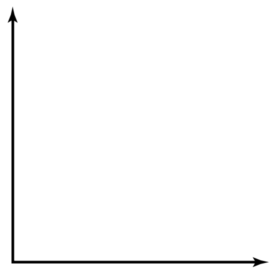
SKILL 1

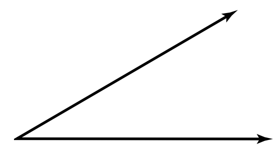
Name ______________________ Date __________

Classifying Angles

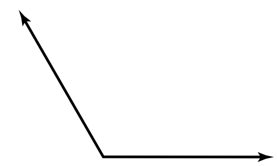
An **angle** is formed by two rays with a common endpoint called the vertex. Angles are measured in degrees. Angles are classified according their measure.



Right angles measure 90°.



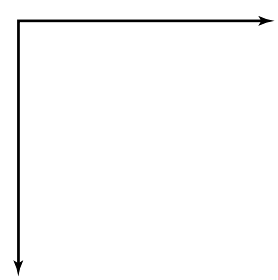
Acute angles measure between 0° and 90°.



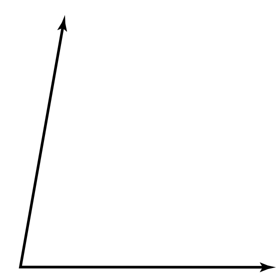
Obtuse angles measure between 90° and 180°.

EXAMPLE *Classify each angle.*

This angle is an obtuse angle.



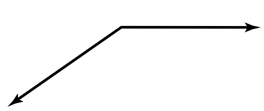
This angle is a right angle.



This angle is an acute angle.

EXERCISES *Classify each angle as right, acute, or obtuse.*

1.



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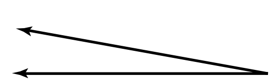

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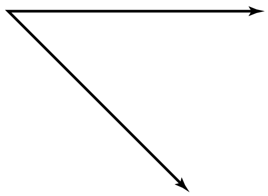
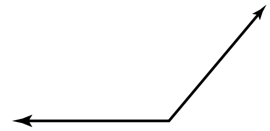
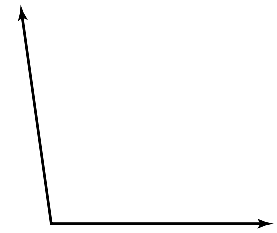
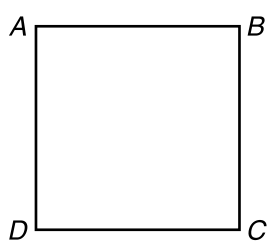
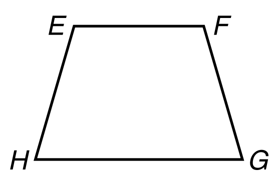
4. 

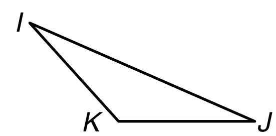
5. 

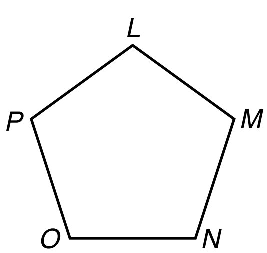
6. 

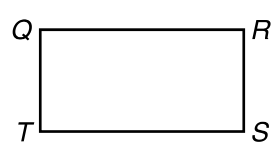
Classify the angles found in each polygon.

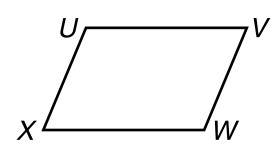
7. 

8. 

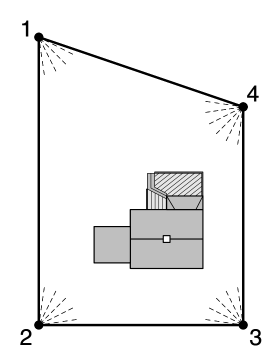
9. 

10. 

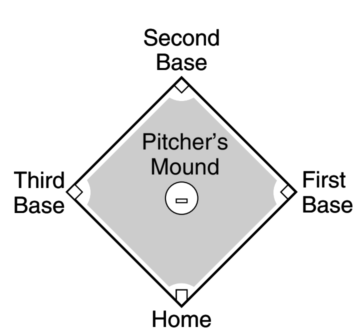
11. 

12. 

APPLICATIONS



13. A diagram of Tara's lawn is shown at the right. Tara plans to place a sprinkler at each corner of the lawn. What type of angle should she set the spray for each sprinkler?



14. A diagram of a baseball field is shown at the right. What type of angle is formed from a ball thrown from first base to second base to third base?

15. What type of angle is formed by a ball thrown from the pitcher to the catcher to the first baseman?

SKILL 2

Name ______________________________ Date ____________

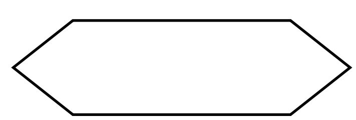
Polygons

Polygons are closed figures formed by line segments called sides. They are classified by their number of sides.

