Knowledge and Skills

- Solve problems involving direct proportional relationships. **TEKS 6.3**
- Use experimental and theoretical probability to make predictions. **TEKS 6.9**

Key Vocabulary

- percent (p. 325)
- probability (p. 341)
- sample space (p. 349)
- tree diagram (p. 350)

Real-World Link

**Soccer** Suppose a soccer player made 6 goals in his last 15 attempts. You can use probability to predict the number of goals he will score in his next 50 attempts.

Foldables Study Organizer

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**Percent and Probability** Make this Foldable to help you understand percents and probability. Begin with a piece of 11” × 17” paper.

1. **Fold** a 2” tab along the long side of the paper.

2. **Unfold** the paper and fold in thirds widthwise.

3. **Draw** lines along the folds and label the head of each column as shown. Label the front of the folded table with the chapter title.
### Option 1

Take the Quick Quiz below. Refer to the Quick Review for help.

#### Quick Quiz

Write each fraction in simplest form. If the fraction is already in simplest form, write simplest form. (Used in Lesson 7-2)

1. \( \frac{25}{100} \)  
2. \( \frac{17}{100} \)  
3. \( \frac{30}{100} \)  
4. \( \frac{15}{100} \)

Solve each proportion. (Used in Lessons 7-1 and 7-8)

5. \( \frac{1}{a} = \frac{3}{9} \)  
6. \( \frac{7}{16} = \frac{h}{48} \)  
7. \( \frac{5}{8} = \frac{30}{y} \)  
8. \( \frac{t}{35} = \frac{6}{7} \)  
9. \( \frac{s}{18} = \frac{2}{3} \)  
10. \( \frac{36}{p} = \frac{2}{3} \)

11. **BAKING** If baking 4 apple pies requires 2 pounds of apples, how many pounds of apples are needed to bake 12 apple pies?

12. Round each number to the nearest ten. (Used in Lesson 7-8)
   
   12. 42  
   13. 5  
   14. 68  
   15. 74  
   16. 18  
   17. 9

18. **COMPUTERS** Rebekah has saved $77 toward new speakers for her computer. To the nearest ten, how much has she saved?

### Example 1

**Simplify** \( \frac{3}{15} \).

\[
\frac{3}{15} = \frac{1}{5}
\]

Divide the numerator and denominator by the GCF, 3.

Since the GCF of 1 and 5 is 1, the fraction \( \frac{1}{5} \) is in simplest form.

### Example 2

**Solve** \( \frac{9}{16} = \frac{n}{32} \).

\[
\frac{9}{16} = \frac{n}{32}
\]

Write the proportion.

\[
\times 2 \quad \quad \frac{9}{16} = \frac{n}{32}
\]

Since \( 16 \times 2 = 32 \), multiply 9 by 2.

So, \( n = 18 \).

### Example 3

**Round 86 to the nearest ten.**

Look at the number in the ones place, 6.

Since 6 is 5 or greater, add one to the number in the tens place.

86 rounded to the tens place is 90.
Math Lab
Modeling Percents

In Lesson 3-1, you learned that a 10 × 10 grid can be used to represent hundredths. The word percent (%) means out of one hundred, so you can also use a 10 × 10 grid to model percents.

Model 18%.

Model each percent.

a. 30%  
b. 8%  
c. 42%  
d. 75%

Identify each percent that is modeled.

So, the model shows 40%.

So, the model shows 25%.

Identify each percent modeled.

e.  
f.  
g.

ANALYZE THE RESULTS
1. Identify the fraction of each model in Exercises a–g that is shaded.
2. MAKE A CONJECTURE How can you write a percent as a fraction? How can you write a fraction with a denominator of 100 as a percent?
Main IDEA
Express percents as fractions and fractions as percents.

Targeted TEKS 6.1
The student represents and uses rational numbers in a variety of equivalent forms.
(B) Generate equivalent forms of rational numbers including whole numbers, fractions, and decimals.
6.3 The student solves problems involving direct proportional relationships.
(B) Represent ratios and percents with concrete models, fractions, and decimals.

NEW Vocabulary
percent

**FOOD** Kimiko asked 100 students in the cafeteria what their favorite fruit bar flavor was: cherry, grape, strawberry, or blueberry. The results are shown in the bar graph.

1. What ratio compares the number of students who prefer grape fruit bars to the total number of students?
2. Draw a decimal model to represent this ratio.
3. What fraction represents this ratio?

Ratios like 32 out of 100, 45 out of 100, 18 out of 100, and 5 out of 100, can be written as percents.

**KEY CONCEPT**

**Write a Percent as a Fraction**

Write 50% as a fraction in simplest form.

50% means 50 out of 100.

\[
50\% = \frac{50}{100} \quad \text{Definition of percent}
\]

\[
= \frac{1}{2} \quad \text{Simplify. Divide the numerator and the denominator by the GCF, 50.}
\]
Write 125% as a mixed number in simplest form.

125% means 125 for every 100.

\[ 125\% = \frac{125}{100} \quad \text{Definition of percent} \]

\[ = 1 \frac{25}{100} \quad \text{Write as a mixed number.} \]

\[ = 1 \frac{25}{100} \text{ or } 1 \frac{1}{4} \quad \text{Divide the numerator and denominator by the GCF, 25.} \]

125% = 1 \frac{1}{4}

Write each percent as a fraction or mixed number in simplest form.

a. 10%

b. 97%

c. 135%

PATRIOTISM What fraction of those surveyed are extremely proud to be an American?

The table shows that 65% of those surveyed are extremely proud to be an American.

\[ 65\% = \frac{65}{100} \quad \text{Definition of percent} \]

\[ = \frac{13}{20} \quad \text{Simplify.} \]

So, \( \frac{13}{20} \) of those surveyed are extremely proud to be American.

d. PATRIOTISM What fraction are moderately proud to be American?

To write a fraction as a percent, write and solve a proportion. One ratio is the fraction. The other is an unknown compared to 100.

Examples Write a Fraction as a Percent

Write \( \frac{9}{20} \) as a percent.

\[ \frac{9}{20} = \frac{n}{100} \quad \text{Write a proportion.} \]

\[ \times 5 \]

\[ \frac{9}{20} = \frac{45}{100} \quad \text{Since } 20 \times 5 = 100, \text{ multiply 9 by 5 to find } n. \]

\[ \times 5 \]

\[ \frac{9}{20} = \frac{45}{100} \quad \text{So, } \frac{9}{20} = \frac{45}{100} \text{ or } 45\%. \]
Write a percent to represent the shaded portion of the model at the right.

The portion shaded is $1\frac{2}{8}$ or $1\frac{1}{4}$.

\[ 1\frac{1}{4} = \frac{5}{4} \]

Write $1\frac{1}{4}$ as an improper fraction.

\[ \frac{5}{4} = \frac{n}{100} \]

Write a proportion.

\[ \frac{5}{4} = \frac{125}{100} \]

Since $4 \times 25 = 100$, multiply 5 by 25 to find $n$.

So, $\frac{125}{100}$ or 125% of the model is shaded.

Write each fraction, mixed number, or shaded portion of each model as a percent.

e. $\frac{3}{5}$
f. $2\frac{9}{10}$
g. 

Extra Examples at tx.msmath1.com

Examples 1, 2 (pp. 325–326)

Write each percent as a fraction or mixed number in simplest form.

1. 15%
2. 80%
3. 180%

Example 3 (p. 326)

4. FISH More than 70% of the world’s farm-raised catfish supply comes from Mississippi. What fraction of the world’s catfish is this?

Example 4 (p. 326)

Write each fraction or mixed number as a percent.

5. $\frac{1}{4}$
6. $\frac{2}{5}$
7. $2\frac{1}{4}$

Example 5 (p. 327)

Write a percent to represent the shaded portion of each model.

8.
9.
10.
11.
Write each percent as a fraction or mixed number in simplest form.

12. 14%  
13. 47%  
14. 2%
15. 20%  
16. 185%  
17. 280%
18. E-MAIL In 2004, 22% of e-mail users said they spend less time using e-mail because of spam. What fraction of e-mail users is this?
19. SOCCER In the 2004 regular season, the Dallas Burn won or tied about 54% of their games. What fraction of their games did they win or tie?

Write each fraction or mixed number as a percent.

20. \(\frac{3}{10}\)  
21. \(\frac{7}{20}\)  
22. \(1\frac{1}{4}\)
23. \(1\frac{2}{5}\)  
24. \(\frac{1}{100}\)  
25. \(\frac{5}{100}\)
26. PETS About \(\frac{7}{10}\) of a cat’s day is spent dozing. About what percent of a cat’s day is spent dozing?
27. FOOD About \(\frac{23}{25}\) of a watermelon is water. About what percent of a watermelon is water?

Write a percent to represent the shaded portion of each model.

28.  
29.  
30.  
31.  
32.  
33.  
34. BASKETBALL Use the table to determine what percent of the baskets Khaliah made and what percent she missed. What is the relationship between these two percents?
35. INTERNET A recent online survey showed that 82% of youth most often connect to the Internet at home. What fraction of youth in the survey most often connect to the Internet somewhere other than at home?
36. ANALYZE TABLES The table shows what fraction of the daily chores a father assigned to his son and daughters. If the remaining chores are for the father to complete, what percent of chores were left for him?
37. **OPEN ENDED** Write three fractions that can be written as percents between 50% and 75%. Justify your solution.

38. **CHALLENGE** Write $\frac{1}{200}$ as a percent.

39. **Which One Doesn’t Belong?** Identify the number that does not belong with the other three. Explain your reasoning.

   - $25\%$
   - $\frac{2}{8}$
   - $\frac{7}{25}$
   - $\frac{25}{100}$

40. **WRITING IN MATH** Determine whether the following statement is true or false. Explain your reasoning. If false, provide a counterexample.

   *When writing a number greater than 1 as a percent, one ratio of the proportion should be an unknown number compared to 1,000.*

41. On Friday, 65% of the students at Plainview Middle School bought a hot lunch in the cafeteria. What fractional part of the school did NOT buy a hot lunch in the cafeteria?

   - A $\frac{1}{65}$
   - B $\frac{13}{20}$
   - C $\frac{7}{20}$
   - D $\frac{6}{5}$

42. Marita used black and white tiles to create the mosaic below. What percent of her mosaic consists of white tiles?

   - F 8%
   - H 32%
   - G 17%
   - J 68%

**BABY-SITTING** Use the following information for Exercises 43–44. (Lesson 6-7)

Vonzell earns $7 per hour for baby-sitting twin boys.

43. Write an equation to represent the total amount $t$ that Vonzell earns for baby-sitting these boys for $h$ hours.

44. How much will she earn if she baby-sits them for 6 hours?

Describe how the next term in each sequence can be found. Then find the next two terms. (Lesson 6-6)

45. 5, 8, 11, 14, ...

46. $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, ...

**PREREQUISITE SKILL** Write each fraction in simplest form. (Lesson 4-2)

47. $\frac{26}{100}$

48. $\frac{50}{100}$

49. $\frac{10}{100}$

50. $\frac{75}{100}$
Circle Graphs

Main IDEA
Sketch and analyze circle graphs.

Targeted TEKS 6.3
The student solves problems involving direct proportional relationships. (B) Represent ratios and percents with concrete models, fractions, and decimals. 6.10 The student uses statistical representations to analyze data. (C) Sketch circle graphs to display data. Also addresses TEKS 6.2(D), 6.11(D), 6.12(A).

