)

Example 1 Writing Percents as Fractions, Fractions as Percents

Write 29% and 45% as fractions in simplest form.

a. 29% = \( \frac{29}{100} \)

b. 45% = \( \frac{45}{100} = \frac{9}{20} \)

Write \( \frac{7}{10} \) and \( \frac{3}{5} \) as percents.

a. \( \frac{7}{10} = \frac{7 \cdot 10}{10 \cdot 10} = \frac{70}{100} = 70\% \)

b. \( \frac{3}{5} = \frac{3 \cdot 20}{5 \cdot 20} = \frac{60}{100} = 60\% \)

Checkpoint

Write the percent as a fraction in simplest form, or write the fraction as a percent.

1. 51% 2. 25% 3. \( \frac{11}{20} \) 4. \( \frac{4}{25} \)

Lesson 7.1 Percents and Fractions
Here are some common percent-fraction equivalents that may be useful to memorize.

<table>
<thead>
<tr>
<th>Common Percents</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% = $\frac{1}{10}$</td>
</tr>
<tr>
<td>60% = $\frac{3}{5}$</td>
</tr>
</tbody>
</table>

**Example 2**  
*Writing a Probability as a Percent*

**Prizes**  
A radio station randomly selects 1 of 5 finalists for a prize. You are one of the finalists. What is the probability that you will win? Write your answer as a percent.

**Solution**  
There are 5 possible outcomes, and 1 outcome is favorable.

\[ P(\text{you win}) = \frac{1}{5} \quad \text{Write probability as a fraction.} \]

\[ = 20\% \quad \text{Write fraction as a percent.} \]

**Answer**  
The probability that you will win is 20%.

**Example 3**  
*Finding a Percent of a Number*

**Tortoises**  
A desert tortoise can go a year or more without drinking water. When it does drink, its body weight can increase by 40%. Suppose a desert tortoise weighs 15 pounds after a long period without water. How many pounds can the tortoise gain when it drinks?

**Solution**  
To find 40% of 15 pounds, use the fact that 40% = $\frac{2}{5}$. Then multiply.

\[ 40\% \text{ of } 15 = \frac{2}{5} \cdot 15 \quad \text{Write percent as a fraction.} \]

\[ = \frac{30}{5} \quad \text{Multiply.} \]

\[ = 6 \quad \text{Simplify.} \]

**Answer**  
The desert tortoise can gain 6 pounds when it drinks.

**Checkpoint**

5. In Example 2, suppose that there are 10 finalists. What is the probability that you will win? Write your answer as a percent.

Find the percent of the number.

6. 25% of 36  
7. 70% of 70  
8. 50% of 14  
9. 75% of 80
Guided Practice

Vocabulary Check
1. Copy and complete: A percent is a ratio whose denominator is \( \frac{25}{25} \).

2. Explain how you would rewrite \( \frac{13}{25} \) as a percent.

Skill Check
Write the percent as a fraction in simplest form, or write the fraction as a percent.

3. 65%  
4. 98%  
5. \( \frac{12}{25} \)  
6. \( \frac{9}{10} \)

Guided Problem Solving
7. Tennis In tennis, you can serve the ball a second time if your first serve is not successful. The table shows the first serves by you and your opponent in a match. How many more successful first serves did you have than did your opponent?

<table>
<thead>
<tr>
<th>Player</th>
<th>Total first serves</th>
<th>Percent successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>You</td>
<td>152</td>
<td>75%</td>
</tr>
<tr>
<td>Your opponent</td>
<td>125</td>
<td>60%</td>
</tr>
</tbody>
</table>

1) Find the number of successful first serves you had.  
2) Find the number of successful first serves your opponent had.  
3) Find the difference of the numbers in Steps 1 and 2.

Practice and Problem Solving

Write the percent as a fraction.
8. 34%  
9. 40%  
10. 71%  
11. 27%  
12. 55%  
13. 18%  
14. 90%  
15. 85%

Write the fraction as a percent.
16. \( \frac{4}{5} \)  
17. \( \frac{3}{25} \)  
18. \( \frac{9}{20} \)  
19. \( \frac{7}{10} \)  
20. \( \frac{33}{50} \)  
21. \( \frac{1}{4} \)  
22. \( \frac{18}{25} \)  
23. \( \frac{17}{20} \)  
24. Food You buy ice cream that contains 10% milk fat. What fraction of the ice cream is milk fat?  
25. Currency The composition of a U.S. dollar bill is \( \frac{3}{4} \) cotton and \( \frac{1}{4} \) linen. What percent of a dollar bill is cotton?  
26. Football A football player completes 19 of his 25 passes during the season. What percent of his passes did the player complete?
27. **Art** The bristles on a Chinese writing brush are 70% rabbit hair and 30% goat hair. What fraction of the bristles is goat hair?

A computer randomly generates an integer from 1 to 10. Find the probability of the given event. Write your answer as a percent.

28. $P(5)$  
29. $P(4)$  
30. $P(\text{odd number})$

31. $P(\text{even number})$  
32. $P(\text{factor of 20})$  
33. $P(\text{prime number})$

34. **Tests** A multiple choice question on a test has 4 answer choices. You guess at the answer. What is the probability that you will select the correct choice? Write your answer as a percent.

Find the percent of the number.

35. 75% of 12  
36. 20% of 95  
37. 30% of 50  
38. 70% of 90

39. 50% of 94  
40. 10% of 130  
41. 40% of 175  
42. 25% of 500

43. **Plants** Alfalfa plants can take up metals from the ground and store them in their roots and stems. In 2002, a scientist claimed that an alfalfa plant could produce 20% of its weight in gold by taking up tiny gold particles left behind from rock mining. How many pounds of gold could be produced from 3000 pounds of alfalfa plants?

44. **Astronomy** The International Space Station orbits Earth about every 90 minutes. About 40% of the time, Earth prevents the space station from receiving direct sunlight. About how many minutes per orbit does the space station **not** receive sunlight?

45. **Writing** Use the definition of percent to explain why $100\% = 1$.

Use a number line to order the numbers from least to greatest.

46. $89\%, \frac{4}{5}, \frac{7}{10}, 0.83$  
47. $54\%, \frac{9}{20}, 0.62, \frac{16}{25}$  
48. $\frac{9}{25}, 17\%, 0.22, \frac{9}{50}$

**Algebra** Evaluate the expression when $k = 20$.

49. $k\%$ of 90  
50. $40\%$ of $k$  
51. $(80 - k)\%$ of 30

52. $25\%$ of $(k + 8)$  
53. $(k + 10)\%$ of 200  
54. $(k - 10)\%$ of 350

55. **Extended Problem Solving** An 18th century Indian version of chess uses a 10 square by 10 square board. On the board shown, the dots represent your opponent’s chess pieces at the start of the game.

a. **Illustrate** Copy the board shown. Mark X’s on your side of the board to represent your chess pieces in an arrangement that matches your opponent’s.

b. What percent of the squares are occupied at the start of a game?

c. **Explain** During one game, 75% of the pieces are still on the board. Of these pieces, 14 belong to you. How many pieces belong to your opponent? Explain.
56. **Phone Numbers** You forgot the last two digits of your friend’s phone number. You know that the next-to-last digit is 4 or 5, and the last digit is an odd number. If you guess the phone number, what is the probability that you will be correct? Write your answer as a percent.

57. **Estimation** The circle graph shows the results of a class survey that asked 800 students where they make most of their music purchases.

   a. Estimate how many students chose either record stores or other stores.

   b. Estimate how many more students chose record stores than music clubs.

   c. The class surveyed 100 other students and found that 9% of them make most of their purchases on the Internet. Estimate how many students in both surveys combined make most of their purchases on the Internet.

58. **Challenge** Suppose the length and width of rectangle A are each 40% of the length and width of rectangle B. Is the area of rectangle A 40% of the area of rectangle B? Justify your answer.

59. **Critical Thinking** Let $x$ and $y$ represent two different whole numbers.

   a. Suppose you add 40% of $x$ to 60% of $y$. Is this sum equal to 100% of the sum $x + y$? Justify your answer.

   b. Suppose you find the average of 40% of $x$ and 60% of $y$. Is this average equal to 50% of the sum $x + y$? Justify your answer.

**Mixed Review**

Find the product or quotient. *(Lessons 5.4, 5.5)*

60. $-8 \cdot \frac{3}{4}$
61. $\frac{-11}{25} \cdot \frac{10}{11}$
62. $\frac{5}{12} \div \left(\frac{-5}{6}\right)$
63. $\frac{3}{14} \div \frac{3}{7}$

Use equivalent ratios to solve the proportion. *(Lesson 6.2)*

64. $\frac{a}{3} = \frac{14}{21}$
65. $\frac{b}{18} = \frac{5}{9}$
66. $\frac{11}{13} = \frac{x}{26}$
67. $\frac{5}{30} = \frac{y}{6}$

68. **Groceries** A grocery store charges $3 for 4 mangoes. How many mangoes can you buy with $6.75? *(Lesson 6.3)*

**Standardized Test Practice**

69. **Multiple Choice** The table shows how many of the 50 states entered the Union in each century. What percent of the states entered the Union after the 18th century?

<table>
<thead>
<tr>
<th>Century</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>18th century</td>
<td>16</td>
</tr>
<tr>
<td>19th century</td>
<td>29</td>
</tr>
<tr>
<td>20th century</td>
<td>5</td>
</tr>
</tbody>
</table>

   A. 16%  
   B. 29%  
   C. 34%  
   D. 68%

70. **Short Response** In a survey of 300 adults, 32% said they read the daily newspaper, and 56% said they read only the Sunday newspaper. Estimate how many more adults surveyed read only the Sunday newspaper than the daily newspaper. Explain your reasoning.
7.2 Using Percent Bar Models

**Goal**
Use a percent bar model to find the percent of a number.

**Materials**
- paper
- pencil

**Investigate**

**Use a percent bar model to find 24% of 75.**

1. Draw a percent bar model that has ten equal sections. Label the left side of the model from 0 to 75. Label the right side of the model from 0% to 100%. Shade the bar to the 24% mark. Let \( x \) represent the number that you need to find.

2. Write a proportion using the arrangement of the numbers in the percent bar model. Then solve the proportion to find 24% of 75.

\[
\frac{x}{75} = \frac{24}{100}
\]

\[
75 \cdot \frac{x}{75} = 75 \cdot \frac{24}{100}
\]

\[
x = 18
\]

**Draw Conclusions**

Use a percent bar model to find the percent of the number.

1. 18% of 30
2. 65% of 140
3. 36% of 225
4. 7% of 400
5. 22% of 600
6. 85% of 780

7. **Critical Thinking** Suppose that 40% of a number \( b \) is 28. You want to find \( b \). Explain how you would use a percent bar model to illustrate the problem. Then write and solve a proportion to find \( b \).

8. **Critical Thinking** You want to find what percent of 150 is 102. Draw a percent bar model that has ten equal sections. Explain how you would decide what part of the bar that you should shade. Then write and solve a proportion to find the percent.
**Percents and Proportions**

**B E F O R E**
You found a percent of a number.

**N O W**
You'll use proportions to solve percent problems.

**W H Y ?**
So you can find how much food adult cats eat daily, as in Ex. 16.

A percent bar model compares a part to a base. In the model shown, 35 is the base, and 14 is a part of the base. The percent bar model shows that 14 is 40% of 35 or, equivalently, that $\frac{14}{35} = \frac{40}{100}$.

---

**Solving Percent Problems**

You can represent “$a$ is $p$ percent of $b$” using the proportion

$$\frac{a}{b} = \frac{p}{100}$$

where $a$ is a part of the base $b$ and $p\%$, or $\frac{p}{100}$, is the percent.

---

**Example 1**

**Finding a Percent**

What percent of 7 is 4?

$$\frac{a}{b} = \frac{p}{100}$$

Write proportion.

$$\frac{4}{7} = \frac{p}{100}$$

Substitute 4 for $a$ and 7 for $b$.

$$100 \cdot \frac{4}{7} = 100 \cdot \frac{p}{100}$$

Multiply each side by 100.

$$57 \frac{1}{7} = p$$

Simplify.

**Answer** 4 is $57 \frac{1}{7}\%$ of 7.

---

**Checkpoint**

Use a proportion to answer the question.

1. What percent of 72 is 54?
2. What percent of 60 is 25?
3. What percent of 90 is 40?
4. What percent of 35 is 7?
Example 2  Finding a Part of a Base

**What number is 24% of 200?**

\[
\frac{a}{b} = \frac{p}{100}
\]

Write proportion.

\[
\frac{a}{200} = \frac{24}{100}
\]

Substitute 200 for \(b\) and 24 for \(p\).

\[
200 \cdot \frac{a}{200} = 200 \cdot \frac{24}{100}
\]

Multiply each side by 200.

\[
a = 48
\]

Simplify.