NEW Vocabulary
circle graph

The table below shows the number of people driving together in one vehicle during a spring break trip. These data can be displayed in a circle graph.

<table>
<thead>
<tr>
<th>People in Vehicle</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3</td>
<td>11%</td>
</tr>
<tr>
<td>4–5</td>
<td>35%</td>
</tr>
<tr>
<td>6–7</td>
<td>29%</td>
</tr>
<tr>
<td>8–9</td>
<td>11%</td>
</tr>
<tr>
<td>10 or more</td>
<td>14%</td>
</tr>
<tr>
<td>Source: carmax.com</td>
<td></td>
</tr>
</tbody>
</table>

For each category, let 1 centimeter equal 1%. Mark the length, in centimeters, that represents each percent on a piece of adding machine tape. Label each section.

1. Make a bar graph of the data.
2. Which graph represents the data better, a circle graph or a bar graph? Explain.

A circle graph is used to compare data that are parts of a whole.
**EXAMPLE**

**Sketch Circle Graphs**

**SCHOOL** A group of teenagers were asked to name their top priority for the school year. The results are shown at the right. Sketch a circle graph to display the data.

- Write a fraction to estimate each percent.
  - 52% $\approx$ 50% and 50% = $\frac{50}{100}$ or $\frac{1}{2}$
  - 23% $\approx$ 25% and 25% = $\frac{25}{100}$ or $\frac{1}{4}$
  - 12.5% $\approx$ 10% and 10% = $\frac{10}{100}$ or $\frac{1}{10}$

- Use a compass to draw a circle with at least a 1-inch radius.

  - Since 52% is little more than 50% or $\frac{1}{2}$, shade a little more than $\frac{1}{2}$ of the circle for “Good Grades.”
  - Since 23% is a little less than 25% or $\frac{1}{4}$, shade a little less than $\frac{1}{4}$ of the circle for “Friends.”

  Since the last two sections are equal, take the remaining portion of the circle and divide it into two equal parts.

- Label each section of the circle graph. Then give the graph a title.

**a. VACATION** The table shows how people responded to a question about the importance of sunny weather in a vacation location. Sketch a circle graph to display the data.

<table>
<thead>
<tr>
<th>Sunshine While on Vacation</th>
<th>Response</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Important</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Not Very Important</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Not At All Important</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Source: Opinion Research Corp.

You can review simplifying fractions in Lesson 4-2.
You can analyze data displayed in a circle graph.

**Analyze Circle Graphs**

**CHORES** Karen surveyed her class to see which rooms in their homes were the messiest. The circle graph at the right shows the results of her survey.

2. **Which room did students say is the messiest?**
   
   The largest section of the graph is the section that represents a child’s room. So, students said that a child’s room is the messiest room in the home.

3. **Which two sections represent the responses by the same amount of students?**
   
   By comparing the percents, the sections labeled “Other” and “Family Room” are the same size. So, the same number of students chose these two rooms.

4. **How does the number of students that say their parents’ room is the messiest compare to the number of students that say the family room is the messiest?**
   
   The section representing parents’ room is about twice the size of the section representing family room. So, twice as many students say that the parents’ room is the messiest room.

**LANDFILLS** The circle graph at the right shows the items that fill landfills in the United States.

b. **Which item is found most in U.S. landfills?**

c. **Which item(s) is found the least in U.S. landfills?**

d. **Which two sections represent items that are found about the same amount in U.S. landfills?**

e. **How does the amount of food and yard waste compare to the amount of rubber and leather in U.S. landfills?**
1. **DATING** In a national online survey, 13-year-olds were asked if they have started going out or dating. The table shows the results. Sketch a circle graph to display the data.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>72%</td>
<td>3%</td>
</tr>
</tbody>
</table>

**Source:** Time

**READING** For Exercises 2–4, use the graph at the right.

2. Who most influences kids to read?
3. Which two groups are least influential in getting kids to read?
4. About how much more do parents influence kids to read than teachers?

**Who Influences Kids to Read**

- Parents 60%
- Teachers 23%
- Friends 13%
- Siblings 2%
- Other 2%

**Source:** SWR Worldwide for shopforschool.com

**5. ELECTIONS** The table shows the results of an election for class president. Sketch a circle graph to display the data.

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melissa</td>
<td>31%</td>
</tr>
<tr>
<td>Lacey</td>
<td>25%</td>
</tr>
<tr>
<td>Troy</td>
<td>25%</td>
</tr>
<tr>
<td>Omar</td>
<td>19%</td>
</tr>
</tbody>
</table>

**6. MUSIC** In Mrs. Castro’s class, 75% of the students like rock music, 10% favor country music, 5% prefer classical, and 10% chose another type of music. Sketch a circle graph to display the data.

**INTERNET** For Exercises 7–9, use the graph below that shows the ages at which libraries in the U.S. stop requiring parental permission for children to use the Internet.

- age 18 67%
- ages 14–15 8%
- ages 16–17 16%
- age 13 or younger 9%

**Ages at Which Libraries Stop Requiring Permission to Use the Internet**

Source: University of Illinois

7. At what age do all libraries stop requiring parental permission?
8. For which two age intervals do libraries stop requiring permission to use the Internet about the same percent of the time?
9. How does the number of libraries that stop requiring parental permission at ages 14–15 compare to the number of libraries that stop requiring parental permission at ages 16–17?
**SUMMER** For Exercises 10–12, use the graph at the right.

10. Which summer nuisances are named least often?
11. Which two sections represent the same percent of summer nuisances?
12. How does humidity compare to yard work as a summer nuisance?

13. **SCHOOL** Refer to the graph in Example 1 on page 331. How does the number of teenagers that said sports were their top priority compare to the number of teenagers that said good grades were their top priority?

14. **MOVIES** A group of 100 students was asked about their movie-going experience pet peeves. The table shows their responses. Sketch a circle graph to compare the students’ responses. What percent of the students chose bad manners or overpriced food as their pet peeves?

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad Manners</td>
<td>49</td>
</tr>
<tr>
<td>Preshow Commercials</td>
<td>24</td>
</tr>
<tr>
<td>Overpriced Food</td>
<td>12</td>
</tr>
<tr>
<td>Babies/Noisy Children</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
</tbody>
</table>

15. **COLLECT THE DATA** Record your activities for one 24-hour period. Sketch a circle graph to display your data. Then write a few sentences that analyze the data.

16. **CHALLENGE** Decide which of the following is the least appropriate data to display in a circle graph. Explain your decision.
   a. data that show what age groups buy athletic shoes
   b. data that show what most motivates teens to volunteer
   c. data that show the average price of a hamburger every five years
   d. data that show how many hours adults help their children study

17. **SELECT A TECHNIQUE** Carter wants to sketch a circle graph of the data in the table. Which of the following techniques might Carter use to determine how big to make each section of the circle graph? Justify your selection(s). Then use the technique(s) to sketch the circle graph.

<table>
<thead>
<tr>
<th>How Students Travel to Clint Middle School</th>
</tr>
</thead>
<tbody>
<tr>
<td>bicycle</td>
</tr>
<tr>
<td>bus</td>
</tr>
<tr>
<td>carpool</td>
</tr>
<tr>
<td>walk</td>
</tr>
</tbody>
</table>

18. **WRITING IN MATH** Write a problem that can be solved using one of the circle graphs in this lesson. Be sure to include a statement about the graph to which you are referring.
19. A group of adults was asked to give a reason why they honor their moms. “She survived raising me” was given by 50% of the adults, 22% said “she was a great role model,” 19% said “she has become my best friend,” and 9% said “she always had dinner on the table and clean clothes in the closet.” Which circle graph best displays the data?

**A**

![Circle Graph A](image)

**B**

![Circle Graph B](image)

**C**

![Circle Graph C](image)

**D**

![Circle Graph D](image)

MOVIES Use the following information for Exercises 23 and 24. (Lesson 6-7)

A video store charges $3 to rent a DVD.

23. Write an equation to represent the total cost $c$ for renting $d$ DVDs.

24. How much will it cost to rent 4 DVDs?

25. Order 3.8, 3.05, 0.39, and 3.5 from greatest to least. (Lesson 3-2)
**Draw a Picture**

Have you heard the expression *a picture is worth a thousand words*? Sometimes drawing a picture can help you better understand the numbers you find in a word problem. For example, a *number map* can show how numbers are related to each other. Start by placing a number in the center of the map.

Below is a number map that shows various meanings of the decimal 0.5. Notice that you can add both mathematical meanings and everyday meanings to the number map.

Make a number map for each number. (*Hint*: For whole numbers, think of factors, prime factors, divisibility, place value, and so on.)

1. 0.75
2. 0.1
3. 0.01
4. 1.25
5. 2.5
6. 25
7. 45
8. 60
9. 100

10. Refer to Exercise 1. Explain how each mathematical or everyday meaning on the number map relates to the decimal 0.75.
Main IDEA
Express percents as decimals and decimals as percents.

Targeted TEKS 6.1
The student represents and uses rational numbers in a variety of equivalent forms.
(B) Generate equivalent forms of rational numbers including whole numbers, fractions, and decimals.
6.3 The student solves problems involving direct proportional relationships.
(B) Represent ratios and percents with concrete models, fractions, and decimals.

GET READY for the Lesson
SCHOOL The circle graph shows the favorite subjects of students in a recent survey.

1. What percent does the entire circle graph represent?
2. What fraction represents the section of the graph labeled math?
3. Write the fraction from Exercise 2 as a decimal.

Percents can be written as decimals. To write a percent as a decimal, rewrite the percent as a fraction with a denominator of 100. Then write the fraction as a decimal.

EXAMPLES
Write a Percent as a Decimal

Write each percent as a decimal.

1. 56%
   56% = \frac{56}{100} \quad \text{Rewrite the percent as a fraction with a denominator of 100.}
   = 0.56 \quad \text{Write 56 hundredths as a decimal.}

2. 8%
   8% = \frac{8}{100} \quad \text{Rewrite the percent as a fraction with a denominator of 100.}
   = 0.08 \quad \text{Write 8 hundredths as a decimal.}

3. 120%
   120% = \frac{120}{100} \quad \text{Rewrite the percent as a fraction with a denominator of 100.}
   = 1\frac{20}{100} \quad \text{Write as a mixed number.}
   = 1.20 \text{ or } 1.2 \quad \text{Write 1 and 20 hundredths as a decimal.}

CHECK Your Progress
Write each percent as a decimal.
a. 32%  
   b. 6%  
   c. 190%
You can also write a decimal as a percent. To write a decimal as a percent, write the decimal as a fraction whose denominator is 100. Then write the fraction as a percent.

**Write a Decimal as a Percent**

Write each decimal as a percent.

4. 0.38
   
   \[0.38 = \frac{38}{100}\]
   Write 38 hundredths as a fraction.
   
   \[= 38\%\]
   Write the fraction as a percent.

5. 1.45
   
   \[1.45 = \frac{145}{100}\]
   Write 1 and 45 hundredths as a mixed number.
   
   \[= \frac{145}{100}\]
   Write the mixed number as an improper fraction.
   
   \[= 145\%\]
   Write the fraction as a percent.