**Answer** 48 is 24% of 200.

---

Example 3  Finding a Base

**Heptathlon** In a heptathlon, an athlete earns points in seven track-and-field events. Suppose an athlete earns 836 points in the 100 meter hurdles. This score makes up 16% of the total score. What is the total score?

**Solution**

In this situation, 836 is a part of the total score, which is the base.

\[
\frac{a}{b} = \frac{p}{100}
\]

Write proportion.

\[
\frac{836}{b} = \frac{16}{100}
\]

Substitute 836 for \(a\) and 16 for \(p\).

\[
836 \cdot 100 = 16 \cdot b
\]

Cross products property

\[
83,600 = 16b
\]

Multiply.

\[
5225 = b
\]

Divide each side by 16.

**Answer** The athlete’s total score is 5225 points.

---

**Checkpoint**

Use a proportion to answer the question.

5. What number is 18% of 50?  
6. 105 is 84% of what number?

You may find it useful to group percent problems into three types.

<table>
<thead>
<tr>
<th>Percent problem</th>
<th>Example</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find a percent.</td>
<td>What percent of 48 is 12?</td>
<td>[\frac{12}{48} = \frac{p}{100}]</td>
</tr>
<tr>
<td>Find a part of a base.</td>
<td>What number is 15% of 80?</td>
<td>[\frac{a}{80} = \frac{15}{100}]</td>
</tr>
<tr>
<td>Find a base.</td>
<td>20 is 30% of what number?</td>
<td>[\frac{20}{b} = \frac{30}{100}]</td>
</tr>
</tbody>
</table>
Guided Practice

Vocabulary Check
1. Choose the proportion you can use to represent this statement: 15 is 30% of 50.
   \[ \frac{30}{15} = \frac{50}{100} \]

2. Tell whether the answer to the following question represents the base, the part of the base, or the percent: 30 is 85% of what number?

Skill Check
Use a proportion to answer the question.
3. What number is 65% of 120?
4. What percent of 24 is 4?
5. What percent of 30 is 27?
6. 18 is 45% of what number?
7. Error Analysis Describe and correct the error in finding what percent of 30 is 20.

\[ \frac{a}{30} = \frac{20}{100} \]
\[ 100 \cdot a = 30 \cdot 20 \]
\[ 100a = 600 \]
\[ a = 6 \]

8. Soccer In the 2002 World Cup, 5 of the 32 soccer teams that competed were from South America. What percent of the teams were from South America?

Practice and Problem Solving

Use a proportion to answer the question.
9. What percent of 56 is 14?
10. What percent of 125 is 98?
11. What number is 55% of 80?
12. What number is 30% of 130?
13. 11 is 22% of what number?
14. 48 is 75% of what number?
15. Basketball Of the 325 teams in NCAA Division 1 Women's Basketball, 4% are in the Mid-American Conference. How many teams are in the Mid-American Conference?
16. Cats An adult cat has a body mass of 3500 grams. It can eat up to 8% of its body mass in food each day. How many grams of food can the cat eat each day? Use estimation to justify that your answer is reasonable.
17. Paintings An artist's collection of paintings includes 22 portraits. The portraits make up 40% of the collection. How many paintings are in the collection?
18. **Tanana River** When a certain section of the ice breaks on the Tanana River in Nenana, Alaska, the townspeople consider spring to have started. During the period 1917–2001, the ice broke 34 times on or between May 4 and May 10. What percent of those 85 years were years in which the ice broke on or between May 4 and May 10?

19. **Talent Show** You are performing in a talent show. To decide who performs first, the names of all 15 participants are written on slips of paper and put in a hat. One name is drawn from the hat. What is the probability that you go first? Write your answer as a percent.

20. **Solar Cars** The 2001 American Solar Challenge was a race among solar-powered cars traveling from Chicago, Illinois, to Claremont, California.

   a. Three of the cars in the race weighed less than 600 pounds. These cars made up 10% of all the cars. How many cars were in the race?

   b. There were 16 three-wheeled cars in the race. What percent of the cars were three-wheeled?

   c. The course was 2247.39 miles long, and it was completed by 40% of the cars. How many cars completed the course?

21. **Writing** Write a real-world percent problem that can be solved by using the proportion \( \frac{30}{x} = \frac{40}{100} \). Then find the value of \( x \) and solve the problem.

22. **Extended Problem Solving** You conduct a survey asking middle school students in which season they would prefer to hold their school trip. The bar graph shows the results of your survey.

   a. What percent of the students surveyed prefer summer? fall?

   b. **Calculate** Of the students who prefer spring, 75% are 8th graders. How many 8th graders prefer spring?

   c. **Predict** You are using the results of the survey to predict the preferences of all 780 students in the school. How many students do you predict would prefer a school trip in the spring? Explain your reasoning.

23. The table below shows several fractions whose percents may be useful to know. Use a proportion to find the equivalent percent for each fraction. Then copy and complete the table with the equivalent percents.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>1/8</th>
<th>1/3</th>
<th>3/8</th>
<th>5/8</th>
<th>2/3</th>
<th>7/8</th>
</tr>
</thead>
</table>
24. **Baseball**  A baseball player makes 152 hits in 570 times at bat in one season and 180 hits in 580 times at bat in the next season. For both seasons combined, what percent of the times at bat were hits?

25. **Dogs**  In a dog agility competition, dogs are tested in their ability to get past obstacles. The table shows the number of dogs from each breed that competed in a dog agility competition.

<table>
<thead>
<tr>
<th>Dog breed</th>
<th>Number that competed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheepdog</td>
<td>75</td>
</tr>
<tr>
<td>Spaniel</td>
<td>24</td>
</tr>
<tr>
<td>Terrier</td>
<td>14</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
</tr>
</tbody>
</table>

a. What percent of the dogs that competed were spaniels? sheepdogs?

b. In the competition, 70% of the dogs that finished in the top half were sheepdogs. What percent of the sheepdogs finished in the top half?

26. **Algebra**  Solve for \(x\) in the following equation: \(x\% = \frac{2x + 1}{300}\).

*Use a proportion to answer the question in terms of \(y\).*

27. What number is 40% of 10\(y\)?

28. What number is 75% of 8\(y\)?

29. 3\(y\) is 60% of what number?

30. 11\(y\) is 25% of what number?

31. **Challenge**  An art director has 75 photos to display in an art exhibit. Of these, 9 are color photos and 66 are black-and-white photos. The director wants to add more color photos so that they represent 25% of the photos at the exhibit. Write and solve a proportion to find the number of color photos to be added. Then find the total number of photos in the exhibit.

---

**Mixed Review**

*Find the product. (p. 775)*

32. \(0.2 \times 7\)
33. \(0.75 \times 1.3\)
34. \(0.7 \times 2.4\)
35. \(0.003 \times 0.5\)

36. **Personal Finance**  You use an ATM to withdraw $20 from your checking account. The ATM receipt shows a balance of $168 after the withdrawal. Write and solve an equation to find the balance before the withdrawal. (Lesson 2.5)

**Write the fraction or mixed number as a decimal. (Lesson 5.1)**

37. \(-\frac{1}{3}\)
38. \(\frac{7}{10}\)
39. \(-1\frac{3}{5}\)
40. \(\frac{11}{25}\)

41. **Multiple Choice**  Of the 32 teams in the National Football League, 4 teams are in the AFC East division. What percent of the teams are in the AFC East division?

   A. 4%
   B. 8%
   C. 12\(\frac{1}{2}\)%
   D. 28%

42. **Multiple Choice**  A camel that weighs 1500 pounds can drink up to about 20% of its weight in water at one time. About how many pounds of water can a camel that weighs 1500 pounds drink at one time?

   F. 10 pounds
   G. 75 pounds
   H. 300 pounds
   I. 30,000 pounds
Percents and Decimals

You used fractions to solve percent problems.

You’ll use decimals to solve percent problems.

So you can find the wind speed in a tornado, as in Ex. 45.

Pygmy Hippos  The African pygmy hippo is the smallest species of hippopotamus. Suppose a common adult hippo weighs 5600 pounds, and an adult pygmy hippo’s weight is 10.5% of the common adult hippo’s weight. How much does the adult pygmy hippo weigh? You will find the answer in Example 4.

Because \(0.25 = \frac{25}{100}\) and \(\frac{25}{100} = 25\%\), you can say that \(0.25 = 25\%\).

This relationship suggests the following rules for writing decimals as percents and percents as decimals.

**Study Strategy**

Percents greater than 100% are written as numbers greater than 1. Percents less than 1% are written as numbers less than 0.01. To write such percents as decimals, follow the same steps as you would for percents between 1% and 100%.

**Example 1**

**Writing Decimals as Percents**

Write 0.62, 1, and 2.3 as percents.

a. \(0.62 = \frac{62}{100} = 62\%\)

b. \(1 = \frac{100}{100} = 100\%\)

c. \(2.3 = \frac{230}{100} = 230\%\)

**Example 2**

**Writing Percents as Decimals**

Write 75%, 0.4%, and 168% as decimals.

a. \(75\% = \frac{75}{100} = 0.75\)

b. \(0.4\% = \frac{0.4}{100} = 0.004\)

c. \(168\% = \frac{168}{100} = 1.68\)
**Checkpoint**

Write the decimal as a percent or the percent as a decimal.

1. 0.461  
2. 5  
3. 1.9  
4. 0.007  
5. 27%  
6. 184%  
7. 3%  
8. 0.55%

**Fractions, Decimals, and Percents** A fraction, a decimal, and a percent can all represent the same number. You can write a fraction as a percent by first writing the fraction as a decimal.

**Example 3**  
**Writing Fractions as Percents**

Write \( \frac{3}{8} \) and \( \frac{5}{3} \) as percents.

a. \( \frac{3}{8} = 0.375 \)  
Write fraction as a decimal.  
  \( = 37.5\% \)  
Write decimal as a percent.  

b. \( \frac{5}{3} = 1.666\ldots \)  
Write fraction as a decimal.  
  \( = 166.\overline{6}\% \)  
Write decimal as a percent.

**Checkpoint**

Write the fraction as a percent.

9. \( \frac{7}{8} \)  
10. \( \frac{5}{12} \)  
11. \( \frac{11}{6} \)  
12. \( \frac{5}{4} \)

**Example 4**  
**Finding a Percent of a Number**

Find the weight of the pygmy hippo described on page 340.

**Solution**

Find 10.5\% of 5600.

\[ 10.5\% \text{ of } 5600 = 0.105 \cdot 5600 \quad \text{Write percent as a decimal.} \]

\[ = 588 \quad \text{Multiply.} \]

**Answer** The adult pygmy hippo weighs about 588 pounds.

✓ **Check** You can use estimation to check the reasonableness of the result. Because 10\% of 5600 is 560, the answer is reasonable.

**Checkpoint**

In Exercises 13–16, find the percent of the number.

13. 20\% of 85  
14. 3.8\% of 45  
15. 125\% of 64  
16. 0.5\% of 600

17. In a survey of 1100 adults, 2\% chose cooking as their favorite leisure activity. How many adults chose cooking?
Guided Practice

**Vocabulary Check**

1. When you write a decimal as a percent, do you move the decimal point two places to the left or to the right?

2. Is 0.5 less than, greater than, or equal to 0.5%? Explain.

**Skill Check**

**Write the decimal as a percent or the percent as a decimal.**

3. 0.13  
4. 6.27  
5. 5%  
6. 0.98%

**Write the fraction as a percent.**

7. \( \frac{1}{2} \)  
8. \( \frac{2}{3} \)  
9. \( \frac{7}{6} \)  
10. \( \frac{11}{4} \)

**11. Error Analysis** Describe and correct the error in writing 1.5 as a percent.

1.5 = 01.5 = 0.015%

**12. Geography** The area of Earth’s dry land is about 58 million square miles. The land area of North America is about 16% of Earth’s land area. What is the approximate land area of North America?

Practice and Problem Solving

**Write the decimal as a percent or the percent as a decimal.**

13. 0.28  
14. 0.1  
15. 2  
16. 5.46

17. 0.087  
18. 0.00205  
19. 8%  
20. 19%

21. 108%  
22. 104.2%  
23. 0.302%  
24. 0.051%

**Write the fraction as a percent.**

25. \( \frac{3}{20} \)  
26. \( \frac{1}{8} \)  
27. \( \frac{7}{15} \)  
28. \( \frac{1}{9} \)

29. \( \frac{7}{2} \)  
30. \( \frac{9}{4} \)  
31. \( \frac{4}{3} \)  
32. \( \frac{6}{5} \)

**33. Electricity** Wind power generates about 0.0015 of the world’s electricity. What percent of the world’s electricity does wind power generate?

**34. Water** About 0.3% of the water on Earth is usable by humans. Write 0.3% as a decimal.

**35. Music** Of a radio station’s 40 most popular songs for the week, \( \frac{5}{8} \) were sung by female soloists. What percent of the songs were sung by female soloists?
Find the percent of the number.

36. 12% of 150  
37. 80% of 340  
38. 18.2% of 90  
39. 60.1% of 70  
40. 225% of 80  
41. 120% of 400  
42. 0.4% of 260  
43. 0.35% of 50

44. **Raffle** A total of 600 tickets were sold for a raffle. The probability that your friend will win the prize is 7%. How many of the raffle tickets did your friend buy?

45. **Winds** The winds on Neptune are the strongest on any planet in our solar system and can reach a speed of about 1500 miles per hour. The winds of a tornado near Bridge Creek, Oklahoma, in 1999 were about 21.2% as fast as the winds on Neptune. What was the wind speed in the tornado?

46. **Internet Sales** A company made $350 million in retail sales last year. About 0.9% of those sales were over the Internet. About how much money did the company make in sales over the Internet?

47. **Roller Coasters** There were 1429 operating roller coasters in the world in 2001. Copy the table. Then use a calculator to complete the table with the number of roller coasters in each region. Be sure to round answers to the nearest whole number.

<table>
<thead>
<tr>
<th>Region</th>
<th>North America</th>
<th>South America</th>
<th>Central America</th>
<th>Europe</th>
<th>Asia and Australia</th>
<th>Middle East and Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of total</td>
<td>42.4%</td>
<td>2.74%</td>
<td>0.42%</td>
<td>26.8%</td>
<td>25.54%</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

48. **Number Sense** Find 5% of 185. Use the result to find 15% of 185.

Use a number line to order the numbers from least to greatest.

49. 150%, 2, \( \frac{5}{3} \), 100%, \( \frac{3}{4} \)  
50. 0.45, 42%, \( \frac{2}{5} \), 4%, 0.5

**Algebra** Evaluate the expression when \( k = 10 \).

51. \( k \% \text{ of } 67 \)  
52. 25% of \( k \)  
53. 120% of \( k \)  
54. \( k \% \text{ of } 400 \)

55. 7.9% of \( 3k \)  
56. 0.8% of \( 2k \)  
57. \((k - 9)\% \text{ of } 9 \)  
58. \( \left( \frac{k}{4} \right) \% \text{ of } 20 \)

59. **Ships** In 1694, the English ship *Sussex* sank in the Mediterranean Sea while on its way to Spain. In 2002, a U.S. salvage company and Great Britain agreed to share any money made from the sale of gold and silver coins recovered from the wreckage of the ship.

a. The company will get 80% of the first $45 million of the sales. If sales total $45 million, how much money will the company get?

b. The company will get 50% of any sales between $45 million and $500 million. If sales total $500 million, how much money will the company get?

c. The company will get 40% of any sales above $500 million. If sales total $650 million, how much money will the company get?
60. **Extended Problem Solving** The circle graph shows the results of a survey asking 500 students their main reason for using the Internet.

<table>
<thead>
<tr>
<th>Reasons for Using Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail 44%</td>
</tr>
<tr>
<td>News and research 23%</td>
</tr>
<tr>
<td>Games 10%</td>
</tr>
<tr>
<td>Chat rooms 10%</td>
</tr>
<tr>
<td>Other 13%</td>
</tr>
</tbody>
</table>

a. How many students chose either games or chat rooms?

b. **Compare** How many more students chose e-mail than news and research?

c. **Apply** Suppose 300 other students were surveyed, and 14% of them chose games. What percent of all 800 students chose games?

61. **Challenge** Suppose $x$ is 200% of $y$. What percent of $x$ is $y$?

62. **Geometry** The area of square A is 400 square centimeters. The side length of square B is 65% of the side length of square A. Is the area of square B 65% of the area of square A? Explain your reasoning.

### Mixed Review

**Algebra Basics** Solve the equation. *(Lesson 2.7)*

63. $0.3 = 5x$

64. $8 = 3.5 + x$

65. $7.6 = x - 8.3$

66. $1.2 = x \div 6$

67. The odds in favor of your winning a prize are 3 to 7. What is the probability that you will win the prize? *(Lesson 6.7)*

**Use a proportion to answer the question.** *(Lesson 7.2)*

68. What number is 10% of 60?

69. 93 is 124% of what number?

### Standardized Test Practice

70. **Multiple Choice** You made 82.5% of your 160 attempted free throws in a basketball season. How many free throws did you make?

A. 28  
B. 78  
C. 132  
D. 140

71. **Short Response** In a survey of 3000 music buyers, 5% of them preferred cassettes and 89% preferred CDs. How many more music buyers preferred CDs than cassettes? Explain your reasoning.

### Brain Game

**Percents in the Squares**

Describe the pattern. Then draw the grid that represents the fifth figure.

1  
2  
3  
4  
5  

---

344 Chapter 7 Percents
The Percent Equation

**Before**  
You used proportions to solve percent problems.  

**Now**  
You’ll use equations to solve percent problems.  

**Why?**  
So you can analyze the results of an election, as in Ex. 29.

**Astronomy**  
On June 14, 2002, the distance between Earth and the moon was about 375,000 kilometers. On that day, a traveling asteroid missed Earth by about 32% of that distance. How far away from Earth was the asteroid at that time?

You have used the proportion \( \frac{a}{b} = \frac{p}{100} \) to solve percent problems. When you solve this proportion for \( a \) and write \( \frac{p}{100} \) as \( p\% \), you get the equation \( a = p\% \cdot b \).

**Example 1**  
**Finding a Part of a Base**

To find how far away from Earth the asteroid was, as described above, use the percent equation.

\[
\begin{align*}
    a &= p\% \cdot b \\
    &= 32\% \cdot 375,000 \\
    &= 0.32 \cdot 375,000 \\
    &= 120,000
\end{align*}
\]

**Answer**  
The asteroid was about 120,000 kilometers away from Earth.

**Checkpoint**

Use the percent equation to answer the question.

1. What number is 16% of 75?  
2. What number is 89% of 110?
Example 2  Finding a Commission

Commission  A car salesperson earns a 6.5% commission on every car sold. The salesperson sells a car for $21,800. What is the commission?

Solution
\[ a = \frac{p\%}{b} \quad \text{Write percent equation.} \]
\[ = 6.5\% \cdot 21,800 \quad \text{Substitute 6.5 for } p \text{ and } 21,800 \text{ for } b. \]
\[ = 0.065 \cdot 21,800 \quad \text{Write percent as a decimal.} \]
\[ = 1417 \quad \text{Multiply.} \]

Answer  The salesperson's commission is $1417.

Checkpoint

3. In Example 2, find the commission if a car is sold for $23,000.

Example 3  Finding a Percent

What percent of 25 is 60?

\[ a = \frac{p\%}{b} \quad \text{Write percent equation.} \]
\[ 60 = \frac{p\%}{25} \quad \text{Substitute 60 for } a \text{ and } 25 \text{ for } b. \]
\[ 2.4 = \frac{p\%}{25} \quad \text{Divide each side by 25.} \]
\[ 240\% = \frac{p\%}{25} \quad \text{Write decimal as a percent.} \]

Answer  60 is 240% of 25.

Example 4  Finding a Base

Movies  Your friend paid $9 for a movie ticket. This amount was 72% of the total amount your friend spent at the theater. How much money did your friend spend?

Solution
\[ a = \frac{p\%}{b} \quad \text{Write percent equation.} \]
\[ 9 = \frac{72\%}{b} \quad \text{Substitute 9 for } a \text{ and } 72 \text{ for } p. \]
\[ 9 = 0.72 \cdot b \quad \text{Write percent as a decimal.} \]
\[ 12.5 = b \quad \text{Divide each side by 0.72.} \]

Answer  Your friend spent $12.50 at the theater.

Checkpoint

Use the percent equation to answer the question.

4. What percent of 48 is 45?  5. 27 is 7.5% of what number?
**Summary**  
**Methods for Solving a Percent Problem**

To find the percent of a number:
- Write the percent as a fraction.
  
  **Example:**
  
  $20\%$ of $35 = \frac{1}{5} \cdot 35 = 7$

- Write the percent as a decimal.
  
  **Example:**
  
  $5\%$ of $16 = 0.05 \cdot 16 = 0.8$

To find the percent $p\%$, the base $b$, or a part $a$ of the base:
- Use the proportion
  
  \[
  \frac{a}{b} = \frac{p}{100}
  \]
  
  **Example:**
  
  $21$ is $35\%$ of what number?

  \[
  \frac{21}{b} = \frac{35}{100}
  \]
  
  $60 = b$

- Use the percent equation
  
  \[
  a = p\% \cdot b
  \]
  
  **Example:**
  
  What percent of $250$ is $40$?

  \[
  40 = p\% \cdot 250
  \]
  
  $16\% = p\%$

---

**Guided Practice**

**Vocabulary Check**
1. Identify the percent, the base, and the part of the base in the following statement: $32$ is $40\%$ of $80$.

2. Tell whether the answer to the following question represents the base, the part of the base, or the percent: What number is $20\%$ of $65$?

**Skill Check**

**Use the percent equation to answer the question.**
3. What number is $60\%$ of $25$?
4. What percent of $25$ is $24$?
5. $18$ is $36\%$ of what number?
6. What percent of $48$ is $36$?

**Guided Problem Solving**

**Income**
You earn a weekly salary of $200$ plus a $3\%$ commission on the total value of the sales made in the week. This week, your sales total $2000$. What are your total earnings for the week?

1. Identify the percent, the base, and the part of the base.

2. Write and solve a percent equation to find the commission.

3. Add the commission to the weekly salary to find the total earnings.
Practice and Problem Solving

Use the percent equation to answer the question.

8. What number is 20% of 45?  
9. What number is 10% of 56?

10. What percent of 500 is 25?  
11. What percent of 200 is 1?

12. 9 is 0.03% of what number?  
13. 10.5 is 30% of what number?

14. 90 is 120% of what number?  
15. What percent of 90 is 72?

16. What percent of 80 is 212?  
17. What number is 150% of 96?

18. **Music** - A music collector has 1200 CDs, and 65% of them were produced after 1990. How many of the CDs were produced after 1990?

19. **Community Service** - Your class surveyed 560 students and asked what kind of community service activity they prefer. Of the students surveyed, 25% chose recycling. How many students chose recycling?

20. **Televisions** - A salesperson earns a 4% commission on the sales of televisions. If the salesperson's television sales total $7000, how much is the commission?

21. **Survey** - A school newspaper says that 3 students, or 6% of the students surveyed, can wiggle their ears. How many students were surveyed?

22. **Bake Sale** - At a club bake sale, cookies cost $.40 each and cupcakes cost $.65 each. The club sells 65 cookies and 60 cupcakes.
   
a. How much money was made from selling cookies? cupcakes?
   
b. What percent of the money made came from sales of cookies?
   
c. **Critical Thinking** - What percent of the baked goods sold were cookies? Why is this percent not the same as the percent you found in part (b)?

Use the percent equation to answer the question when \( k = 20 \).

23. What is \((k - 15)\)% of 90?  
24. What percent of 70 is \((k + 36)\)?

25. \((2k)\)% is 8% of what number?  
26. What is \((3k)\)% of 130?

27. **Writing** - Would you change the percent to a fraction or to a decimal in order to find 75% of 120? 31% of 120? Explain your choices.

28. **Sports** - The table shows a breakdown of the seats in a football stadium at Houston, Texas. Use a calculator to answer the following questions.

   - About what percent of the seats are either main level seats or middle level seats?
   - Suppose that 75% of the upper level seats and 50% of the middle level seats are occupied. How many seats in these two sections together are occupied?

<table>
<thead>
<tr>
<th>Type of seat</th>
<th>Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main level seats</td>
<td>25,739</td>
</tr>
<tr>
<td>Middle level seats</td>
<td>14,446</td>
</tr>
<tr>
<td>Upper level seats</td>
<td>24,968</td>
</tr>
<tr>
<td>Seats in suites</td>
<td>4,185</td>
</tr>
</tbody>
</table>
29. **Extended Problem Solving** In a presidential election, the candidate who receives the most popular votes in a state usually receives that state’s electoral votes. In the 1996 election, about 96 million popular votes were cast, and 538 electoral votes were cast. The table shows the voting results for the election.

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Electoral votes</th>
<th>Popular votes (estimated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinton</td>
<td>379</td>
<td>47 million</td>
</tr>
<tr>
<td>Dole</td>
<td>159</td>
<td>39 million</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>10 million</td>
</tr>
</tbody>
</table>

a. **Compare** For which candidate was the percent of popular votes greater than the percent of electoral votes?

b. **Interpret** Was this election closer with respect to popular votes or to electoral votes? Explain.

30. **Computers** A salesperson earns a 4% commission on every computer sold. The salesperson wants to earn $1000 in commissions in the next 4 days. What is the average amount of computer sales that the salesperson needs to make per day to reach the goal?

31. **Art Programs** In New York City’s Percent for Art Program, money is set aside for creating artwork at public building sites. The program requires that 1% of the first $20,000,000 of the cost of a building project and 0.5% of the remaining cost be spent on the artwork.

a. How much money must be spent on artwork if a project is expected to cost $30,000,000?

b. For each project, no more than $400,000 can be spent on artwork. The maximum amount that can be spent on artwork per year on all projects in the city is $1,500,000. Suppose that in one year the city has a project that costs $50,000,000 and another project that costs $62,000,000. What percent of the yearly maximum amount for artwork is used by the two projects?