**CHECK Your Progress**

Write each decimal as a percent.

d. 0.47  
e. 1.75  
f. 0.52

**Real-World Example**

**CROPS** The United States produces more corn than any other country, producing 0.4 of the total corn crops. Write 0.4 as a percent.

\[0.4 = \frac{4}{10}\]
Write 4 tenths as a fraction.

\[= \frac{4 \times 10}{10 \times 10}\]
Multiply the numerator and denominator by 10 so that the denominator is 100.

\[= \frac{40}{100}\]
Simplify.

\[= 40\%\]
Write the fraction as a percent.

**CHECK Your Progress**

g. **ANIMALS** The komodo dragon, which can weigh as much as 300 pounds, can eat up to 0.8 of its body weight during one meal. What percent is equivalent to 0.8?

h. **ATTENDANCE** About 0.01 of the students at Central Middle School were born outside of the United States. What percent is equivalent to 0.01?

**Online Personal Tutor at tx.msmath1.com**
Write each percent as a decimal.

1. 27%  
2. 15%  
3. 4%  
4. 9%  
5. 115%  
6. 136%

Write each decimal as a percent.

7. 0.32  
8. 0.15  
9. 0.91  
10. 1.25  
11. 2.91  
12. 4.63

Example 6  

13. **BIOLOGY** About 0.7 of the human body is water. What percent is equivalent to 0.7?

Express each percent as a decimal.

14. 17%  
15. 35%  
16. 2%  
17. 3%  
18. 125%  
19. 104%  
20. 11%  
21. 95%

22. **FRUIT** Each year about 14% of the world’s fruit is produced in China. Write 14% as a decimal.

23. **LIFE SCIENCE** About 95% of all species of fish have skeletons made of bone. Write 95% as a decimal.

Express each decimal as a percent.

24. 0.22  
25. 0.99  
26. 1.75  
27. 3.55  
28. 0.5  
29. 0.6  
30. 0.16  
31. 0.87

32. **DIGITAL CAMERAS** In 2004, the number of homes with digital cameras grew 0.44 from the previous year. Write 0.44 as a percent.

33. **PASTA** According to the *American Pasta Report*, 0.12 of Americans say that lasagna is their favorite pasta. What percent is equivalent to 0.12?

34. **ANALYZE TABLES** A batting average is the ratio of hits to at bats. Batting averages are expressed as a decimal rounded to the nearest thousandth. Show two methods for finding how much greater Carlos Quentin’s batting average was than Jesus Cota’s batting average. Express the difference as a percent.

Replace each • with <, >, or = to make a true sentence.

35. 18% • 0.2  
36. 0.5 • 5%  
37. 2.3 • 23%
38. **OPEN ENDED** Write a decimal between 0.5 and 0.75. Then write it as a fraction in simplest form and as a percent.

39. **CHALLENGE** Order 23.4%, 2.34, 0.0234, and 20.34% from least to greatest.

40. **CHALLENGE** Order $2\frac{1}{4}$, 0.6, 2.75, 40%, and $\frac{7}{5}$ from greatest to least.

41. **WRITING IN MATH** Write a problem about a real-world situation in which you would either write a percent as a decimal or write a decimal as a percent.

42. Each square below is divided into sections of equal size. Which square has 75% of its total area shaded?

   A
   
   B
   
   C
   
   D

43. **GRIDDABLE** Tionna is buying the baseball hat shown below.

   What decimal represents the discount she received?

44. **FOOD** The circle graph shows pie sales at a local bakery. What part of the total sales is peanut butter and strawberry? (Lesson 7-2)

   Write each percent as a fraction or mixed number in simplest form. (Lesson 7-1)

   45. 24%
   46. 38%
   47. 125%
   48. 35%

49. **AGE** The equation $17 - v = 5$ gives Virginia’s age, $v$, in years. Solve the equation mentally. (Lesson 1-8)

**GET READY for the Next Lesson**

**PREREQUISITE SKILL** Write each fraction in simplest form. (Lesson 4-2)

50. $\frac{5}{45}$
51. $\frac{15}{40}$
52. $\frac{21}{30}$
53. $\frac{9}{21}$
Duane and Morgan are playing cards. Morgan needs to draw a 3 in order to make a match and win the game. The cards shown are shuffled and placed facedown on the table.

1. Write a ratio that compares the number of cards numbered 3 to the total number of cards.

2. What percent of the cards are numbered 3?

3. Does Morgan have a good chance of winning? Explain.

4. What would happen to her chances of winning if cards 1, 4, 7, 9, and 10 were added to the cards shown?

5. What happens to her chances if only cards 3 and 8 are facedown on the table?

It is equally likely to select any one of the five cards. The player hopes to select a card numbered 3. The five cards represent the possible outcomes. A simple event is one outcome or a collection of outcomes. For example, selecting a card numbered 3 is a simple event.

Probability is the chance that some event will occur. You can use a ratio to find probability.

**KEY CONCEPT**

- **Words**: The probability of an event is a ratio that compares the number of favorable outcomes to the number of possible outcomes.

- **Symbols**: \[ P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} \]
The probability that an event will occur is a number from 0 to 1, including 0 and 1. The closer a probability is to 1, the more likely it is that an event will happen.

Outcomes occur at random if each outcome is equally likely to occur.

Find Probability

There are eight equally likely outcomes on the spinner.

Find the probability of landing on red.

There is one section of the spinner that is red.

\[
P(\text{red}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{1}{8}
\]

The probability of landing on red is \(\frac{1}{8}\).

Find the probability of landing on blue or yellow.

The word or indicates that the number of favorable outcomes needs to include the blue and yellow sections. There is one section of the spinner that is blue and one section that is yellow.

\[
P(\text{blue or yellow}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{2}{8} \text{ or } \frac{1}{4} \quad \text{Simplify.}
\]

The probability of landing on blue or yellow is \(\frac{1}{4}\).

The number cube with sides labeled 1 through 6 is rolled. Find each probability. Write each answer as a fraction.

a. \(P(2)\)  
b. \(P(5 \text{ or } 6)\)  
c. \(P(\text{less than 4})\)
If you toss a coin, it can either land on heads or not land on heads. These two events are complementary events. Complementary events are two events in which either one or the other must happen, but they cannot happen at the same time. The sum of the probability of an event and its complement is 1 or 100%.

**Find Probability of the Complement**

Find the probability of not landing on red in Example 1.

The probability of not landing on red and the probability of landing on red are complementary. So, the sum of the probabilities is 1.

\[ P(\text{red}) + P(\text{not red}) = 1 \]

\[ \frac{1}{8} + P(\text{not red}) = 1 \quad \text{Replace } P(\text{red}) \text{ with } \frac{1}{8}. \]

\[ \frac{1}{8} + \frac{7}{8} = 1 \quad \text{Think } \frac{1}{8} \text{ plus what number equals 1?} \]

So, the probability of not landing on red is \( \frac{7}{8} \).

A bag contains 5 blue, 8 red, and 7 green marbles. A marble is selected at random. Find each probability.

d. \( P(\text{not red}) \)
e. \( P(\text{not blue and not green}) \)

**WEATHER** The morning newspaper reported a 20% chance of snow. Identify the complement. Then find its probability.

The complement of snowing is not snowing. The sum of the probabilities is 100%.

\[ P(\text{snow}) + P(\text{not snowing}) = 100\% \]

\[ 20\% + P(\text{not snowing}) = 100\% \quad \text{Replace } P(\text{snow}) \text{ with } 20\%. \]

\[ 20\% + 80\% = 100\% \quad \text{Think } 20\% \text{ plus what number equals 100%?} \]

So, the probability that it will not snow is 80%.

**EYE COLOR** Mr. Harada surveyed his class and came up with the results shown in the table. Identify the complement of each event. Then find the probability of the complement.

f. blue
g. brown or green

<table>
<thead>
<tr>
<th>Eye Color</th>
<th>Percent of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>34</td>
</tr>
<tr>
<td>Blue</td>
<td>30</td>
</tr>
<tr>
<td>Green</td>
<td>21</td>
</tr>
<tr>
<td>Hazel</td>
<td>15</td>
</tr>
</tbody>
</table>
A counter is chosen randomly. Find each probability. Write each answer as a fraction, a decimal, and a percent.

1. \( P(4) \)  
2. \( P(2 \text{ or } 5) \)  
3. \( P(\text{less than } 8) \)  
4. \( P(\text{prime}) \)  
5. \( P(\text{not } 6) \)  
6. \( P(\text{not } 1 \text{ and } \text{not } 10) \)

7. **SCHOOL** The probability of guessing the correct answer to a true-false question is 50%. Describe the complement of this event and find its probability.

The spinner shown is spun once. Find each probability. Write each answer as a fraction.

8. \( P(Z) \)  
9. \( P(U) \)  
10. \( P(A \text{ or } M) \)  
11. \( P(C, D \text{ or } A) \)  
12. \( P(\text{not a vowel}) \)  
13. \( P(\text{not a consonant}) \)

A number cube marked with 1, 2, 3, 4, 5, and 6, one number on each face, is rolled. Find each probability. Write each answer as a fraction.

14. \( P(3) \)  
15. \( P(4 \text{ or } 6) \)  
16. \( P(\text{greater than } 4) \)  
17. \( P(\text{less than } 1) \)  
18. \( P(\text{even}) \)  
19. \( P(\text{odd}) \)  
20. \( P(\text{not a multiple of } 2) \)  
21. \( P(\text{not } 3 \text{ and } \text{not } 4) \)

**ANALYZE TABLES** For Exercises 22 and 23, use the table on air travel at selected Texas airports.

<table>
<thead>
<tr>
<th>Texas Airport</th>
<th>Arrivals (percent on-time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amarillo</td>
<td>83</td>
</tr>
<tr>
<td>El Paso</td>
<td>79</td>
</tr>
<tr>
<td>Laredo</td>
<td>80</td>
</tr>
<tr>
<td>Lubbock</td>
<td>78</td>
</tr>
<tr>
<td>San Antonio</td>
<td>79</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Transportation

One marble is selected, without looking, from the bag shown. Write a sentence stating how likely it is for each event to happen. Justify your answer.

24. green  
25. yellow  
26. purple, yellow, or orange  
27. blue

**Real-World Link**
Texas has 27 commercial airports in 24 cities. 
Source: tded.state.tx.us
28. **SCHOOL**  Of the students at Grant Middle School, 63% are girls. The school newspaper is randomly selecting a student to be interviewed. Describe the complement of selecting a girl and find the probability of the complement.

**ANALYZE GRAPHS**  For Exercises 29–31, use the information below and the bar graph.

The students at Meridian Middle School were asked how they get to school.

![Bar graph showing transportation modes]

29. If a student is selected at random, what is the probability that he or she primarily rides the bus to school?

30. If a student is selected at random, is the probability that he or she primarily rides in a car more or less likely than the probability that he or she rides a bike? Explain your reasoning.

31. If a student is selected at random, what is the probability that he or she does not walk to school?

**H.O.T. Problems**

32. **FIND THE ERROR**  Laura and Luisa are finding the probability of rolling a 5 on a number cube. Who is correct? Explain your reasoning.