32. **Challenge** The base $b$ of a triangle is 60% of the height $h$. Write a formula for the area of the triangle in terms of $h$ only.

---

**In the Real World**

**Art Programs** The artwork shown above was financed by New York City’s Percent for Art Program. Titled *Multiple Choice*, it shows five benches that spell out the words ALWAYS, NEVER, OFTEN, SELDOM, and SOMETIMES. About what percent of the 31 letters used for the benches are E’s?

**Mixed Review**

Find the difference. \( p. 774 \)

33. \( 892.1 - 420.5 \)  
34. \( 73.98 - 5.16 \)  
35. \( 18.9 - 6.72 \)

Solve the equation. Check your solution. \( \text{Lesson 2.6} \)

36. \( 6x = 12 \)  
37. \( 7x = -42 \)  
38. \( -9x = -36 \)

Write the fraction as a percent. \( \text{Lesson 7.3} \)

39. \( \frac{1}{8} \)  
40. \( \frac{11}{20} \)  
41. \( \frac{12}{9} \)

42. **Multiple Choice** In a class of 35 students, 28 take the bus to school. What percent of the students take the bus to school?

A. 7%  
B. 63%  
C. 80%  
D. 125%

43. **Short Response** There are 20 marbles in a bag, and 35% of them are blue. You put 6 more blue marbles in the bag. What percent of the marbles in the bag are now blue? Explain how you got your answer.
Mid-Chapter Quiz

Write the fraction as a percent.

1. \(\frac{17}{25}\)  
2. \(\frac{1}{5}\)  
3. \(\frac{5}{6}\)  
4. \(\frac{11}{16}\)

Write the decimal as a percent.

5. 0.87  
6. 0.728  
7. 2  
8. 0.0061

Find the percent of the number.

9. 75% of 64  
10. 20% of 18  
11. 30% of 300  
12. 25% of 980

13. 35% of 90  
14. 22.5% of 200  
15. 140% of 500  
16. 0.6% of 600

17. Flowers A bouquet of 40 flowers is made up of roses, carnations, and daisies. The bouquet is 45% roses and 15% carnations. How many of the flowers are roses? carnations?

Use a proportion or the percent equation to answer the question.

18. What number is 95% of 80?  
19. What percent of 40 is 4?

20. What percent of 400 is 190?  
21. 6 is 7.5% of what number?

22. Furniture A furniture salesperson earns a 4.5% commission on every piece of furniture sold. The salesperson sells a sofa for $1000 and a chair for $200. What commission does the salesperson earn?

---

Brain Game

The Greatest Sum

Fill in the blue boxes with the numbers shown. Use each number only once. Find the percent of the number in parts (a), (b), and (c). Then add the results. What is the greatest sum that you can make?
7.5 Modeling Percent of Change

**Goal**
Model the percent of change in a quantity.

**Materials**
- graph paper
- colored pencils

---

**Investigate**

A figure has an area of 10 square units. You increase its area to 15 square units. By what percent does the area of the figure change?

1. Let each square on your graph paper have an area of 1 square unit. Draw a figure that has an area of 10 square units, as shown at the right. Shade all of the squares red.

2. Add squares to the figure so that its area becomes 15 square units. Shade the added squares blue.

3. Find the ratio of the added area to the original area. Express the result as a percent. This percent is called the **percent of change**. 

\[
\frac{\text{Added area}}{\text{Original area}} = \frac{5 \text{ square units}}{10 \text{ square units}} = 50\%
\]

---

**Draw Conclusions**

Use a model to find the percent of change in the area of the figure.

1. Original area: 5 square units
   New area: 7 square units

2. Original area: 4 square units
   New area: 5 square units

3. Original area: 3 square units
   New area: 6 square units

4. Original area: 5 square units
   New area: 12 square units

5. **Critical Thinking** A figure has an area of 16 square units, and you increase its area to 20 square units. What percent of the original area is the new area? How is this percent related to the percent of change in the area?
Percent of Change

**Vocabulary**
- percent of change, p. 352
- percent of increase, p. 352
- percent of decrease, p. 352

**B E F O R E**
You found a percent of a number.

**N O W**
You’ll find a percent of change in a quantity.

**W H Y ?**
So you can analyze data about wetlands, as in Ex. 22.

**Balloons** The International Balloon Fiesta takes place every year in Albuquerque, New Mexico. In 1999, 903 balloons participated. In 2000, 1019 balloons participated. By about what percent did the number of balloons increase from 1999 to 2000?

A **percent of change** indicates how much a quantity increases or decreases with respect to the original amount. If the new amount is greater than the original amount, the percent of change is called a **percent of increase**. If the new amount is less than the original amount, the percent of change is called a **percent of decrease**.

**Percent of Change**
The percent of change is the ratio of the amount of increase or decrease to the original amount.

\[
\text{Percent of change, } p\% = \frac{\text{Amount of increase or decrease}}{\text{Original amount}}
\]

**Example 1** Finding a Percent of Increase

To answer the question stated above, find the percent of increase in the number of balloons from 1999 to 2000.

\[
p\% = \frac{\text{Amount of increase}}{\text{Original amount}}
\]

\[
= \frac{1019 - 903}{903}
\]

\[
= \frac{116}{903}
\]

\[
= 0.128 = 12.8\%
\]

**Answer** The number of balloons increased by about 12.8%.

**Checkpoint**
Find the percent of increase.

1. Original: 20
   New: 25
2. Original: 150
   New: 189
3. Original: 55
   New: 143
Example 2  Finding a Percent of Decrease

Find the percent of decrease from 512 to 320.

\[
p\% = \frac{\text{Amount of decrease}}{\text{Original amount}}
\]

Write formula for percent of decrease.

\[
= \frac{512 - 320}{512}
\]

Substitute.

\[
= \frac{192}{512}
\]

Subtract.

\[
= \frac{3}{8} = 37.5\%
\]

Simplify fraction. Then write as a percent.

Answer  The percent of decrease is 37.5%.

Checkpoint

Find the percent of decrease.

4. Original: 20  New: 15
5. Original: 75  New: 35
6. Original: 102  New: 51

Finding a New Amount  If you know the original amount and the percent of change, you can find the new amount. First multiply the percent of change by the original amount to find the amount of change. Then increase or decrease the original amount by the amount of change.

Example 3  Using a Percent of Increase

Action Sports  There were about 198,000 spectators at an action sports event in 1995. The number of spectators increased by about 12% from 1995 to 2002. About how many spectators were there in 2002?

Solution

To find the number of spectators in 2002, you need to increase the number of spectators in 1995 by 12%.

\[
\text{Spectators in 2002} = \text{Spectators in 1995} + \text{Amount of increase}
\]

\[
= 198,000 + 12\% \cdot 198,000
\]

Substitute.

\[
= 198,000 + 0.12 \cdot 198,000
\]

Write percent as a decimal.

\[
= 221,760
\]

Evaluate.

Answer  There were about 221,760 spectators in 2002.

Checkpoint

Find the new amount.

7. Increase 45 by 20%.
8. Decrease 85 by 28%.
Another Way  In Example 3, you can find the new amount by evaluating \(100\% \cdot 198,000 + 12\% \cdot 198,000\), or \(198,000 \cdot (100\% + 12\%)\). This result suggests another way to find a new amount.

- For a \(p\%\) increase, multiply the original amount by \((100\% + p\%)\).
- For a \(p\%\) decrease, multiply the original amount by \((100\% - p\%)\).

Example 4  Finding a New Amount

Music  In 1983, the average price of an audio CD was $21.50. By 2000, the average price had decreased by 34.8%. What was the average price of a CD in 2000?

Solution

Price in 2000 = Price in 1983 \cdot (100\% - p\%)

\[
= 21.5 \cdot (100\% - 34.8\%)
\]

Substitute.

\[
= 21.5 \cdot 65.2\%
\]

Subtract percents.

\[
= 21.5 \cdot 0.652
\]

Write percent as a decimal.

\[
= 14.018
\]

Multiply.

Answer  The average price of a CD in 2000 was about $14.02.

---

7.5  Exercises

More Practice, p. 809

Guided Practice

Vocabulary Check

1. Is the percent of change from 79 to 56 a percent of increase or a percent of decrease?

2. A number is increased by 30%. Explain how you can find the new amount without first calculating the amount of increase.

Skill Check  Identify the percent of change as an increase or a decrease. Then find the percent of change.

3. Original: 30  New: 45


5. Original: 28  New: 7

Guided Problem Solving

6. Reptiles  In 1981, there were 25 endangered and threatened species of reptiles in the U.S. In 2001, there were 36 species. By what percent did the number of these reptile species change from 1981 to 2001?

1. Tell whether the amount of change is an increase or a decrease.

2. Find the amount of change from 1981 to 2001.

3. Divide the amount of change by the original amount. Write the quotient as a percent.
Identify the percent of change as an increase or a decrease. Then find the percent of change.

7. Original: 28  
   New: 35
8. Original: 45  
   New: 72
9. Original: 70  
   New: 42
10. Original: 40  
    New: 9
11. Original: 140  
    New: 189
12. Original: 350  
    New: 196

13. Error Analysis  Describe and correct the error in finding the percent of change from 90 to 50.

\[ p\% = \frac{90 - 50}{50} = \frac{40}{50} = 0.8 = 80\% \]

14. Hot Dogs  In 1991, the price of a hot dog at a Texas baseball stadium was $1.25. In 2001, the price of a hot dog at the stadium was $2.25. By what percent did the price change from 1991 to 2001?

15. Lakes  Lake Chad in Africa had a surface area of about 10,000 square miles in 1963. Because of climate changes and increased water usage by humans, the surface area decreased to about 850 square miles in 2001. By what percent did the surface area change from 1963 to 2001?

Find the new amount.

16. Increase 25 by 24%.
17. Increase 120 by 75%.
18. Decrease 35 by 60%.
19. Decrease 72 by 65%.

20. Computers  In 1992, one gigabyte of information stored in computers cost $3000. In 2002, one gigabyte of stored information cost 99.9% less. How much did one gigabyte of stored information cost in 2002?

21. Auctions  A sweater is being sold at an online auction. The minimum bid is $9. At the end of the auction, the sweater is sold for 75% above the minimum bid. What is the selling price of the sweater?

22. Wetlands  A wetland is a region where water is usually present near or on the soil. The states in the table below had the greatest acreage of wetlands in the United States in the 1980s. The table shows the surface area of wetlands in these states in the 1780s and in the 1980s.

<table>
<thead>
<tr>
<th>State</th>
<th>1780s</th>
<th>1980s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>170.2</td>
<td>170.0</td>
</tr>
<tr>
<td>Florida</td>
<td>20.3</td>
<td>11.0</td>
</tr>
<tr>
<td>Louisiana</td>
<td>16.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Minnesota</td>
<td>15.1</td>
<td>8.7</td>
</tr>
</tbody>
</table>

a. Compare  In which state was the percent of change in the area of wetlands from the 1780s to the 1980s the least? the greatest?

b. Analyze  For the four states combined, by about what percent did the area of wetlands change from the 1780s to the 1980s?

23. Writing  Can you increase an amount by more than 100%? Explain.
24. **Investing** An investor buys 500 shares of a stock at a price of $24 per share. Three years later the value of each share has increased by 15%. What is the total value of the 500 shares of the stock?

25. **Extended Problem Solving** The bar graph shows the number of pairs of footwear that were manufactured in the U.S. for 5 years. You may want to use a calculator to answer the following questions.

   a. By about what percent did the number of pairs of footwear change from 1996 to 2000?

   b. **Compare** In which year did the number of pairs of footwear decrease the most from the previous year? What was the approximate percent of change?

   c. **Interpret and Apply** Can you conclude from the graph that footwear manufacturers have been making less money every year from 1996 to 2000? Explain.

26. **Challenge** The number of people between the ages of 2 and 18 who accessed streaming media on the Internet in November 1999 increased by 65% to about 7 million in November 2000. About how many people in this age group accessed streaming media in November 1999?

27. **Critical Thinking** Suppose an original amount decreases by 75%. By what percent must the new amount increase in order to return to the original amount? Justify your answer.

---

**Mixed Review**

Find the sum or difference. (p. 774)

28. 5.98 + 3.72  
29. 9 + 4.55  
30. 3.4 – 1.9  
31. 8.04 – 2.6

**Algebra Basics** Solve the equation. Check your solution. (Lesson 3.1)

32. 9 = 5n + 4  
33. 6y + 1 = 19  
34. 14 = 4w – 2  
35. 9x – 7 = 20

Use the percent equation to answer the question. (Lesson 7.4)

36. What number is 60% of 135?  
37. What percent of 120 is 78?

38. What percent of 96 is 84?  
39. 36 is 48% of what number?

---

**Standardized Test Practice**

40. **Multiple Choice** A homebuilder orders 10% more floor tiles than the original estimate of 170 tiles in case some tiles break while they are being installed. How many tiles does the homebuilder order?