Laura: Favorable: 5  
Possible: 1, 2, 3, 4, 5, 6  
P(5) = \frac{1}{6}

Luisa: Favorable: 5  
Unfavorable: 1, 2, 3, 4, 6  
P(5) = \frac{1}{5}

**CHALLENGE**  Another way to describe the chance of an event occurring is with odds. The odds in favor of an event is the ratio that compares the number of ways the event can occur to the ways that the event cannot occur.

odds of rolling a 3 or a 4 on a number cube \( \rightarrow 2 : 4 \) or \( 1 : 2 \)

Find the odds of each outcome if a number cube is rolled.

33. a 2, 3, 5, or 6  
34. a number less than 3  
35. an even number  
36. a number greater than 5
37. **CHALLENGE** A spinner for a board game has more than three sections, all of equal size, and the probability of the spinner stopping on blue is 0.5. Design two possible spinners for the game. Explain why each spinner drawn makes sense.

38. **WRITING IN MATH** Explain the relationship between the probability of an event and its complement. Give an example.

39. Joel has a bowl containing the mints shown in the table.

<table>
<thead>
<tr>
<th>Color</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>5</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
</tr>
<tr>
<td>Yellow</td>
<td>1</td>
</tr>
<tr>
<td>Green</td>
<td>6</td>
</tr>
</tbody>
</table>

If he randomly chooses one mint from the bowl, what is the probability that the mint will be orange?

A $\frac{1}{5}$  
B $\frac{2}{3}$  
C $\frac{11}{15}$  
D $\frac{4}{5}$

40. A miniature golf course has a bucket with 7 yellow golf balls, 6 green golf balls, 3 blue golf balls, and 8 red golf balls. If Tamika draws a golf ball at random from the bucket, what is the probability that she will NOT draw a green golf ball?

F $\frac{1}{4}$  
G $\frac{1}{3}$  
H $\frac{2}{3}$  
J $\frac{3}{4}$

41. **FARMS** About 93% of Nebraska’s land area is occupied by 48,500 farms and ranches. Write 93% as a decimal. (Lesson 7-3)

42. **VIDEO GAMES** The table shows the time several students spend playing video games. Sketch a circle graph to display the data. (Lesson 7-2)

Add or subtract. Write in simplest form. (Lessons 5-6 and 5-7)

43. $4\frac{3}{8} + 7\frac{1}{8}$
44. $1\frac{2}{3} + 5\frac{3}{4}$
45. $4\frac{3}{5} - 1\frac{1}{2}$
46. $8\frac{1}{6} - 2\frac{2}{3}$

**GET READY for the Next Lesson**

**PREREQUISITE SKILL** List all possible outcomes for each situation.

47. tossing a coin  
48. rolling a number cube  
49. selecting a month of the year  
50. choosing a color of the American flag
Probability Lab
Experimental and Theoretical Probability

Main IDEA
Compare experimental probability with theoretical probability.

Targeted TEKS 6.9
The student uses experimental and theoretical probability to make predictions. (B) Find the probabilities of a simple event and its complement and describe the relationship between the two.

NEW Vocabulary
theoretical probability
experimental probability

READING Math
Trials A trial is a single part of a well-defined experiment. In this lab, a trial is the selection of a cube from the bag.

Theoretical probability is based on what should happen under perfect conditions. These are the probabilities you found in Lesson 7-4. Experimental probability is based on what actually happens in an experiment. In this lab, you will investigate the relationship between these two types of probability.

Place 3 blue cubes and 5 red cubes in a paper bag.

Without looking, draw a cube out of the bag. If the cube is blue, record a Y in a table like the one shown. If the cube is not blue, record an N.

Replace the cube and repeat steps 1 and 2 for a total of 30 trials.

ANALYZE THE RESULTS

1. To find the experimental probability of selecting a blue cube, write the ratio of the number of times a blue cube was selected to the number of trials. What is the experimental probability of selecting a blue cube?

2. What is the theoretical probability of selecting a blue cube? How does this probability compare to the experimental probability found in Exercise 1? Explain any differences.

3. Compare your results to the results of other groups in your class. Why do you think the experimental probabilities usually vary when an experiment is repeated?

4. Find the experimental probability for the entire class’s trials. How do the experimental and theoretical probability compare?

5. MAKE A CONJECTURE Explain why the experimental probability obtained in Exercise 4 may be closer in value to the theoretical probability that the experimental probability in Exercise 1.

6. COLLECT THE DATA Work with a partner. Have your partner place a different number of red and blue cubes totaling 10 into the bag. Use experimental probability to guess the correct number of red and blue cubes in the bag. Explain your reasoning.
Write each percent as a fraction in simplest form. (Lesson 7-1)

1. 39%  
2. 18%  
3. 175%

4. **TEST PRACTICE** On Tuesday, 48% of the students at West Middle School rode the bus to school. What fractional part of the school did NOT ride the bus to school? (Lesson 7-1)
   A \(\frac{13}{25}\)  
   B \(\frac{1}{48}\)  
   C \(\frac{5}{4}\)  
   D \(\frac{12}{15}\)

Write each fraction or mixed number as a percent. (Lesson 7-1)

5. \(\frac{8}{20}\)  
6. \(1\frac{1}{2}\)  
7. \(\frac{3}{100}\)

**FOOD** For Exercises 8 and 9, use the graph below. (Lesson 7-2)

```
<table>
<thead>
<tr>
<th>Pasta Sales by Pasta Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long 41%</td>
</tr>
<tr>
<td>Short 31%</td>
</tr>
<tr>
<td>Special 13%</td>
</tr>
<tr>
<td>Spiral 15%</td>
</tr>
</tbody>
</table>
```

8. What percent of the sales came from spiral pasta?
9. Which two types of pasta have about the same amount of sales?

10. **SPORTS** In Ms. Thorne’s class, 60% of the students like soccer, 25% favor football, 5% prefer tennis, and 10% choose another type of sport. Sketch a circle graph to display the data. (Lesson 7-2)

Write each percent as a decimal. (Lesson 7-3)

11. 73%  
12. 145%  
13. 9%

14. **PLAYS** Twyla has memorized 85% of her lines for the school play. What decimal is equivalent to 85%? (Lesson 7-3)

Write each decimal as a percent. (Lesson 7-3)

15. 0.22  
16. 6.75  
17. 0.1

18. **MUSIC** The number of chorus students increased by 1.2 from the previous year. Write 1.2 as a percent. (Lesson 7-3)

19. **TEST PRACTICE** Each circle is divided into sections of equal size. Which circle has 25% of its total area shaded? (Lesson 7-3)

```
<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>J</td>
</tr>
</tbody>
</table>
```

The spinner is spun once. Find each probability. Write each answer as a fraction, a decimal, and a percent. (Lesson 7-4)

20. \(P(\text{red})\)  
21. \(P(\text{green or red})\)  
22. \(P(\text{orange})\)  
23. \(P(\text{not yellow})\)

24. **WEATHER** There is a 25% chance that tomorrow’s baseball game will be cancelled due to bad weather. What is the probability that the baseball game will *not* be cancelled? (Lesson 7-4)
Main IDEA
Construct sample spaces using tree diagrams or lists.

Targeted TEKS 6.9
The student uses experimental and theoretical probability to make predictions. (A) Construct sample spaces using lists and tree diagrams. (B) Find the probabilities of a simple event and its complement and describe the relationship between the two.

NEW Vocabulary
sample space
tree diagram

MOVIES A movie theater’s concession stand sign is shown.

1. List all the possible ways to choose a soft drink, a popcorn, and a candy.
2. How do you know you have accounted for all possible combinations?

The set of all possible outcomes is called the sample space. The sample space for rolling a number cube and the sample space for spinning the spinner shown are listed below.

You can make a list to determine the sample space.

EXAMPLE
Use a List to Find Sample Space

PETS The names of three bulldog puppies are shown. In how many different ways can the puppies be arranged in a row?

Make an organized list. Use A for Alex, B for Bailey, and C for Chester. Use each letter exactly once.

ABC ACB BAC BCA CAB CBA

There are 6 ways to arrange the three puppies in a row.

CHECK Your Progress

a. FOOD How many chicken and sauce combinations are possible if you can choose from crispy or grilled chicken with ranch or barbeque sauce? Make an organized list to show the sample space.

Personal Tutor at tx.msmtath.com
A tree diagram can also be used to show a sample space. A **tree diagram** is a diagram that shows all possible outcomes of an event.

**Example**

**Use a Tree Diagram to Find Sample Space**

1. Use a tree diagram to find how many outfits are possible from a choice of jean or khaki shorts and a choice of a yellow, white, or blue shirt?

   List each shorts choice. Then pair each shorts choice with each shirt choice.

   **Outcomes**

<table>
<thead>
<tr>
<th>Shorts</th>
<th>Shirt</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>jean (J)</td>
<td>yellow (Y)</td>
<td>JY</td>
</tr>
<tr>
<td>white (W)</td>
<td>JW</td>
<td></td>
</tr>
<tr>
<td>blue (B)</td>
<td>JB</td>
<td></td>
</tr>
<tr>
<td>khaki (K)</td>
<td>yellow (Y)</td>
<td>KY</td>
</tr>
<tr>
<td>white (W)</td>
<td>KW</td>
<td></td>
</tr>
<tr>
<td>blue (B)</td>
<td>KB</td>
<td></td>
</tr>
</tbody>
</table>

   There are six possible outfits.

   **Check Your Progress**

   b. Use a tree diagram to find how many different words can be made using the words *fast*, *slow*, *old*, and *young* and the suffixes -er and -est.

**Example**

**Use a Tree Diagram to Find Probability**

2. Lexi spins two spinners. What is the probability of spinning red on the first spinner and blue on the second spinner?

   Use a tree diagram to find all of the possible outcomes.

   **Spiner 1**
   
   **Spiner 2**

   The possible outcomes are RR, RB, BR, and BB. One outcome has red and then blue. Since there are four possible outcomes, \( P(\text{red, blue}) = \frac{1}{4} = 0.25 \), or 25%.

   **Check Your Progress**

   c. A penny is tossed, and a number cube is rolled. Use a tree diagram to find the probability of tossing heads and rolling a 5.
Example 1  (p. 349)  
1. **LIBRARY** How many ways can Ramiro, Garth, and Lakita line up to check out library books? Make an organized list to show the sample space.

Example 2  (p. 350)  
2. Use a tree diagram to find how many sandwich and drink combinations can be made if you can choose from a hamburger or cheeseburger with a soft drink, water, or juice.

Example 3  (p. 350)  
3. If each spinner shown is spun once, what is \( P(\text{blue, green}) \) in that order?

For Exercises 4–7, make an organized list to show the sample space for each situation.

4. **AMUSEMENT PARK** The names of three roller coasters at Six Flags over Georgia are shown. In how many different ways can Felipe and his friend ride each of the three roller coasters, one time on each roller coaster?

5. **MUSIC** In how many ways can Kame listen to 4 CDs assuming he listens to each CD once?

6. **BOOKS** Refer to the table at the right. Ms. Collins plans on buying one of the books listed for her nephew. She can also choose from yellow or green gift bags. How many book and gift bag combinations are possible?

7. **RESEARCH** Use the Internet or another source to find the fifth book on the all-time best-selling list of children’s hardcover books. How many book and gift bag combinations are possible if Ms. Collins can also choose from the fifth best-selling book?

Draw a tree diagram to show the sample space for each situation. Then tell how many outcomes are possible.