   A. 153 tiles  
   B. 180 tiles  
   C. 187 tiles  
   D. 1700 tiles

41. **Multiple Choice** There were about 23,000 movie screens in the U.S. in 1990. The number of screens increased to about 34,500 by 2001. By what percent did the number of screens change from 1990 to 2001?

   F. 25%  
   G. 33%  
   H. 50%  
   I. 250%
Percent Applications

**Vocabulary**
- markup, p. 357
- discount, p. 358

**Before**
- You found percents of change.

**Now**
- You’ll find markups, discounts, sales tax, and tips.

**Why?**
- So you can find the cost of in-line skates, as in Ex. 25.

**Jewelry** A street vendor buys bracelets from a manufacturer for $7 each. The vendor marks up the price by 150%. What is the retail price?

A retailer buys items from manufacturers at **wholesale prices**. The retailer then sells those items to customers at **retail prices**.

An increase from the wholesale price of an item to the retail price is a **markup**.

The markup is calculated using a percent of the wholesale price.

**Example 1**  
**Finding a Retail Price**

Find the retail price of a bracelet, as described above.

**Solution**

**Method 1** Add the markup to the wholesale price.

Retail price = **Wholesale price + Markup**

= $7 + 150\% \cdot 7$

= $7 + 1.5 \cdot 7$

= $7 + 10.5$

= 17.5

**Method 2** Multiply the wholesale price by (100\% + Markup percent).

Retail price = **Wholesale price \cdot (100\% + Markup percent)**

= $7 \cdot (100\% + 150\%)$

= $7 \cdot 250\%$

= $7 \cdot 2.5$

= 17.5

**Answer** The retail price of a bracelet is $17.50.

**Checkpoint**

1. In Example 1, what is the retail price of a bracelet if the markup percent is 120%?
**Discounts**  A decrease from the original price of an item to the sale price is a **discount**. The discount is calculated using a percent of the original price.

---

**Example 2**  **Finding a Sale Price**

**Electronics**  You buy an electronic organizer that is on sale for 15% off the original price of $25. What is the sale price?

**Solution**

**Method 1**  Subtract the discount from the original price.

Sale price = \( \text{Original price} - \text{Discount} \)

\[
25 - 15\% \cdot 25 \quad \text{Substitute.} \\
= 25 - 0.15 \cdot 25 \quad \text{Write 15\% as a decimal.} \\
= 25 - 3.75 \quad \text{Multiply.} \\
= 21.25 \quad \text{Subtract.}
\]

**Method 2**  Multiply the original price by \((100\% - \text{Discount percent})\).

Sale price = \( \text{Original price} \cdot (100\% - \text{Discount percent}) \)

\[
25 \cdot (100\% - 15\%) \quad \text{Substitute.} \\
= 25 \cdot 85\% \quad \text{Subtract percents.} \\
= 25 \cdot 0.85 \quad \text{Write 85\% as a decimal.} \\
= 21.25 \quad \text{Multiply.}
\]

**Answer**  The sale price of the electronic organizer is $21.25.

---

**Example 3**  **Using Sales Tax and Tips**

**Restaurants**  The bill for your restaurant meal is $22. You leave a 15% tip. The sales tax is 6%. What is the total cost of your meal?

**Solution**

Sales tax and tips are calculated using a percent of the purchase price. These amounts are then added to the purchase price.

Total = \( \text{Food bill} + \text{Sales tax} + \text{Tip} \)

\[
22 + 6\% \cdot 22 + 15\% \cdot 22 \quad \text{Substitute.} \\
= 22 + 0.06 \cdot 22 + 0.15 \cdot 22 \quad \text{Write 6\% and 15\% as decimals.} \\
= 22 + 1.32 + 3.3 \quad \text{Multiply.} \\
= 26.62 \quad \text{Add.}
\]

**Answer**  The total cost of the meal is $26.62.

---

**Checkpoint**

2. A pair of jeans that originally costs $42 is 25% off. Find the sale price.
3. In Example 3, find the total cost of the meal if the sales tax is 5%.
**Study Strategy**

Another Way In Example 4, you can use the verbal model:

\[
\text{Retail} = \text{Wholesale} + \text{Markup}
\]

Retail price = Wholesale price + Markup to find the wholesale price. When you substitute variables and values, you get the equation \(35 = x + 0.8x\), where \(x\) is the wholesale price.

**Example 4 Finding an Original Amount**

**Lamps** A furniture store marks up the wholesale price of a desk lamp by 80%. The retail price is $35. What is the wholesale price?

**Solution**

Let \(x\) represent the wholesale price.

\[
\text{Retail price} = \text{Wholesale price} \times (100\% + \text{Markup percent})
\]

\[
35 = x \times (100\% + 80\%)
\]

\[
35 = x \times 1.8
\]

\[
19.44 = x
\]

**Answer** The wholesale price of the lamp is about $19.44.

**Checkpoint**

4. A store marks up the wholesale price of a printer by 80%. The retail price is $120. What is the wholesale price of the printer?

---

**7.6 Exercises**

**Guided Practice**

**Vocabulary Check**

1. Copy and complete: The retail price of an item for sale is the sum of the wholesale price and the ___.

2. Describe two methods for finding the sale price of an item if you know the original price and the discount percent.

**Skill Check**

In Exercises 3–6, use the given information to find the new amount.

3. Wholesale price: $13
   Markup percent: 110%

4. Original price: $60
   Discount percent: 20%

5. Food bill: $15
   Sales tax: 5%

6. Taxi fare: $22
   Tip: 10%

**Guided Problem Solving**

7. **Headsets** When you use a coupon for 15% off the original price of a headset, you pay $27. What is the original price of the headset?

   1) Identify the discount price and the discount percent.

   2) Let \(x\) represent the original price. Write an equation that you can use to find the original price.

   3) Solve the equation to find the original price of the headset.
In Exercises 8–11, use the given information to find the new price.

8. Wholesale price: $34  
   Markup percent: 125%  
9. Wholesale price: $125  
   Markup percent: 50%  
10. Original price: $37  
    Discount percent: 25%  
11. Original price: $54  
    Discount percent: 40%  

12. Outdoor Speakers  A music store buys a set of outdoor speakers for $90. The store marks up the wholesale price by 110%. What is the retail price of the speakers?

13. Zoo Trips  For a child, the regular admission price to a zoo is $13. With a special pass, the admission price is discounted 20%. What is the admission price when the pass is used?

In Exercises 14–17, use the given information to find the total cost.

14. Original price: $42  
    Sales tax: 5%  
15. Original price: $78  
    Sales tax: 6%  
16. Food bill: $25  
    Sales tax: 6%  
    Tip: 15%  
17. Food bill: $18  
    Sales tax: 5%  
    Tip: 20%  

18. Walking Dogs  A dog owner pays you $20 plus a 10% tip for walking a dog. What is the total amount of money that the dog owner pays you?

In Exercises 19–22, use the given information to find the original price.

19. Retail price: $50  
    Markup percent: 90%  
20. Retail price: $24  
    Markup percent: 115%  
21. Sale price: $150  
    Discount percent: 25%  
22. Sale price: $210  
    Discount percent: 30%  

23. Bicycles  A store marks up the wholesale price of a bicycle by 120%. The retail price is $215. What is the wholesale price of the bicycle?

24. Laptops  A laptop computer is on sale for 10% off the original price of $1500. When it doesn’t sell, the laptop goes on sale for 15% off the sale price. What is the new sale price of the laptop?

25. In-line Skates  A sports store is having a sale on in-line skates. You want to buy a pair of in-line skates that originally costs $135. The sales tax is 5.5%, and it will be applied to the sale price of the skates. What is the total cost of the skates?

26. Critical Thinking  Which situation results in a greater final amount, an 80% markup of the wholesale price followed by a 30% discount of the retail price, or a 30% markup of the wholesale price followed by an 80% discount of the retail price? Justify your answer.
27. **Extended Problem Solving** The pizzas you order for home delivery cost $19. The sales tax is 4.9%, and you plan to give a 15% tip.
   
a. **Estimate** Estimate the amount of the sales tax.
   
b. **Estimate** Use mental math to estimate a 15% tip. Explain the method of estimation you use.
   
c. **Interpret** Estimate the total cost of the order. Is your estimate a high estimate or a low estimate of the total cost? Explain.
   
d. Find the exact total cost of the order. How close was your estimate?

28. **Challenge** A store marks up the wholesale price of an item by 60%. A month later the store puts the item on sale. If the store doesn’t want to lose money on the item, what is the maximum discount percent the store can use?

---

**Mixed Review**

**Give the place and value of the red digit. Then round the number to that place.**  
(*p. 770*)

29. 9321  
30. 341.073  
31. 1595.962  
32. 17,024.981

**Evaluate the expression when x = 5, y = 7, and z = 10.** (*Lesson 1.3*)

33. xyz  
34. x(3z + y)  
35. x(5 + yz)  
36. xz − xy

**Write the percent as a decimal.** (*Lesson 7.3*)

37. 45%  
38. 8.6%  
39. 102%  
40. 0.4%

---

**Standardized Test Practice**

41. **Extended Response** Your bill for a meal at a diner is $11. The sales tax is 6%, and you plan to give a 15% tip.
   
a. What is the total cost of the meal?
   
b. If you have $14, what is the maximum amount you can give for a tip and still cover the food bill and sales tax? About what percent of the food bill would this tip be? Explain your thinking.

---

**Going Shopping**

You have $500 to spend on items from the list shown. Spend as much of the money as you can using the following conditions:

- Buy no more than 1 of each item.
- Use a coupon for 15% off the original prices of your purchases.
- Add a sales tax of 5% of the sale prices of your purchases.

Which items did you buy, and how much money did you spend?
Simple and Compound Interest

**Bonds** People buy bonds as a way to earn money. If a $1500 bond earns 4% simple interest per year on its purchase price, how much will it earn in interest after 2 years?

The amount earned or paid for the use of money is called interest. The amount of money deposited or borrowed is the principal. Interest that is earned or paid only on the principal is called simple interest. The percent of the principal earned or paid per year is the annual interest rate.

**Simple Interest Formula**

Simple interest \( I \) is given by the formula

\[ I = Prt \]

where \( P \) is the principal, \( r \) is the annual interest rate (written as a decimal), and \( t \) is the time in years.

**Example 1**

**Finding Simple Interest**

Find the interest earned after 2 years for the bond described above.

**Solution**

\[ I = Prt \]

\[ = (1500)(0.04)(2) \quad \text{Write simple interest formula.} \]

\[ = 120 \quad \text{Substitute 1500 for } P, 0.04 \text{ for } r, \text{ and 2 for } t. \]

\[ = 120 \quad \text{Multiply.} \]

**Answer** The bond will earn $120 in interest after 2 years.

**Checkpoint**

1. A $1000 bond earns 6% simple annual interest. What is the interest earned after 4 years?
Balance  When an account earns interest, the interest is added to the money in the account. The balance \( A \) of an account that earns simple annual interest is the sum of the principal \( P \) and the interest \( Prt \).

\[
A = P + Prt \quad \text{or} \quad A = P(1 + rt)
\]

Example 2  Finding an Interest Rate

Summer Job  You get a summer job at a bakery. Suppose you save $1400 of your pay and deposit it into an account that earns simple annual interest. After 9 months, the balance is $1421. Find the annual interest rate.

Solution

Because \( t \) in the formula \( A = P(1 + rt) \) is the time in years, write 9 months as \( \frac{9}{12} \) or \( \frac{3}{4} \) year. Then solve for \( r \) after substituting values for \( A, P, \) and \( t \) in \( A = P(1 + rt) \).

\[
A = P(1 + rt)
\]

Write formula for finding balance.

\[
1421 = 1400 \left[ 1 + \frac{3}{4} \right]
\]

Substitute.

\[
1421 = 1400 + 1050r
\]

Distributive property

\[
21 = 1050r
\]

Subtract 1400 from each side.

\[
0.02 = r
\]

Divide each side by 1050.

Answer  The annual interest rate is 2%.

Checkpoint

Find the unknown quantity for an account that earns simple annual interest.

2. \( A = ?, \ P = \$1000, \ r = 2.5\%, \ t = 2 \text{ years} \)

3. \( A = \$1424.50, \ P = ?, \ r = 3.5\%, \ t = 6 \text{ months} \)

Compound Interest  Compound interest is interest that is earned on both the principal and any interest that has been earned previously. Suppose you deposit $50 into a savings account that earns 2% interest compounded annually. The table below shows the balance of your account after each of 3 years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Principal at start of year</th>
<th>Balance at end of year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>( 50(1 + 0.02)^1 )</td>
</tr>
<tr>
<td>2</td>
<td>( 50(1 + 0.02)^1 )</td>
<td>( 50(1 + 0.02)^1 \cdot (1 + 0.02) = 50(1 + 0.02)^2 )</td>
</tr>
<tr>
<td>3</td>
<td>( 50(1 + 0.02)^2 )</td>
<td>( 50(1 + 0.02)^2 \cdot (1 + 0.02) = 50(1 + 0.02)^3 )</td>
</tr>
</tbody>
</table>

The table above suggests a formula, shown on the next page, for finding the balance of an account that earns interest compounded annually.
Compound Interest Formula

When an account earns interest compounded annually, the balance \( A \) is given by the formula

\[
A = P(1 + r)^t
\]

where \( P \) is the principal, \( r \) is the annual interest rate (written as a decimal), and \( t \) is the time in years.

Example 3  
Calculating Compound Interest

You deposit $1500 into an account that earns 2.4% interest compounded annually. Find the balance after 6 years.

Solution

\[
A = P(1 + r)^t
\]

Write formula.

\[
= 1500(1 + 0.024)^6
\]

Substitute.

\[
\approx 1729.38
\]

Use a calculator.

Answer  The balance of the account after 6 years is about $1729.38.

Guided Practice

Vocabulary Check

1. In the simple interest formula \( I = Prt \), what does \( P \) represent?
2. How is compound interest different from simple interest?

Skill Check

For an account that earns simple annual interest, find the interest and the balance of the account.

3. \( P = $500, r = 7\%, t = 4 \) years  
4. \( P = $2500, r = 3\%, t = 9 \) months

Find the unknown quantity for an account that earns simple annual interest.

5. \( A = $563, P = $500, r = \_, t = 7 \) years  
6. \( A = $1670, P = $1600, r = 3.5\%, t = \_ \)

7. Savings Account You deposit $700 into a savings account that earns 2% interest compounded annually. Find the balance of the account after 4 years. Round your answer to the nearest cent.
**Practice and Problem Solving**

**In the following exercises, you may find it helpful to use a calculator for compound interest.**

**For an account that earns simple annual interest, find the interest and the balance of the account.**

8. \( P = 1250, r = 4\%, t = 10 \) years
9. \( P = 325, r = 7\%, t = 8 \) years
10. \( P = 600, r = 2.7\%, t = 4.5 \) years
11. \( P = 3200, r = 3.5\%, t = 3.5 \) years
12. \( P = 100, r = 8\%, t = 6 \) months
13. \( P = 495, r = 5\%, t = 21 \) months
14. **Loan** You loan your brother $300 and charge him 2% simple annual interest. He promises to repay you one year later. How much will your brother have to pay you?

15. The table shows three accounts that earn simple annual interest. Copy and complete the table by finding the unknown quantity.

<table>
<thead>
<tr>
<th>Balance</th>
<th>Principal</th>
<th>Interest rate</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5,000</td>
<td>$4,000</td>
<td>5%</td>
<td>?</td>
</tr>
<tr>
<td>$11,160</td>
<td>?</td>
<td>8%</td>
<td>36 months</td>
</tr>
<tr>
<td>$3,207</td>
<td>$3,000</td>
<td>?</td>
<td>18 months</td>
</tr>
</tbody>
</table>

16. Suppose you deposit $800 into an account that earns simple annual interest. After 2 years, the account balance is $900. Find the annual interest rate.

17. **Error Analysis** A $200 bond earns 5.5% simple annual interest. Describe and correct the error in finding the total interest earned after 6 months.

\[
I = Prt
= (200)(0.055)(6)
= 66
\]

18. \( P = 800, r = 5\%, t = 3 \) years
19. \( P = 2200, r = 7\%, t = 8 \) years
20. \( P = 1750, r = 2.3\%, t = 4 \) years
21. \( P = 680, r = 6.2\%, t = 10 \) years
22. **Bonds** A certain bond pays simple annual interest directly to the investor every 6 months. Suppose an investor purchases this bond for $5000 at a 4.5% annual interest rate. What is the total amount of interest paid after 6 months? 18 months? 30 months?

23. **Compare** The accounts below earn interest compounded annually. Which account will have the greater balance in the given time?

<table>
<thead>
<tr>
<th>Account A</th>
<th>Account B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal: $150</td>
<td>Principal: $150</td>
</tr>
<tr>
<td>Interest rate: 3.25%</td>
<td>Interest rate: 6.5%</td>
</tr>
<tr>
<td>Time: 20 years</td>
<td>Time: 10 years</td>
</tr>
</tbody>
</table>

24. **Writing** Does the amount of interest earned each year increase, decrease, or stay the same in a simple interest account? in a compound interest account? Explain your answers.

---

**In the Real World**

**Bonds** To pay for the 1933 construction of the Golden Gate Bridge, the state of California raised $35 million by selling bonds. The state had paid about $39 million in interest by the time the last of the bonds were repaid in 1971. What percent of the $35 million raised in 1933 is the $39 million paid in interest?
25. **Extended Problem Solving**  You deposit $1000 into an account that earns 5% simple annual interest, and your friend deposits $1000 into an account that earns 5% interest compounded annually.

   **a. Calculate** Copy and complete the table.

   **b. Graph** Make a scatter plot of the data. Show the time in years on the x-axis and the account balance on the y-axis. Plot points representing the simple interest account balance in blue and the compound interest account balance in red.

   **c. Compare** Describe how the graph of the simple interest balance is different from the graph of the compound interest balance.

26. You deposit $1400 into an account that earns 4% interest compounded annually. You check the balance of the account after 5 years. By about what percent did the balance of the account change over those 5 years?

27. **Critical Thinking** How long will it take you to double your principal when you deposit it into an account that earns 10% simple annual interest? Explain how you found your answer.

28. **Challenge** At the start of every year, you deposit $3000 into an account that earns 7% interest compounded annually.

   **a.** What is the balance at the end of the second year? third year?

   **b.** Will you have enough money at the end of the fifth year to buy a car that costs $18,000? Explain your reasoning.

### Mixed Review

**Solve the equation. Check your solution.** *(Lesson 3.3)*

29. \(5x + 9 = 2x + 6\)  
30. \(-5y - 13 = 7 - 15y\)

**Find the least common multiple of the numbers.** *(Lesson 4.4)*

31. 3, 7  
32. 9, 45  
33. 12, 18  
34. 40, 50

35. **Video Game** You buy a video game that is on sale for 15% off the original price of $35. Find the sale price. *(Lesson 7.6)*

### Standardized Test Practice

36. **Multiple Choice** A $1200 bond earns 8.5% simple annual interest. What is the interest earned after 15 months?

   A. $15.30  
   B. $127.50  
   C. $1275  
   D. $1530

37. **Multiple Choice** You deposit $3500 into an account that earns 10% interest compounded annually. What is the balance after 2 years?

   F. $700  
   G. $4200  
   H. $4235  
   I. $7000
7.7 Computing Compound Interest

**Goal** Use a calculator to compute compound interest.

In many investment accounts, the interest is compounded several times a year. The balance \( A \) of an account that earns interest compounded \( n \) times a year is given by the formula

\[
A = P \left(1 + \frac{r}{n}\right)^{nt}
\]

where \( P \) is the principal, \( r \) is the annual interest rate (written as a decimal), and \( t \) is the time in years.

**Example**

You deposit $1000 into an account that earns 6% interest compounded semiannually. What is the balance after 4 years?

When interest is compounded semiannually, or twice a year, \( n = 2 \).

Use the compound interest formula given above.

\[
A = P \left(1 + \frac{r}{n}\right)^{nt}
\]

Write compound interest formula.

\[
= 1000 \left(1 + \frac{0.06}{2}\right)^{2 \cdot 4}
\]

Substitute.

Enter the expression \( 1000 \left(1 + \frac{0.06}{2}\right)^{2 \cdot 4} \) into your calculator.

**Keystrokes**

\[
1000 \quad \text{[ENTRY]} \quad 1 \quad \text{[ENTRY]} \quad .06 \quad \text{[ENTRY]} \quad 2 \quad \text{[ENTRY]} \quad \text{[ENTRY]}
\]

\[
1000 \left(1 + \frac{0.06}{2}\right)^{2 \cdot 4} \quad \rightarrow \quad 1266.770081
\]

**Answer** The balance of the account after 4 years is about $1266.77.

**Draw Conclusions**

For an account that earns compound interest, find the balance of the account when interest is compounded as specified.

1. \( P = $2000, \ r = 5\%, \ t = 9 \) years; compounded semiannually
2. \( P = $3000, \ r = 6.2\%, \ t = 7 \) years; compounded quarterly
3. \( P = $500, \ r = 4\%, \ t = 8 \) years; compounded monthly
4. **Critical Thinking** In the example above, would the account have the greatest balance if the interest were compounded annually, semiannually, quarterly, or monthly? Justify your answer.
Chapter Review

**Vocabulary Review**

- percent, p. 329
- percent of change, p. 352
- percent of decrease, p. 352
- markup, p. 357
- discount, p. 358
- interest, p. 362
- principal, p. 362
- simple interest, p. 362
- annual interest rate, p. 362
- balance, p. 363
- compound interest, p. 363

**Copy and complete the statement.**

1. A(n) **%** is a ratio whose denominator is 100.
2. A(n) **%** is an increase from the wholesale price of an item to the retail price.

3. Is the percent of change from 85 to 34 a **percent of increase** or a **percent of decrease**?

4. You open an account with $500. After 1 year, the account has $510. Identify the principal, interest earned, and balance.

---

**7.1 Percents and Fractions**

**Goal**

Use fractions to find the percent of a number.

**Example** Write 44% as a fraction and \(\frac{4}{5}\) as a percent.

\[
\text{a. } 44\% = \frac{44}{100} = \frac{11}{25}
\]

\[
\text{b. } \frac{4}{5} = \frac{4 \cdot 20}{5 \cdot 20} = \frac{80}{100} = 80\%
\]

**Example** Find 75% of 32.

\[
75\% \text{ of } 32 = \frac{3}{4} \cdot 32
\]

Write percent as a fraction.

\[
= \frac{96}{4}
\]

Multiply.

\[
= 24
\]

Simplify.

**Exercise**

- **5.** 53%
- **6.** 85%
- **7.** 60%
- **8.** 28%

**Write the percent as a fraction.**

- **9.** \(\frac{31}{100}\)
- **10.** \(\frac{7}{20}\)
- **11.** \(\frac{31}{50}\)
- **12.** \(\frac{24}{25}\)

**Write the fraction as a percent.**

- **13.** 25% of 76
- **14.** 60% of 50
- **15.** 20% of 25
- **16.** 90% of 70
7.2 Percents and Proportions

**Goal**
Use proportions to solve percent problems.

**Example**
117 is 65% of what number?

\[
\frac{a}{b} = \frac{p}{100}
\]

Write proportion.

\[
\frac{117}{b} = \frac{65}{100}
\]

Substitute 117 for a and 65 for p.

\[
117 \cdot 100 = 65 \cdot b
\]

Cross products property

\[
11,700 = 65b
\]

Multiply.

\[
180 = b
\]

Divide each side by 65.

**Check**

17. 36 is 24% of what number?
18. What number is 92% of 75?
19. What percent of 85 is 34?
20. 51 is 60% of what number?
21. What number is 22% of 150?
22. What percent of 120 is 108?

7.3 Percents and Decimals

**Goal**
Use decimals to find the percent of a number.

**Example**
Write 0.6 and \(\frac{5}{8}\) as percents.

a. \(0.6 = 0.60 = 60\%

b. \(\frac{5}{8} = 0.625 = 62.5\%

**Example**
Find 21.5% of 80.

\[
21.5\% \text{ of } 80 = 0.215 \times 80
\]

Write percent as a decimal.

\[
= 17.2
\]

Multiply.

**Check**

23. 0.589
24. 1.3
25. 0.48
26. 3

Write the fraction as a percent.

27. \(\frac{3}{8}\)
28. \(\frac{9}{16}\)
29. \(\frac{2}{3}\)
30. \(\frac{6}{5}\)

Find the percent of the number.

31. 45% of 75
32. 30.2% of 130
33. 105% of 450
34. 0.8% of 675

35. **Shopping** Last year you spent $210 on clothes. You spent 37.5% of this amount on school clothes. How much money did you spend last year on school clothes?
7.4 The Percent Equation

**Goal**

Use an equation to solve percent problems.

**Example**

What percent of 70 is 31.5?

\[ a = \frac{p}{100} \times b \quad \text{Write percent equation.} \]

\[ 31.5 = \frac{p}{100} \times 70 \quad \text{Substitute 31.5 for } a \text{ and } 70 \text{ for } b. \]

\[ 0.45 = \frac{p}{100} \quad \text{Divide each side by 70.} \]

\[ 45\% = \frac{p}{100} \quad \text{Write decimal as a percent.} \]

**Check**

Use the percent equation to answer the question.