8. apple, peach, or cherry pie with milk, juice, or tea
9. nylon, leather, or mesh backpack in red, blue, gold, or black
10. roll two number cubes
11. toss a dime, quarter, and penny

**Real-World Link**

Over 14.8 million copies of *The Poky Little Puppy* have been sold.

Source: ala.org
For Exercises 12–17, a number cube is tossed, and a letter is chosen from the bag shown. Use a tree diagram to find each probability.

12. \( P(\text{prime}, E) \)  
13. \( P(\text{odd}, M) \)  
14. \( P(4, \text{vowel}) \)  
15. \( P(1 \text{ or } 6, Z) \)  
16. \( P(\text{greater than } 2, \text{ consonant}) \)  
17. \( P(\text{even}, M \text{ or } A \text{ or } Y) \)

18. **DELI** Use a tree diagram to find how many different sandwiches can be made from a choice of white or multigrain bread, a choice of ham, turkey, or roast beef, and a choice of American or provolone cheese.

19. **SCHOOL** A science quiz has one multiple-choice question with answer choices A, B, and C, and two true/false questions. Draw a tree diagram that shows all of the ways a student can answer the questions. Then find the probability of answering all three questions correctly by guessing.

For Exercises 20–22, a coin is tossed, the spinner shown is spun, and a number cube is rolled.

20. How many outcomes are possible?
21. What is \( P(\text{heads}, \text{purple}, 5) \)?
22. Find \( P(\text{tails}, \text{orange}, \text{less than } 4) \).

23. **OPEN ENDED** Describe a situation in which there are 8 possible outcomes.

24. **REASONING** A video game allows you to personalize your player’s vehicle. You can choose a vehicle, an exterior paint color, and an interior upholstery color. Determine the number of possible outcomes without using a tree diagram. Explain your reasoning.

25. **CHALLENGE** One of the bags shown is selected without looking, and then one marble is selected from the bag without looking. Draw a tree diagram showing all of the outcomes. Decide if each outcome is equally likely. Explain your reasoning.

26. **WRITING IN MATH** Each homeroom class at your school will select one boy and one girl to be homeroom representative and alternate. Recommend a method your teacher can use to determine all the possible combinations of one boy and one girl from your homeroom.
27. Claire is deciding between a red shirt and a blue shirt. The shirt also comes in small, medium, and large sizes. Which diagram shows all of the possible combinations of shirt color and size?

A

\[
\begin{array}{ccc}
\text{Red} & \text{Blue} \\
\text{Small} & \text{Medium} & \text{Large} & \text{Small} & \text{Medium} & \text{Large} \\
\end{array}
\]

B

\[
\begin{array}{ccc}
\text{Red} & \text{Blue} \\
\text{Small} & \text{Large} & \text{Medium} & \text{Large} \\
\end{array}
\]

C

\[
\begin{array}{ccc}
\text{Red} & \text{Blue} \\
\text{Small} & \text{Medium} & \text{Large} & \text{Small} & \text{Medium} & \text{Large} \\
\end{array}
\]

D

\[
\begin{array}{ccc}
\text{Small} & \text{Medium} & \text{Large} \\
\text{Red} & \text{Blue} & \text{Red} \\
\end{array}
\]

28. Joey’s Pizza Parlor offers 3 kinds of toppings and 3 sizes of pizza. Which table shows all the possible 2 topping pizzas?

F

<table>
<thead>
<tr>
<th>Size</th>
<th>Toppings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Medium</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Large</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Small</td>
<td>Cheese</td>
</tr>
<tr>
<td>Medium</td>
<td>Cheese</td>
</tr>
<tr>
<td>Large</td>
<td>Cheese</td>
</tr>
</tbody>
</table>

H

<table>
<thead>
<tr>
<th>Size</th>
<th>Toppings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Medium</td>
<td>Cheese</td>
</tr>
<tr>
<td>Large</td>
<td>Veggie</td>
</tr>
</tbody>
</table>

G

<table>
<thead>
<tr>
<th>Size</th>
<th>Toppings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Pepperoni</td>
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<tr>
<td>Small</td>
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<tr>
<td>Medium</td>
<td>Cheese</td>
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<tr>
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<td>Cheese</td>
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<tr>
<td>Medium</td>
<td>Cheese</td>
</tr>
<tr>
<td>Large</td>
<td>Veggie</td>
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<tr>
<td>Large</td>
<td>Veggie</td>
</tr>
<tr>
<td>Large</td>
<td>Veggie</td>
</tr>
</tbody>
</table>

J

<table>
<thead>
<tr>
<th>Size</th>
<th>Toppings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Small</td>
<td>Cheese</td>
</tr>
<tr>
<td>Small</td>
<td>Veggie</td>
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<tr>
<td>Medium</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Medium</td>
<td>Cheese</td>
</tr>
<tr>
<td>Medium</td>
<td>Veggie</td>
</tr>
<tr>
<td>Large</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Large</td>
<td>Cheese</td>
</tr>
<tr>
<td>Large</td>
<td>Veggie</td>
</tr>
</tbody>
</table>

29. \(P(\text{green})\)

30. \(P(\text{green or blue})\)

31. \(P(\text{red or blue})\)

32. **SNOWBOARDING** At a popular ski resort, 35% of all people who buy tickets are snowboarders. What decimal is equivalent to 35%? (Lesson 7-3)

33. \(\frac{2}{3} = \frac{8}{x}\)

34. \(\frac{k}{9} = \frac{10}{45}\)

35. \(\frac{5}{c} = \frac{30}{96}\)

36. \(\frac{15}{35} = \frac{3}{d}\)
Making Predictions

**Main IDEA**
Predict the actions of a larger group using a sample.

**Targeted TEKS 6.3**
The student solves problems involving direct proportional relationships. (C) Use ratios to make predictions in proportional situations.

6.9 The student uses experimental and theoretical probability to make predictions. (B) Find the probabilities of a simple event and its complement and describe the relationship between the two. Also addresses TEKS 6.1(B), 6.2(C), 6.3(B), 6.4(A), 6.11(D).

**NEW Vocabulary**
survey
population
sample

**Mini Lab**
In this activity, you will make a prediction about the number of left-handed or right-handed students in your school.

1. **STEP 1** Have one student in each group copy the table shown.

2. **STEP 2** Count the number of left-handed students and right-handed students in your group. Record the results.

3. **STEP 3** Predict the number of left-handed and right-handed students in your school.

4. **STEP 4** Combine your results with the other groups in your class. Make a class prediction.

1. When working in a group, how did your group predict the number of left-handed and right-handed students in your school?

2. Compare your group’s prediction with the class prediction. Which do you think is more accurate? Explain.

A survey is a method of collecting information. The group being studied is the population. Sometimes, the population is very large. To save time and money, part of the group, called a sample, is surveyed.

**Surveys** A survey has questions that require a response. The most common types of surveys are interviews, telephone surveys, or mailed surveys.

A good sample is:
- selected at random, or without preference,
- representative of the population, and
- large enough to provide accurate data.
The responses of a good sample are proportional to the responses of the population. So, you can use the results of a survey or past actions to predict the actions of a larger group.

**Make Predictions Using Proportions**

**PIZZA** Lorenzo asked every tenth student who walked into school to name his or her favorite pizza topping.

<table>
<thead>
<tr>
<th>Favorite Pizza Topping</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>pepperoni</td>
<td>17</td>
</tr>
<tr>
<td>cheese</td>
<td>8</td>
</tr>
<tr>
<td>sausage</td>
<td>3</td>
</tr>
<tr>
<td>mushroom</td>
<td>4</td>
</tr>
</tbody>
</table>

1. What was the probability that a student preferred pepperoni?

   \[
P(\text{pepperoni}) = \frac{\text{number of students that like pepperoni}}{\text{number of students surveyed}} = \frac{17}{30}
\]

   So, the probability that a student preferred pepperoni was \( \frac{17}{30} \).

2. There are 300 students at the school Lorenzo attends. Predict how many students prefer pepperoni pizza.

   Let \( s \) represent the number of students who prefer pepperoni.

   \[
   \frac{17}{30} = \frac{s}{300} \quad \text{Write a proportion.}
   \]

   \[
   \times 10 \quad \frac{17}{30} = \frac{s}{300} \quad \text{Since } 30 \times 10 = 300, \text{ multiply } 17 \text{ by } 10 \text{ to find } s.
   \]

   \[
   \frac{170}{300} \quad s = 170
   \]

   Of the 300 students, about 170 will prefer pepperoni pizza.

**INTERNET** A survey at a school found that 6 out of every 10 students have an Internet weblog.

   a. What is the probability that a student at the school has a weblog?

   b. If there are about 250 students at the school, about how many have a weblog?

**MANUFACTURING** For every 75 light bulbs produced at a light-bulb factory, 2 are defective.

   c. What is the probability that a light bulb selected at random from those produced at the plant will be defective?

   d. If a box from this plant contains 150 light bulbs, how many of these bulbs will be defective?
**FOOD** For Exercises 1 and 2, use the following information and the table shown.

Every tenth person entering a concert is asked to name his or her favorite milk shake flavor.

<table>
<thead>
<tr>
<th>Favorite Milk Shake</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>vanilla</td>
<td>30</td>
</tr>
<tr>
<td>chocolate</td>
<td>15</td>
</tr>
<tr>
<td>strawberry</td>
<td>10</td>
</tr>
<tr>
<td>mint</td>
<td>5</td>
</tr>
</tbody>
</table>

1. Find the probability that a person attending the concert prefers chocolate milk shakes.
2. Predict how many people out of 620 would prefer chocolate milk shakes.

**SOCkER** For Exercises 3 and 4, use the following information.

In soccer, Isabelle scored 4 goals in her last 10 attempts.

3. Find the probability of Isabelle scoring a goal on her next attempt.
4. Suppose Isabelle attempts to score 20 goals. About how many goals would you expect her to make?

**VIDEO GAMES** For Exercises 5 and 6, use the following information.

Luther won 12 of the last 20 video games he played.

5. Find the probability of Luther winning the next game he plays.
6. Suppose Luther plays a total of 60 games with his friends over the next month. Predict how many of these games Luther will win.

**MUSIC** For Exercises 7–10, use the table to predict the number of students out of 450 that would prefer each type of music.

<table>
<thead>
<tr>
<th>Favorite Music</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>rock</td>
<td>9</td>
</tr>
<tr>
<td>country</td>
<td>5</td>
</tr>
<tr>
<td>pop</td>
<td>2</td>
</tr>
<tr>
<td>rap</td>
<td>5</td>
</tr>
<tr>
<td>alternative</td>
<td>4</td>
</tr>
</tbody>
</table>

7. rock
8. alternative
9. country
10. pop

**VOLUNTEERING** For Exercises 11–13, use the graph.

11. About 2.8 million kids ages 10–14 live in California. Predict the number of kids that volunteer a few times a year.
12. North Carolina has about 600,000 kids ages 10–14. Predict the number of kids in this age group that volunteer once a week.
13. About 300,000 kids ages 10–14 live in South Carolina. Predict the number of kids in this age group that volunteer once a year.

**Real-World Link** In the U.S., 28.8 percent of the population volunteered at some point during 2004.

Source: U.S. Department of Labor
14. **BOOKS** The school librarian recorded the types of books students checked out on a typical day. If there are 605 students enrolled at the school, predict the number of students that prefer humor books. Compare this to the number of students at the school that prefers nonfiction.

![Types of Books Checked Out](chart)

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Type of Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Romance</td>
</tr>
<tr>
<td>13</td>
<td>Humor</td>
</tr>
<tr>
<td>15</td>
<td>Mystery</td>
</tr>
<tr>
<td>8</td>
<td>Nonfiction</td>
</tr>
<tr>
<td>13</td>
<td>Adventure</td>
</tr>
</tbody>
</table>

15. **BASKETBALL** The probability of Jaden making a free throw is 15%. Predict the number of free throws that he can expect to make if he attempts 40 free throws.

16. **FIND THE ERROR** A survey of a sixth-grade class showed that 4 out of every 10 students are taking a trip during spring break. There are 150 students in the sixth grade. Raheem and Elisa are trying to determine how many of the sixth-grade students can be expected to take a trip during spring break. Who is correct? Explain your reasoning.

![Raheem and Elisa](pictures)

17. **CHALLENGE** If the spinner is spun 400 times, predict how many times the spinner will stop on something other than yellow.

18. **OPEN ENDED** Give an example of a situation in which you would make a prediction.

19. **SELECT A TOOL** Nolan is going to listen to a CD on random mode. There are 14 songs on the CD, and 4 of them are Nolan’s favorites. Which of the following tools can Nolan use to find the probability that the first song played will be one of his favorites? Justify your selection(s). Then use the tool(s) to solve the problem.

20. **WRITING IN MATH** Three out of four of Mitch’s sixth-grade friends say that they will not attend the school dance. Based on this information, Mitch predicts that only 25 of the 100 sixth graders at his school will attend the dance. Is this a valid prediction? Explain your reasoning.
21. At the school carnival, Jesse won the balloon dart game 1 out of every 5 times he played. If he plays the game 15 more times, about how many times can he expect to win?

   A 3  
   B 4  
   C 5  
   D 15

22. **GRIDDABLE** If 7 out of 30 students are going on the ski trip, predict the number of students out of 150 that are going on the ski trip.

23. The table shows the results of a survey of sixth-grade students in the lunch line.

<table>
<thead>
<tr>
<th>Favorite Drink</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate Milk</td>
<td>15</td>
</tr>
<tr>
<td>Soda</td>
<td>12</td>
</tr>
<tr>
<td>Milk</td>
<td>6</td>
</tr>
<tr>
<td>Water</td>
<td>2</td>
</tr>
</tbody>
</table>

If there are 245 sixth graders in the school, how many can be expected to prefer chocolate milk?

F 45  
H 90  
G 84  
J 105

24. **VIDEOS** How many ways can a person watch 3 different videos? Make an organized list to show the sample space. (Lesson 7-5)

Sarah randomly turns to a page in a 12-month calendar. Find each probability. (Lesson 7-4)

25. \( P(\text{April or May}) \)  
26. \( P(\text{not June}) \)  
27. \( P(\text{begins with a J}) \)  
28. \( P(\text{begins with an M}) \)

29. **INSECTS** A mosquito’s proboscis, the part that sucks blood, is the first \( \frac{1}{3} \) of its body’s length. The rest of the mosquito is made up of the head, thorax, and abdomen. How much of a mosquito is the head, thorax, and abdomen? (Lesson 5-4)

30. \( \frac{16}{9} \)  
31. \( \frac{22}{9} \)  
32. \( \frac{35}{6} \)

33. Write each improper fraction as a mixed number. (Lesson 4-3)

34. **MONEY** About how much more is $74.50 than $29.95? (Lesson 3-4)

35. **PREREQUISITE SKILL** Chandler collected $2 from each student to buy a gift for their teacher. If one student contributed $3 extra, and a total of $59 was collected, how many students contributed? Work backward to solve the problem. (Lesson 3-6)
MAIN IDEA: Solve problems by solving a simpler problem.

TARGETED TEKS 6.11 The student applies Grade 6 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. (C) Select or develop an appropriate problem-solving strategy from a variety of different types, including... working a simpler problem... to solve a problem. Also addresses TEKS 6.11(B).

I-M: SOLVE A SIMPLER PROBLEM

YOUR MISSION: Solve a simpler problem in order to solve a given problem.

THE PROBLEM: How many students voted for the tiger for the school mascot?

ROSS: A total of 400 students voted on whether a tiger or a dolphin should be the new school’s mascot.

MARCOS: I heard that 70% of the students voted for the tiger.

EXPLORE You know the number of students that voted and that 70% of the students voted for the tiger. We need to find the number of students who voted for the tiger.

PLAN Solve a simpler problem by finding 10% of the number of students that voted and then use the result to find 70% of the number of students that voted.

SOLVE Since 10% = \( \frac{10}{100} \) or \( \frac{1}{10} \), 1 out of every 10 students voted for the tiger. 400 ÷ 10 = 40 students. Since there are seven 10% in 70%, multiply 40 by 7. 40 × 7 = 280. So, 280 students voted for the tiger.

CHECK You know that 70% is close to 75%, which is \( \frac{3}{4} \). Since \( \frac{1}{4} \) of 400 is 100, \( \frac{3}{4} \) of 400 is 300. So, 280 is a reasonable answer.

Analyze The Strategy

1. Explain when you would use the solve a simpler problem strategy.
2. Explain why the students found it simpler to work with 10%.
3. **WRITING IN MATH** Write a problem that can be solved by working a simpler problem. Then write the steps to find the solution.
Use the solve a simpler problem strategy to solve Exercises 4–6.

4. **MONEY** Kip’s mom wants to leave a 20% tip for a $19.30 restaurant bill. About how much money should she leave?

5. **GEOGRAPHY** The total area of Minnesota is 86,939 square miles. Of that, about 90% is land area. About how much of Minnesota is not land area?

6. **SCIENCE** Sound travels through air at a speed of 1,129 feet per second. At this rate, about how far will sound travel in 1 minute?

Use any strategy to solve Exercises 7–12. Some strategies are shown below.

**PROBLEM-SOLVING STRATEGIES**
- Use the four-step plan.
- Guess and check.
- Look for a pattern.
- Solve a simpler problem.

7. **WATCHES** Yuma’s watch beeps every hour. How many times will it beep in one week?

8. **BORDER** Part of a strip of border for a bulletin board is shown.

All the sections of the border are the same width. If the first shape on the strip is a triangle, and the strip is 74 inches long, what is the last shape on the strip?

9. **EXERCISE** To train for a marathon, you plan to run one mile the first week and double the number of miles each week for 6 weeks. How many miles will you run the sixth week?

10. **PATTERNS** Find the area of the sixth figure in the pattern shown.

11. **SCHOOL** Jewel’s math scores for her last four tests were 94, 87, 90, and 89. What score does she need on the next test to average a score of 91?

12. **HANDSHAKES** If a total of 10 handshakes were exchanged at a party and each person shook hands exactly once with each of the others, how many people were at the party?

For Exercises 13–15, select the appropriate operation(s) to solve the problem. Justify your selection(s) and solve the problem.

13. **VENN DIAGRAMS** The Venn diagram shows information about the members in Jared’s scout troop.

How many more members have a badge than do not have a badge?

14. **MONEY** To go on a field trip, each student must pay $6.75 for travel and $7.50 for dining. How much money must each student pay?

15. **STICKERS** Julie has 32 stickers. She plans to give each of 4 friends an equal number of the stickers. How many stickers will each person receive?
You can use a model and find a fractional part of a number. The model below shows how to find $\frac{1}{4}$ of 20.

**STEP 1** Model 20 on a piece of grid paper.

Draw a 20 $\times$ 1 rectangle.

Each section contains 5 grid squares.

**STEP 2** Divide the rectangle into 4 equal sections and shade one of them.

So, $\frac{1}{4}$ of 20 is 5.

Use grid paper to find the fractional portion of each number.

1. $\frac{1}{2}$ of 10
2. $\frac{1}{5}$ of 10
3. $\frac{2}{5}$ of 20
4. $\frac{5}{6}$ of 36

5. **MAKE A CONJECTURE** How can you find a fractional part of a number without drawing a model on grid paper?

Estimating with percents will provide a reasonable solution to many real-world problems. The table below shows some commonly used percents and their fraction equivalents.

<table>
<thead>
<tr>
<th>Percent-Fraction Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% $= \frac{1}{5}$</td>
</tr>
<tr>
<td>30% $= \frac{3}{10}$</td>
</tr>
<tr>
<td>40% $= \frac{2}{5}$</td>
</tr>
</tbody>
</table>

**Estimate the Percent of a Number**

Estimate 52% of 298.

52% is close to 50% or $\frac{1}{2}$. Round 298 to 300.

$\frac{1}{2}$ of 300 is 150.  $\frac{1}{2}$ or half means to divide by 2.

So, 52% of 298 is about 150.
2 Estimate 60% of 27.

60% is \( \frac{3}{5} \).

Round 27 to 25 since it is divisible by 5.

\( \frac{1}{5} \) of 25 is 5. \( \frac{1}{5} \) or 1 fifth means divide by 5.

So, \( \frac{3}{5} \) of 25 is \( 3 \times 5 \) or 15.

Thus, 60% of 27 is about 15.

CHECK Your Progress

Estimate each percent.

a. 48% of 76
b. 18% of 42
c. 73% of 41

3 MONEY A DVD that originally costs $15.99 is on sale for 50% off. If you have $9, would you have enough money to buy the DVD?

To determine whether you have enough money to buy the DVD, you need to estimate 50% of $15.99.

**METHOD 1** Use a proportion.

\[ 50\% = \frac{1}{2} \] and \( $15.99 \approx $16 \)

\[ \frac{1}{2} = \frac{x}{16} \] Write the proportion.

\[ \times 8 \]

\[ \frac{1}{2} = \frac{x}{16} \]

Since \( 2 \times 8 = 16 \), multiply 1 by 8.

\[ \times 8 \]

\[ x = 8 \]

**METHOD 2** Use mental math.

\[ 50\% = \frac{1}{2} \] and \( $15.99 \approx $16 \)

\( \frac{1}{2} \) of 16 is 8.

Since $8 is less than $9, you should have enough money.

**CHOOSE Your Method**

d. HIKING A group of friends went on a hiking trip. They planned to hike a total of 38 miles. They want to complete 25% of the hike by the end of the first day. About how many miles should they hike the first day?
Yutaka surveyed the students in his health class regarding their favorite juice. Which is the most likely number of students out of 353 that would prefer orange juice?

<table>
<thead>
<tr>
<th>Favorite Juice</th>
<th>Percent of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed Fruit</td>
<td>34</td>
</tr>
<tr>
<td>Apple</td>
<td>29</td>
</tr>
<tr>
<td>Orange</td>
<td>22</td>
</tr>
<tr>
<td>Grape</td>
<td>15</td>
</tr>
</tbody>
</table>

A 20
B 70
C 175
D 350

**Read the Test Item**

You need to estimate the number of students out of 353 that would prefer orange juice. 22% of the students chose orange juice.

**Solve the Test Item**

22% is about 20% or \( \frac{1}{5} \). Round 353 to 350.

\( \frac{1}{5} \) of 350 is 70.

So, about 70 students would prefer orange juice. The answer is B.

e. According to a recent survey, about 80% of sixth graders eat lunch in their school cafeteria. About how many of Westside Middle School’s 126 sixth graders eat lunch in the cafeteria?