36. What number is 40\% of 26?

37. What percent of 130 is 104?

38. What percent of 80 is 72?

39. 2.56 is 8\% of what number?

7.5 Percent of Change

**Goal**

Solve problems involving percent of change.

**Example**

Find the percent of decrease from 55 to 33.

\[ p\% = \frac{\text{Amount of decrease}}{\text{Original amount}} \quad \text{Write formula for percent of decrease.} \]

\[ = \frac{55 - 33}{55} \quad \text{Substitute.} \]

\[ = \frac{22}{55} = 40\% \quad \text{Subtract. Then write as a percent.} \]

**Example**

Find the new amount when you increase 90 by 24\%.

New amount = Original amount \times (100\% + p\%)

\[ = 90 \times (100\% + 24\%) \quad \text{Substitute.} \]

\[ = 90 \times 124\% \quad \text{Add percents.} \]

\[ = 90 \times 1.24 = 111.6 \quad \text{Write as a decimal. Multiply.} \]

**Check**

Identify the percent of change as an increase or a decrease. Then find the percent of change.

40. Original: 50 \hspace{1cm} 41. Original: 40 \hspace{1cm} 42. Original: 25 \hspace{1cm} 43. Original: 96

New: 90 \hspace{1cm} New: 42 \hspace{1cm} New: 24 \hspace{1cm} New: 36

Find the new amount.

44. Increase 38 by 10%.

45. Decrease 670 by 42%.
7.6 Percent Applications

**Goal**
Find markups, discounts, sales tax, and tips.

**Example**
You buy a cell phone that is 20% off the original price of $129. Find the sale price.

Sale price = Original price \cdot (100\% - Discount percent)

= 129 \cdot (100\% - 20\%)

= 129 \cdot 80\%

= 129 \cdot 0.8

= 103.2

Multiply. The sale price is $103.20.

**Use the given information to find the new price.**

46. Wholesale price: $95
    Markup percent: 120%

47. Original price: $330
    Discount percent: 15%

7.7 Simple and Compound Interest

**Goal**
Calculate interest earned and account balances.

**Example**
Suppose you deposit $400 into an account that earns 5% simple annual interest. Find the balance of the account after 3 years.

\[ A = P(1 + rt) \]

Write formula for finding balance.

= 400(1 + 0.05 \cdot 3)

Substitute 400 for \( P \), 0.05 for \( r \), and 3 for \( t \).

= 460

Evaluate. The balance is $460.

**Example**
You deposit $500 into an account that earns 4.5% interest compounded annually. Find the balance of the account after 6 years.

\[ A = P(1 + r)^t \]

Write formula for finding balance.

= 500(1 + 0.045)^6

Substitute 500 for \( P \), 0.045 for \( r \), and 6 for \( t \).

= 651.13

Evaluate. The balance is about $651.13.

**48.** Suppose you deposit $900 into an account that earns 4% simple annual interest. Find the balance of the account after 6 months.

**49.** You deposit $6000 into an account that earns 3.8% interest compounded annually. Find the balance of the account after 7 years.
Write the percent as a fraction or the fraction as a percent.

1. 33%  
2. 65%  
3. \(\frac{6}{25}\)  
4. \(\frac{7}{50}\)

Write the percent as a decimal or the decimal as a percent.

5. 68%  
6. 42.5%  
7. 0.9  
8. 1.47

Find the percent of the number.

9. 75% of 68  
10. 40% of 180  
11. 27.5% of 300  
12. 0.6% of 980

13. **Baseball** A baseball team won 55% of its 160 games during a season. How many games did the team win during the season?

14. What number is 24% of 95?  
15. What number is 78% of 370?

16. What percent of 90 is 60?  
17. What percent of 70 is 31.5?

18. 4.5 is 0.9% of what number?  
19. 80 is 125% of what number?

20. **Stamps** Your friend has 480 stamps in a collection. Of these, 156 stamps depict historical events. What percent of the stamps in the collection depict historical events?

Identify the percent of change as an **increase** or a **decrease**. Then find the percent of change.

21. Original: 30  
   New: 21

22. Original: 50  
   New: 55

23. Original: 128  
   New: 176

24. Original: 380  
   New: 323

25. **Teen Spending** In 2000, about $155 billion was spent by teenagers in the United States. In 2001, the amount spent by teenagers increased by about 11%. About how much money did teenagers spend in 2001?

26. Wholesale price: $400  
   Markup percent: 110%  
   **Food bill:** $30  
   **Discount percent:** 20%  
   **Sales tax:** 6.5%

27. **Original price:** $650  
   **Discount percent:** 20%

29. **Bonds** A $500 bond earns 6% simple annual interest. Find the total interest earned after 5 years.

30. **Savings Account** You deposit $1800 into a savings account that earns 2% interest compounded annually. Find the balance after 2 years.
Chapter Standardized Test

Test-Taking Strategy If you are having trouble with a question, skip it and return to it after you have answered the other questions on the test.

1. What is 45% as a fraction?
   A. \( \frac{1}{45} \)   B. \( \frac{9}{20} \)   C. \( \frac{9}{10} \)   D. \( \frac{20}{9} \)

2. What number is 40% of 20?
   F. 0.8  G. 8  H. 80  I. 800

3. What is \( \frac{19}{50} \) as a percent?
   A. 19%  B. 31%  C. 38%  D. 260%

4. What percent of 140 is 56?
   F. 40%  G. 56%  H. 84%  I. 250%

5. In a survey of 380 people, 25% said that they enjoy reading before going to sleep. How many of the people surveyed enjoy reading before going to sleep?
   A. 25 people  B. 76 people  C. 95 people  D. 355 people

6. Which situation represents the greatest percent of increase?
   F. Original: 60
       New: 75
   G. Original: 900
       New: 1000
   H. Original: 140
       New: 200
   I. Original: 30
       New: 60

7. What is the new amount when you increase 40 by 25%?
   A. 50  B. 65  C. 70  D. 100

8. A hat costs $28 after a 30% discount is applied. What was the hat’s original price?
   F. $8.40   G. $36.40   H. $40.00   I. $58.00

9. The food bill for a meal at a restaurant is $12. The sales tax is 6.5%, and you leave a 15% tip. What is the total cost of the meal?

10. A retail store buys a DVD player from a manufacturer for $140. The store then marks up the price by 115%. What is the retail price of the DVD player?
    F. $161   G. $255   H. $301   I. $1610

11. An $800 bond earns 4% simple annual interest. How much will the bond earn in interest after 6 years?
    A. $16   B. $32   C. $192   D. $1920

12. Short Response A backpack is on sale for 15% off the original price of $40. Another backpack is on sale for 40% off the original price of $55. Which backpack costs less after the discounts are applied? How much less? Explain you how got your answers.

13. Extended Response Suppose you deposit $500 into an account that earns 5% simple annual interest, and your friend deposits $350 into an account that earns 5.5% interest compounded annually.
    a. Find the balance of each account after 10 years.
    b. For each account, find the total interest earned after 10 years.
    c. Which account balance will have the greater amount of change after 10 years? Will this account balance also have the greater percent of change after 10 years? Explain your reasoning.
Strategies for Answering Short Response Questions

### Problem
A CD player is on sale at a store for 25% off the retail price of $120. If you buy the CD player at the store, you pay a 5% sales tax on the sale price. An identical CD player is on sale at an Internet site for 30% off the retail price of $120. If you buy the CD player online, you pay a $20 shipping cost. Which is less, the total cost at the store or the total cost online?

### Full credit solution

The total cost at the store is the sum of the sale price and a 5% sales tax on the sale price.

- Sale price = Retail price - Discount
  
  \[ 120 - 0.25 \times 120 = 120 - 0.25 \times 120 = 90 \]

- Total cost at store = Sale price + Sales tax
  
  \[ 90 + 0.05 \times 90 = 90 + 0.05 \times 90 = 94.50 \]

The total cost online is the sum of the sale price and the shipping cost.

- Sale price = Retail price - Discount
  
  \[ 120 - 0.30 \times 120 = 120 - 0.3 \times 120 = 84 \]

- Total cost online = Sale price + Shipping cost
  
  \[ 84 + 20 = 104 \]

The total cost at the store, $94.50, is less than the total cost online, $104.

### Partial credit solution

- Total cost at store = $90 + $4.50 = $94.50
- Total cost online = $84 + $20 = $104
- Because $94.50 is less than $104, the total cost at the store is less than the total cost online.
Partial credit solution

The sales tax should be calculated using a percent of the sale price, not of the original price.

- Sale price at store = $120 \cdot 0.25 = 30$
- Sales tax = 0.05 \cdot 120 = 6
- Total cost at store = 90 + 6 = 96
- Sale price online = $120 \cdot 0.3 = 36$
- Shipping cost = 20
- Total cost online = 84 + 20 = 104

The total cost online is correct.

No credit solution

- Total cost at store = Retail price - Discount + Sales tax
  = 120 - 25 + 5 = 100
- Total cost online = Retail price - Discount + Shipping
  = 120 - 30 + 20 = 110

The total cost at the store and the total cost online are incorrect, and the question isn’t answered.

Checkpoint

Score each solution to the short response question below as full credit, partial credit, or no credit. Explain your reasoning.

Problem  The speed of light is about $3 \times 10^8$ meters per second in space. In 2 hours, how many meters does light travel? Write your answer in scientific notation.

1. $(3 \times 10^8) \cdot 2 = 1.5 \times 10^9$. In 2 h, light travels $1.5 \times 10^9$ m.

2. Because $\frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ h}} \times 2 \text{ h} = 7200 \text{ sec}$, there are 7200 seconds in 2 hours. In 2 hours, light travels $7200 \times (3 \times 10^8) = 21,600 \times 10^8 = 2.16 \times 10^{12}$ meters.

3. Because 60 sec = 1 min and 60 min = 1 h, there are 3600 seconds in 1 hour. So, light travels $3600 \times (3 \times 10^8) = 1.08 \times 10^{12}$ meters.

Watch Out

When solving a problem that involves measurements, convert between units if necessary.
1. You are arranging 48 tables for a science fair. You want each row to have the same number of tables. You can have at most 6 tables per row and at most 20 rows. How many different arrangements are possible?

2. The table shows the mean distance of each planet from the Sun. Write the mean distances in standard notation. Then list the planets in order from the least to the greatest mean distance from the Sun.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Distance from Sun (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td>$1.496 \times 10^8$</td>
</tr>
<tr>
<td>Jupiter</td>
<td>$7.784 \times 10^8$</td>
</tr>
<tr>
<td>Mars</td>
<td>$2.279 \times 10^8$</td>
</tr>
<tr>
<td>Mercury</td>
<td>$5.79 \times 10^7$</td>
</tr>
<tr>
<td>Neptune</td>
<td>$4.4982 \times 10^8$</td>
</tr>
<tr>
<td>Pluto</td>
<td>$5.90 \times 10^8$</td>
</tr>
<tr>
<td>Saturn</td>
<td>$1.4267 \times 10^8$</td>
</tr>
<tr>
<td>Uranus</td>
<td>$2.8709 \times 10^8$</td>
</tr>
<tr>
<td>Venus</td>
<td>$1.082 \times 10^8$</td>
</tr>
</tbody>
</table>

3. A recipe calls for $\frac{2}{3}$ cup of milk, $\frac{1}{2}$ cup of sugar, and $2\frac{1}{4}$ cups of flour. You need to reduce the recipe by half. How much of each ingredient do you need?

4. A model train is $5\frac{1}{4}$ inches long. The scale used for the model is 1 inch : 160 inches. What is the length of the actual train?

5. A store sells hot dogs in packages of 10 and hot dog buns in packages of 6. You want to buy an equal number of hot dogs and hot dog buns. What is the least number of packages of hot dogs and hot dog buns you can buy?

6. For 5 days a week, you walk from home to school and back home. It takes you 14 minutes to walk each way. How many hours per week do you spend walking from home to school and back home? Write your answer as a mixed number.

7. You are ordering dinner at a restaurant. For the pasta, you can choose spaghetti, ziti, or shells. For a pasta topping, you can choose meatballs, veal, chicken, or eggplant. For the sauce, you can choose tomato sauce or cheese sauce. How many dinner combinations are possible?

8. You enlarge a 4 inch by 6 inch photo so that the shorter side is 8.5 inches long. What is the length of the longer side?

9. The original price of a hat is $28. You can buy it online for $17, or you can buy it at the store and use a coupon for a 30% discount. Does the hat cost less if you buy it online or at the store?

10. The circle graph shows the results of a survey asking 800 students what they prefer to receive as a gift. Of the students surveyed, how many more chose clothes than sports equipment?