F 50
G 80
H 100
J 125

**Estimate each percent.**

1. 19% of $53
2. 34% of 62
3. 47% of $118
4. 38% of $50
5. 59% of 16
6. 75% of 33

**TIPS** Adrienne wants to give a 20% tip to a taxi driver. If the fare is $23.78, what would be a reasonable amount to tip?

**TEST PRACTICE** Ayana surveyed several classmates about their favorite winter activity. Predict the number of students out of 164 that prefer snowboarding.

<table>
<thead>
<tr>
<th>Favorite Winter Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Skating 22%</td>
</tr>
<tr>
<td>Skiing 45%</td>
</tr>
<tr>
<td>Snowboarding 33%</td>
</tr>
</tbody>
</table>

A 30
B 54
C 75
D 100
Estimate each percent.

9. 21% of 96
10. 53% of 59
11. 19% of 72
12. 35% of 147
13. 26% of 125
14. 42% of 16
15. 79% of 82
16. 67% of 296
17. 89% of 195
18. Estimate seventy-four percent of forty-five.

19. SAVINGS  Louisa deposited 25% of the money she earned baby-sitting into
her savings account. If she earned $237.50, about how much did she
deposit into her savings account?

20. ANIMALS  Penguins spend as much as 75% of their lives in the sea. An
Emperor Penguin living in the wild has a life span of about 18 years.
About how many years does a wild Emperor Penguin spend in the sea?

21. GEOGRAPHY  The Atlantic coast has 2,069 miles of coastline. Of that, about
28% is located in Florida. About how many miles of coastline does Florida
have?

22. TESTING  If you answered 9 out of 26 problems incorrectly on a test, about
what percent of answers were correct? Explain.

23. CIRCLE GRAPHS  A group of students were
asked how they most often communicate
with their grandparents. Sketch a circle graph
of the results shown in the table.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone</td>
<td>43%</td>
</tr>
<tr>
<td>E-mail</td>
<td>32%</td>
</tr>
<tr>
<td>Letters</td>
<td>19%</td>
</tr>
<tr>
<td>Instant Messages</td>
<td>6%</td>
</tr>
</tbody>
</table>

24. FIND THE DATA  Refer to the Texas Data File
on pages 16–19. Choose some data and write a
real-world problem in which you would estimate
the percent of a number.

Estimate the percent that is shaded in each figure.

25.     26.   27.

28. CHALLENGE  Order from least to greatest 40% of 50, 50% of 50,
and $\frac{1}{2}$% of 50.

29. NUMBER SENSE  Rachel wants to buy a shirt regularly priced at $32. It is on
sale for 40% off. Rachel estimates that she will save $\frac{2}{5}$ of $30 or $12. Will the
actual amount be more or less than $12? Explain your reasoning.

30. WRITING IN MATH  A classmate is trying to estimate 42% of $122.
Explain how your classmate should solve the problem.
31. Refer to the graph. If 3,608 people were surveyed, which statement can be used to estimate the number of people that are influenced by a friend or relative when buying a CD?

![Graph showing Who Influences People Age 16–40 to Buy CDs]

- A \( \frac{1}{8} \) of 3,600 is 450.
- B \( \frac{1}{6} \) of 3,600 is 600.
- C \( \frac{1}{5} \) of 3,600 is 720.
- D \( \frac{1}{4} \) of 3,600 is 900.

32. **GRIDDABLE** In a recent survey of teens, 21% said their friends like to read and talk about books. About how many teens out of 1,095 would say their friends read and talk about books?

33. After a group of 24 parts were tested, 5 were found to be defective. About what percent of the parts tested were defective?

- F 5%
- G 20%
- H 25%
- J 33%

34. The volleyball team played 20 games this season. If they won 78% of their games, about how many games did they win?

- A 7
- B 10
- C 16
- D 20

35. **GYMS** Every 12th person entering the gym on Saturday will receive a free T-shirt. How many T-shirts will be given away if 190 people go to the gym on Saturday? (Lesson 7-7)

36. **GLASSES** In Mr. Cardona’s second period class, 9 out of the 20 students wear glasses. If Mr. Cardona has 100 students, predict the number of his students who wear glasses. (Lesson 7-6)

Express each decimal as a percent. (Lesson 7-3)

- 37. 0.45
- 38. 0.02
- 39. 0.362
- 40. 0.058

**Cross-Curricular Project**

**Math and Physical Education**

**Take Me Out to the Ballgame** It’s time to complete your project. Use the scale drawing you’ve created and the data you have gathered about your baseball teams to prepare a Web page or poster. Be sure to include a spreadsheet with your project.

Cross-Curricular Project at tx.msmath1.com
Key Concepts

Percent (Lesson 7-1)

- A percent is a ratio that compares a number to 100.

Percent Conversions (Lessons 7-1 and 7-3)

- To write a percent as a fraction, write the percent as a fraction with a denominator of 100. Then simplify.
- To write a percent as a decimal, rewrite the percent as a fraction with a denominator of 100. Then write the fraction as a decimal.
- To write a decimal as a percent, write the decimal as a fraction whose denominator is 100. Then write the fraction as a percent.

Probability (Lesson 7-4)

- The probability of an event is a ratio that compares the number of favorable outcomes to the number of possible outcomes.

Percent-Fraction Equivalents (Lesson 7-8)

- $20\% = \frac{1}{5}$  $50\% = \frac{1}{2}$  $80\% = \frac{4}{5}$
- $25\% = \frac{1}{4}$  $33\frac{1}{3}\% = \frac{1}{3}$  $30\% = \frac{3}{10}$
- $60\% = \frac{3}{5}$  $90\% = \frac{9}{10}$  $75\% = \frac{3}{4}$
- $66\frac{2}{3}\% = \frac{2}{3}$  $40\% = \frac{2}{5}$  $70\% = \frac{7}{10}$
- $100\% = 1$

Vocabulary Check

State whether each sentence is true or false. If false, replace the underlined word or number to make a true sentence.

1. An organized list that is used to show all of the possible outcomes is called a survey.
2. A percent is a ratio that compares a number to 10.
3. A ratio that compares the number of favorable outcomes to the number of possible outcomes is the probability of an event.
4. If an event is certain to occur, the probability of that event is 0.
5. Two events in which either one or the other must happen, but cannot happen at the same time are called random.
6. In tossing a coin, the notation $P(tails)$ denotes the probability that the coin will land on tails.
Lesson-by-Lesson Review

7-1 Percents and Fractions (pp. 325–329)

Write each percent as a fraction or mixed number in simplest form.

7. 3% 8. 48% 9. 120%

Write each fraction as a percent.

10. \(\frac{7}{8}\) 11. \(\frac{3}{5}\) 12. \(\frac{19}{100}\)

13. DESERTS One third of Earth’s land surface is covered by desert and about 13% of the world’s population live in a desert area. Write the percent of the world’s population that live in a desert area as a fraction in simplest form.

Example 1 Write 24% as a fraction in simplest form.

\[24\% = \frac{24}{100}\]

Definition of percent

\[= \frac{6}{25}\]

Simplify. Divide numerator and denominator by the GCF, 4.

Example 2 Write \(\frac{3}{5}\) as a percent.

\[\frac{3}{5} = \frac{n}{100}\]

Write a proportion.

\[\times 20\]

\[\frac{3}{5} = \frac{60}{100}\]

Since \(5 \times 20 = 100\), multiply 3 by 20 to find \(n\).

\[\times 20\]

So, \(\frac{3}{5} = 60\%\).

7-2 Circle Graphs (pp. 330–335)

14. MOVIES A group of adults were asked to name their favorite type of movie. The results are shown in the table. Sketch a circle graph of the data.

<table>
<thead>
<tr>
<th>Type of Movie</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comedy</td>
<td>40</td>
</tr>
<tr>
<td>Action</td>
<td>25</td>
</tr>
<tr>
<td>Drama</td>
<td>25</td>
</tr>
<tr>
<td>Romance</td>
<td>10</td>
</tr>
</tbody>
</table>

For Exercises 15–17, refer to the circle graph from Exercise 14.

15. Which type of movie did the adults say is their favorite?

16. Which two sections represent the responses by the same amount of adults?

17. How does the number of adults that say their favorite type of movie is comedy compare to the number of adults that say their favorite type of movie is romance?

Example 3 In Mr. Finn’s class, 54% of the students favor chocolate muffins, 23% favor blueberry, and 23% favor banana. Sketch a circle graph of the data.

Use a compass to draw a circle with at least a 1-inch radius.

Since 23% is a little less than 25% or \(\frac{1}{4}\), shade a little less than \(\frac{1}{4}\) of the circle for “Banana.” Do the same for “Blueberry.” The remaining section is “Chocolate.”

Label each section of the graph. Then give the graph a title.
**7-3 Percents and Decimals (pp. 337–340)**

Write each percent as a decimal.

18. 2%  
19. 38%  
20. 140%  
21. 90%

Write each decimal as a percent.

22. 0.03  
23. 1.3  
24. 1.75  
25. 0.51

26. **BREAD** A slice of bread is 30% water. Write this as a decimal.

**Example 4**

Write 46% as a decimal.

\[ 46\% = \frac{46}{100} = 0.46 \]

Write 46 hundredths as a decimal.

**Example 5**

Write 0.85 as a percent.

\[ 0.85 = \frac{85}{100} \]

Write 85 hundredths as a fraction.

Write the fraction as a percent.

---

**7-4 Probability (pp. 341–345)**

One coin shown is chosen without looking. Find each probability. Write each answer as a fraction, a decimal, and a percent.

27. \( P(\text{nickel}) \)  
28. \( P(\text{not dime}) \)  
29. \( P(\text{quarter or penny}) \)  
30. \( P(\text{nickel or dime}) \)

A number cube is rolled. Find each probability. Write each answer as a fraction.

31. \( P(5) \)  
32. \( P(\text{less than 4}) \)  
33. \( P(\text{odd}) \)  
34. \( P(\text{at least 5}) \)

35. **SOCKS** A drawer contains 14 unorganized socks of which 4 are black, 2 are brown, 2 are blue, and the rest are white. Find the probability of randomly selecting a white sock.

36. **WEATHER** There is a 78% chance of rain. Identify the complement of this event. Then find its probability.

**Example 6** The spinner shown is spun once. Find the probability of landing on one of the colors in the United States flag.

There are six equally likely outcomes on the spinner. Three of the colors appear in the United States flag. Those colors are red, white, and blue.

\[ P(\text{red, white, or blue}) = \frac{3}{6} = \frac{1}{2} \]

So, \( P(\text{red, white, or blue}) \) is \( \frac{1}{2} \), 0.5, or 50%.

**Example 7** Refer to Example 6.

Identify the complement of landing on red. Then find the probability.

The complement of landing on “red” is not landing on red. The sum of the probabilities is 1.

\[ P(\text{red}) + P(\text{not red}) = 1 \]

\[ \frac{1}{6} + P(\text{not red}) = 1 \]

\[ P(\text{red}) = \frac{1}{6} \]

\[ \frac{1}{6} + \frac{5}{6} = 1 \]

So, \( P(\text{not red}) \) is \( \frac{5}{6} \).
Sample Spaces (pp. 349–353)

For Exercises 37 and 38, make an organized list to show the sample space for the situation. Then tell how many outcomes are possible.

37. A choice of black or blue jeans in classic fit, stretch, or bootcut style
38. A choice of comedy, action, horror, or science fiction DVD in widescreen or full screen format

Example 8 Suppose you have a choice of a sugar cone (S) or a waffle cone (W) and blueberry (B), mint (M), or peach (P) yogurt. How many yogurt cones are possible?

Use a tree diagram.

<table>
<thead>
<tr>
<th>Cone</th>
<th>Yogurt</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>S</td>
<td>SB</td>
</tr>
<tr>
<td>S</td>
<td>M</td>
<td>SM</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>SP</td>
</tr>
<tr>
<td>W</td>
<td>B</td>
<td>WB</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>WM</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>WP</td>
</tr>
</tbody>
</table>

There are 6 possible cones.

Making Predictions (pp. 354–358)

SCHOOL NEWSPAPER For Exercises 43 and 44, use the following information.

Out of 40 students, 14 are interested in publishing a school newspaper.
43. What is the probability that a student at this school would be interested in publishing a school newspaper?
44. If there are 420 students, how many would you expect to be interested in publishing a school newspaper?

Example 9 If 12 out of 50 people surveyed watch TV after 11 P.M., how many people out of 1,000 would you expect to watch TV after 11 P.M.?

Let \( p \) represent the number of people who watch TV after 11 P.M.

\[
\frac{12}{50} = \frac{p}{1,000}
\]

Write the proportion.

\[
\times 20 \quad \frac{12}{50} \times 20 = \frac{240}{1,000}
\]

Since \( 50 \times 20 = 1,000 \), multiply 12 by 20 to find \( p \).

So, of the 1,000 people, you would expect 240 to watch TV after 11 P.M.
PSI: Solve a Simpler Problem  (pp. 359–360)

Solve. Use the solve a simpler problem strategy.

45. TABLES  The cafeteria has 45 square tables that can be pushed together to form one long table for the lacrosse team’s banquet. Each square table can seat one person on each side. How many people can be seated at the banquet table?

46. RAINFALL  In one year, Orlando received 62.51 inches of rain. In September, the city received 25% of that rainfall. About how much rain did Orlando receive in September?

Example 10  In May, Marisol had earned $240 from baby-sitting. She wants to save 70% of this amount to put toward a new laptop. How much money does she need to save?

Solve a simpler problem.

\[ \text{10\% of } 240 = \frac{1}{10} \text{ of } 240 = \frac{10}{10} = 24 \]

Since 70% is 7 \cdot 10\%, multiply $24 by 7. So, Marisol needs to save 7 \cdot $24 or $168.

Estimating with Percents  (pp. 361–365)

Estimate each percent.

47. 40\% of 78  
48. 73\% of 20  
49. 25\% of 122  
50. 19\% of 99  
51. 48\% of 48  
52. 41\% of 243

53. POPULATION  According to the 2000 Census, about 28.2\% of Texans were under 18 years old. If the population of Texas was estimated at 20,851,820, about how many Texans were under 18 years old?

54. SAVINGS  Sofia wants to save 30\% of her paycheck. If her paycheck is $347.89, what would be a reasonable amount for her to save?

55. SCHOOL UNIFORMS  According to a recent national survey, about 83\% of teens oppose school uniforms. Predict the number of teens out of 2,979 that would not oppose school uniforms.

Example 11  Estimate 33\% of 60.

33\% is close to 33\frac{1}{3}\% or \frac{1}{3}.

\[ \frac{1}{3} \text{ of } 60 \text{ is } 20. \]

So, 33\% of 60 is about 20.

Example 12  When the library surveyed the entire school regarding their favorite type of magazine, about 28\% of the students preferred sports magazines. Predict the number of students out of 1,510 that would prefer sports magazines.

28\% of the students preferred sports.

28\% is about 30\% or \frac{3}{10}.

Round 1,510 to 1,500.

\[ \frac{1}{10} \text{ of } 1,500 \text{ is } 150. \text{ So, } \frac{3}{10} \text{ of } 1,500 \text{ is } 3 \cdot 150 \text{ or } 450. \]

So, about 450 students would prefer sports magazines.
CHAP TER 7

Practice Test

Write each percent as a fraction or mixed number in simplest form.
1. 42%  
2. 110%  
3. 18%

Write each fraction as a percent.
4. \( \frac{2}{5} \)  
5. \( \frac{11}{20} \)  
6. \( 1 \frac{1}{2} \)

7. TEST PRACTICE Eighty-five percent of the students dressed up for spirit week. What fractional part of the student body did NOT dress up for spirit week?
   A \( \frac{17}{20} \)  
   B \( \frac{3}{20} \)  
   C \( \frac{1}{85} \)  
   D \( \frac{1}{5} \)

VEGETABLES For Exercises 8 and 9, refer to the circle graph.

8. Which vegetable is most frequently named as favorite?
9. How do peas compare to corn as a favorite vegetable?

Express each decimal as a percent.
10. 0.3  
11. 0.87  
12. 1.49

A set of 20 cards is numbered 1–20. One card is chosen without looking. Find each probability. Write each probability as a fraction, a decimal, and a percent.
13. \( P(8) \)
14. \( P(3 \text{ or } 10) \)
15. \( P(\text{prime}) \)
16. \( P(\text{not odd}) \)

FOOD For Exercises 17 and 18, use the following information.
A food cart offers a choice of iced tea or soda and nachos, popcorn, or pretzels.
17. Draw a tree diagram that shows all of the choices for a beverage and a snack.
18. Find the probability that the next customer who orders a beverage and a snack will choose iced tea and popcorn.

SPORTS For Exercises 19 and 20, use the table below and the following information.
Alonso asked every fourth sixth-grade student who walked into a school dance to name his or her favorite sport.

<table>
<thead>
<tr>
<th>Favorite Vegetable</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green beans</td>
<td>25%</td>
</tr>
<tr>
<td>Carrots</td>
<td>8%</td>
</tr>
<tr>
<td>Peas</td>
<td>17%</td>
</tr>
<tr>
<td>Corn</td>
<td>33%</td>
</tr>
</tbody>
</table>

19. Find the probability a student prefers football.
20. If there are 375 students in the sixth grade, how many can be expected to prefer football?

21. TEST PRACTICE Jose was outside practicing free throws. He has made 10 out of 12 shots. If he shoots 24 more free throws, about how many of these free throws can he expect to make?
   F 30  
   G 28  
   H 24  
   J 20

Estimate each percent.
22. 19% of 51  
23. 49% of 26  
24. 77% of 51  
25. 69% of 203

MathOnilge Chapter Test at tx.msmath1.com

Chapter 7 Practice Test 371
Read each question. Then fill in the correct answer on the answer document provided by your teacher or on a sheet of paper.

1. The cost of renting a speed boat is $25 plus an additional fee of $12 for each hour that the boat is rented. Which equation can be used to find $c$, the cost in dollars for the rental for $h$ hours?
   A $c = 12h + 25$
   B $c = 25h + 12$
   C $c = 12(h + 25)$
   D $c = 25(h + 12)$

2. A jar contains 4 oatmeal cookies, 9 chocolate chip cookies, 3 sugar cookies, and 4 peanut butter cookies. If you draw a cookie at random from the jar, what is the probability that you will NOT draw a sugar cookie?
   F $\frac{2}{5}$
   G $\frac{3}{4}$
   H $\frac{3}{20}$
   J $\frac{17}{20}$

3. **GRIDDABLE** A bakery offers 5 kinds of muffins and 4 kinds of coffee. How many possible combinations of muffins and coffee are available at the bakery?

4. There were 6 buses and 150 people signed up for the field trip. What is the ratio of people to buses?
   A 1:25
   B 25:1
   C 6:150
   D 150:6

5. Mrs. Patterson has 28 yards of fabric. She needs a certain amount of fabric for a bedspread and bedskirt. Mrs. Patterson wants to find the number of yards of fabric she will have left for curtains.

   Look at the problem-solving steps shown below. Arrange the steps in the correct order to find the number of yards of fabric Mrs. Patterson will have left for curtains.

   - Step R: Find the sum of the yards needed for the bedspread and the bedskirt.
   - Step S: Find the difference between 28 and the sum of the yards needed for the bedspread and the bedskirt.
   - Step T: Identify the number of yards needed for the bedspread and the bedskirt.

   Which list shows the steps in the correct order?
   F R, S, T
   H T, S, R
   G T, R, S
   J S, R, T

6. Which statement best describes the data shown in the line graph?

   - A The greatest decrease in the number of cell phones sold was from Day 5 to Day 6.
   - B The number of cell phones sold on Day 7 can be expected to be 20.
   - C The greatest increase in the number of cell phones sold was from Day 4 to Day 5.
   - D The number of cell phones sold increased each day.
7. Guillermo went to the hardware store. He bought paint for $28.75, paint brushes for $13.50, and masking tape for $2.95. If the total cost was $48.57, which procedure could be used to find the amount of tax Guillermo paid?

F Divide the total cost by the sum of the prices of the items.
G Multiply the total cost by the sum of the prices of the items.
H Add the total cost and the sum of the prices of the items.
J Subtract the sum of the prices of the items from the total cost.

8. Sanford’s Shoe Store received a shipment of shoes for its newest location. The manager determined that 35% of the shoes were athletic shoes. What fraction of the shoes were athletic shoes?

A \( \frac{7}{20} \)
B \( \frac{1}{6} \)
C \( \frac{3}{8} \)
D \( \frac{13}{20} \)

9. A class of 26 students ordered 27 doughnuts for $1.25 each, 5 gallons of orange juice for $1.99 each, and a package of napkins for $1.25. If the class agreed to split the cost evenly, which equation can be used to find \( t \), the amount each student should pay?

F \[ t = 27(1.25) + 5(1.99) + 1.25 \]
G \[ t = \left(27 \times 1.25 + 5 \times 1.99 + 1.25\right) ÷ 26 \]
H \[ t = \left(27 \times 1.25 + 5 \times 1.99 + 1.25\right) ÷ 27 \]
J \[ t = 26 \times 1.25 + 5 \times 1.99 + 1.25 ÷ 26 \]

10. **GRIDDABLE** Cindy planted 4 flowers in 9 minutes. About how many flowers can Cindy plant in 36 minutes?

11. In a piggy bank there are 9 dimes, 13 pennies, 6 nickels, and 7 quarters. If a coin is selected at random from the piggy bank, what is the probability that a quarter will be drawn?

A \( \frac{4}{5} \)
B \( \frac{5}{7} \)
C \( \frac{28}{35} \)
D \( \frac{1}{5} \)

12. Michelle can select her lunch from the following menu.

<table>
<thead>
<tr>
<th>Sandwich</th>
<th>Drink</th>
<th>Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>cheese</td>
<td>apple juice</td>
<td>apple</td>
</tr>
<tr>
<td>ham</td>
<td>milk</td>
<td>banana</td>
</tr>
<tr>
<td>tuna</td>
<td>orange juice</td>
<td>pear</td>
</tr>
</tbody>
</table>

a. What are the possible combinations of one sandwich, one drink, and one piece of fruit Michelle can choose? Show these combinations in a tree diagram.
b. If the tuna sandwich were removed from the menu, how many fewer lunch choices would Michelle have?
c. If an orange is added to the original menu, how many lunch combinations will there be?
d. If Michelle chooses a lunch at random, what is the probability that it will contain a ham sandwich, milk, and an apple or a pear?