11. The odds in favor of your winning a raffle are 1 to 49. The odds in favor of your friend's winning are 3 to 140. Who has the greater chance of winning the raffle, you or your friend? Explain your reasoning.
Multiple Choice

12. What is the prime factorization of 620?
   A. \(2 \cdot 3^2 \cdot 5 \cdot 7\)  
   B. \(2 \cdot 5 \cdot 61\)  
   C. \(2^2 \cdot 5 \cdot 31\)  
   D. \(2^7 \cdot 5\)

13. What is the greatest common factor of \(15x^3y^5\) and \(6xy^2\)?
   F. \(30x^3y^5\)  
   G. \(3xy^2\)  
   H. \(3x^3y^5\)  
   I. \(30xy^2\)

14. Suppose you deposit \$400 into an account that earns 3% simple annual interest. What is the account balance after 9 months?
   A. \$9  
   B. \$108  
   C. \$409  
   D. \$508

15. Given \(\triangle ABC \sim \triangle DEF\), what is the length of \(DE\)?

16. You toss a coin 15 times, and the coin lands heads up 9 times. What is the experimental probability that the coin lands heads up?
   A. 0.4  
   B. 0.5  
   C. 0.6  
   D. 0.9

17. What is the solution of the equation \(1.6x - 5.2 = 9.28\)?
   F. 1.48  
   G. 2.55  
   H. 9.05  
   I. 11

18. Simplify the expression \(\frac{4r^3}{5} \cdot \frac{15r^2}{14}\).
   A. \(\frac{6r^6}{7}\)  
   B. \(\frac{6r^6}{7}\)  
   C. \(\frac{64r^5}{75}\)  
   D. \(\frac{64r^6}{75}\)

19. What is the percent of change from 76 to 190?
   F. 60%  
   G. 114%  
   H. 150%  
   I. 350%

20. A map has a scale of 1 cm : 150 m. If a map distance is 2.5 centimeters, what is the actual distance?
   A. 151.5 meters  
   B. 225 meters  
   C. 300 meters  
   D. 375 meters

Extended Response

21. The table shows the population of Washington, D.C., every 10 years from 1950 to 2000.
   a. Make a data display that shows the population for those years.
   b. In which year did the population decrease the most from 10 years earlier, and what was the approximate percent of change?
   c. Can you conclude from the table that the population of Washington, D.C., has decreased every year since 1950? Explain your reasoning.

22. A store sells granola bars in boxes of 8 and 20. A box of 8 bars costs \$3.12, and a box of 20 bars costs \$7.00.
   a. List all the possible ways that you can buy exactly 80 granola bars.
   b. How should you buy exactly 80 granola bars if you want to spend the least amount of money? Explain your reasoning.
**Unit 2**

**Chapters 4–7**

**Cumulative Practice for Chapters 4–7**

**Chapter 4**

**Multiple Choice** In Exercises 1–7, choose the letter of the correct answer.

1. Which expression is equivalent to \( x \cdot x \cdot y \cdot y \cdot y \)? *(Lesson 4.1)*
   - A. \( 6xy \)
   - B. \( x^2y^3 \)
   - C. \( 2xy^3 \)
   - D. \( 3x^2y \)

2. What is the greatest common factor of \( 6mn \) and \( 27m^2n \)? *(Lesson 4.2)*
   - F. \( 3m \)
   - G. \( 3m^3n \)
   - H. \( 6m \)
   - I. \( 54m^3n \)

3. Which expression is equivalent to \( \frac{18a^6}{3a^2} \)? *(Lesson 4.3)*
   - A. \( 6a^3 \)
   - B. \( 6a^4 \)
   - C. \( 15a^3 \)
   - D. \( 15a^4 \)

4. What is the LCM of 32 and 48? *(Lesson 4.4)*
   - F. \( 6 \)
   - G. \( 48 \)
   - H. \( 96 \)
   - I. \( 144 \)

5. Which expression is equivalent to \( -2x^2 \cdot 3x^3y \)? *(Lesson 4.5)*
   - A. \( -6x^5y \)
   - B. \( -6x^2y \)
   - C. \( -6x^6y \)
   - D. \( x^2 \)

6. Which list of numbers is ordered from least to greatest? *(Lesson 4.6)*
   - F. \( 5^0, 2^{-3}, 7, 5^0 \)
   - G. \( 2^{-3}, 3^{-2}, 7, 5^0 \)
   - H. \( -7, 3^{-2}, 2^{-3}, 5^0 \)
   - I. \( -7, 3^{-2}, 2^{-3}, 5^0 \)

7. Which number is equivalent to \( 8 \times 10^{-3} \)? *(Lesson 4.7)*
   - A. \( 8000 \)
   - B. \( 800 \)
   - C. \( 0.08 \)
   - D. \( 0.008 \)

8. **Short Response** You are arranging 60 pictures on a poster board. The board can fit up to 4 rows of pictures, and each row can have up to 20 pictures. You want each row to have the same number of pictures. How many different ways can you arrange the pictures? *(Lesson 4.1)*

9. **Extended Response** The table shows the typical lengths of four species of roundworm. *(Lesson 4.7)*

<table>
<thead>
<tr>
<th>Roundworm</th>
<th>Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochus</td>
<td>( 3.4 \times 10^{-3} )</td>
</tr>
<tr>
<td>Cephalobus</td>
<td>( 6 \times 10^{-4} )</td>
</tr>
<tr>
<td>Placetonema gigantissima</td>
<td>( 7.9 \times 10^{0} )</td>
</tr>
<tr>
<td>Syphacia peromyisci</td>
<td>( 9.1 \times 10^{-4} )</td>
</tr>
</tbody>
</table>

   a. Order the lengths from least to greatest.
   b. How many meters less is the length of the shortest roundworm than the length of the next shortest roundworm? Write your answer in standard form and in scientific notation.

**Chapter 5**

**Multiple Choice** In Exercises 10–16, choose the letter of the correct answer.

10. Which fraction is equivalent to 0.8? *(Lesson 5.1)*
   - A. \( \frac{9}{10} \)
   - B. \( \frac{8}{9} \)
   - C. \( \frac{6}{7} \)
   - D. \( \frac{4}{5} \)

11. Your pants have a length of 30 inches. A tailor cuts off \( 2 \frac{1}{3} \) inches from the length so that the pants fit you. How long are the pants now? *(Lesson 5.2)*
   - F. \( 27 \frac{1}{3} \) inches
   - G. \( 27 \frac{2}{3} \) inches
   - H. \( 28 \frac{1}{3} \) inches
   - I. \( 28 \frac{2}{3} \) inches

12. Simplify the expression \( \frac{4a}{3} + \frac{3a}{4} \). *(Lesson 5.3)*
   - A. \( \frac{4a}{7} \)
   - B. \( \frac{13a}{12} \)
   - C. \( \frac{a}{3} \)
   - D. \( \frac{7a}{12} \)
13. Simplify the expression \( \frac{6r}{5} \cdot \frac{15r}{2} \). (Lesson 5.4)
   
   F. \( 9r \)  
   G. \( 9r^2 \)  
   H. \( \frac{4r}{25} \)  
   I. \( \frac{4r^2}{25} \)

14. Find the quotient \( \frac{3}{4} + 1\frac{7}{8} \). (Lesson 5.5)
   
   A. \( \frac{1}{3} \)  
   B. \( \frac{2}{5} \)  
   C. \( \frac{2}{3} \)  
   D. \( 1 \frac{1}{14} \)

15. Your friend buys a skateboard that is on sale for one third less than the original price. Your friend spent $36 less than the original price. What was the original price of the skateboard? (Lesson 6.6)
   
   F. $12  
   G. $72  
   H. $108  
   I. $144

16. Which number is not a solution of the inequality \( -\frac{3}{4}x - \frac{1}{4} \leq 3 \)? (Lesson 5.7)
   
   A. \( -4 \frac{2}{3} \)  
   B. \( -3 \frac{1}{3} \)  
   C. \( 3 \frac{1}{3} \)  
   D. \( 4 \frac{2}{3} \)

17. Short Response You agree to donate $10 for every \( \frac{1}{4} \) mile that your friend runs in a race for charity. If your friend runs 15 miles, how much money will you donate? Explain your reasoning. (Lesson 6.6)

18. Extended Response You have $1275.25 to buy stock in a company. Your stockbroker charges a brokerage fee of $12.75 for each transaction. Each share is currently worth $25.75. (Lesson 5.7)
   
   a. How many shares can you buy in one transaction?
   
   b. You save $800 to buy more stock. Each share is now worth $31.49. How many shares can you buy in one transaction?
   
   c. Suppose that the shares in parts (a) and (b) are now worth $28.36 each. What is the total value of the shares? Explain your reasoning.

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Chapter 6

Multiple Choice In Exercises 19–25, choose the letter of the correct answer.

19. Which rate is equivalent to \( \frac{40 \text{ m}^3}{1 \text{ sec}} \)? (Lesson 6.1)
   
   A. \( \frac{2.4 \text{ km}}{1 \text{ h}} \)  
   B. \( \frac{24 \text{ km}}{1 \text{ h}} \)  
   C. \( \frac{144 \text{ km}}{1 \text{ h}} \)  
   D. \( \frac{1440 \text{ km}}{1 \text{ h}} \)

20. You can buy 3 pens for $2. How much money will you spend if you buy 15 pens? (Lesson 6.2)
   
   F. $10  
   G. $15  
   H. $30  
   I. $60

21. What is the solution of the proportion \( \frac{8}{y} = \frac{5}{7} \)? (Lesson 6.3)
   
   A. 5.4  
   B. 5.7  
   C. 6  
   D. 11.2

22. Given \( \triangle ABC \sim \triangle DEF \), which statement is not necessarily true? (Lesson 6.4)
   
   F. \( \angle A \equiv \angle D \)  
   G. \( \frac{AB}{DE} = \frac{AC}{DF} \)  
   H. \( \frac{AB}{DE} = \frac{AC}{DF} \)  
   I. \( \frac{AB}{DE} = \frac{BC}{EF} \)

23. Rectangle \( ABCD \) is similar to rectangle \( EFGH \). What is the length of \( EF \)? (Lesson 6.5)
   
   A. 6.3  
   B. 7.5  
   C. 9  
   D. 9.6

24. An airplane is 38.75 feet tall. A model of the airplane is 7.75 inches tall. What is the scale used for the model? (Lesson 6.6)
   
   F. 1 in. : 0.2 ft  
   G. 1 in. : 5 ft  
   H. 5 in. : 1 ft  
   I. 7 in. : 38 ft
25. You roll a number cube. What are the odds in favor of rolling a number less than 3?  
   (Lesson 6.7)  
   A. 1 to 3  B. 1 to 2  C. 3 to 7  D. 3 to 5  

26. **Short Response** You can do 45 sit-ups in a minute. Your friend can do 40 sit-ups in a minute. At these rates, how many more sit-ups can you do than your friend in 4.5 minutes? Explain your steps.  
   (Lesson 6.1)  

27. **Extended Response** Six numbers are written on slips of paper and placed in one of two hats, as shown. You randomly choose a number from each hat.  
   (Lesson 6.8)  
   First hat  Second hat  
   2  6  7  4  5  9  
   a. Use a tree diagram to list all the possible outcomes of choosing two numbers.  
   b. What is the probability that the sum of the two numbers you choose is even?  
   c. The number 3 is written on a slip of paper and placed in the first hat. Does the probability of choosing two numbers whose sum is even increase, decrease, or stay the same? Explain.  

**Chapter 7**  

**Multiple Choice** In Exercises 28–34, choose the letter of the correct answer.  

28. What is 40% of 2100?  
   (Lesson 7.1)  
   A. 84  B. 525  C. 840  D. 2060  

29. 6 is what percent of 16?  
   (Lesson 7.2)  
   F. $\frac{2}{3}\%$  G. $37\frac{1}{2}\%$  H. 96%  I. 267%  

30. What is 3.4% of 8700?  
   (Lesson 7.3)  
   A. 29.58  B. 295.8  C. 2958  D. 29,580  

31. 27 is 18% of what number?  
   (Lesson 7.4)  
   F. 4.86  G. 45  H. 48.6  I. 150  

32. What is the new amount when 70 is increased by 30%?  
   (Lesson 7.5)  
   A. 73  B. 91  C. 100  D. 2100  

33. You are ordering pizzas for home delivery. The pizzas cost $18. The sales tax is 6%, and you plan to give a 15% tip. What is the total cost of the order?  
   (Lesson 7.6)  
   F. $18.21$  G. $20.10$  H. $21.78$  I. $37.80$  

34. You deposit $1000 into an account that earns 10% interest compounded annually. What is the balance of the account after 2 years?  
   (Lesson 7.7)  
   A. $1200$  B. $1210$  C. $1800$  D. $3528$  

35. **Short Response** A computer is on sale for 25% off the original price of $800. You must pay a sales tax of 6.5% of the sale price. How much money do you spend for the computer? Explain your steps.  
   (Lesson 7.6)  

36. **Extended Response** Suppose you deposit $500 into an account that earns 3% simple annual interest, and your friend deposits $400 into an account that earns 5% simple annual interest.  
   (Lesson 7.7)  
   a. Copy and complete the table.  
   b. After how many years will the balance in your friend’s account equal the balance in your account? Explain your reasoning.