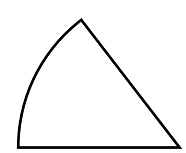
Polygon	Number of Sides
Triangle	3
Quadrilateral	4
Pentagon	5
Hexagon	6
Octagon	8

Regular polygons are polygons in which all sides are the same length and all the angles are the same size.

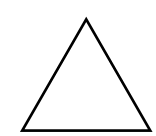
EXAMPLE ***Determine if each figure is a polygon. If the figure is a polygon, classify the polygon by the number of sides and as regular or not regular.***



This figure is a polygon with six sides. It is a hexagon. It is *not* a regular polygon.

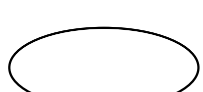


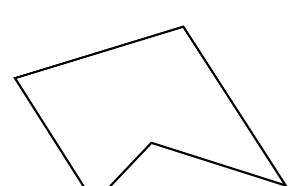
This figure is not a polygon since one of the sides is a curve.

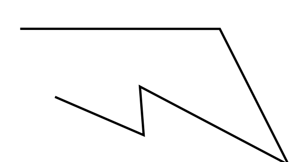


This figure is a polygon with three sides. It is a triangle. It is a regular polygon.

EXERCISES ***Tell whether each figure is a polygon. State* yes *or* no.**

1. 

2. 

3. 

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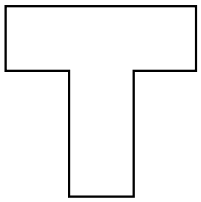
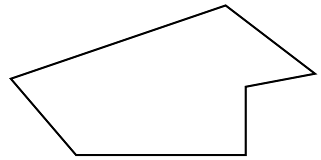


5.



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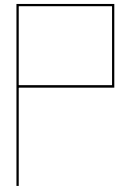
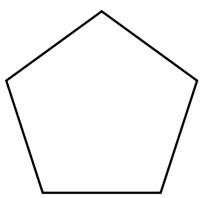


Classify each polygon by the number of sides and as regular or not regular.

7.



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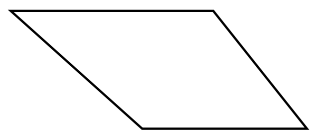

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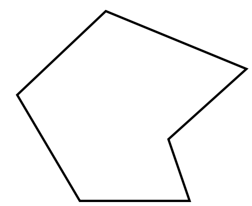

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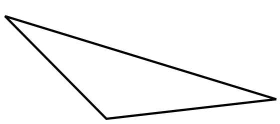

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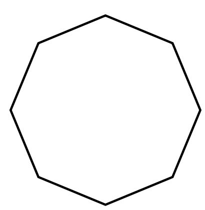
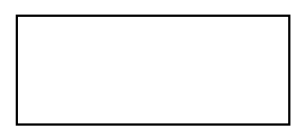
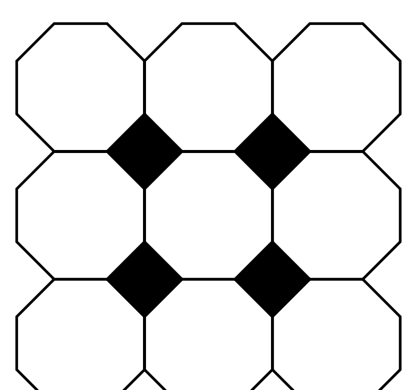


12.



APPLICATIONS

13. A tile pattern is shown at the right. Name the polygons in the pattern.



14. Find a picture of some interesting architecture. Name some examples of polygons in the picture.

15. Draw a picture or design by using various polygons.

SKILL 3

Name ______________________ Date __________

Triangles and Quadrilaterals

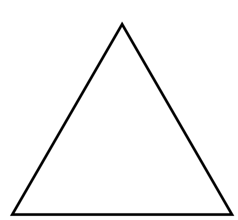
Triangles may be classified by the measures of their angles or by the lengths of their sides.

Triangles			
Classification by Angles		**Classification by Sides**	
Acute	all angles acute	Scalene	all sides different lengths
Right	one right angle	Isosceles	two sides the same length
Obtuse	one obtuse angle	Equilateral	three sides the same length

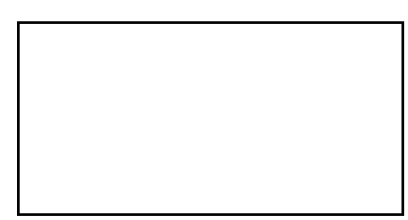
Sides and angles are also used to classify quadrilaterals.

Quadrilaterals	
Trapezoid	only one pair of parallel sides
Parallelogram	both pairs of opposite sides parallel
Rectangle	parallelogram with four right angles
Rhombus	parallelogram with four sides the same length
Square	parallelogram with four right angles and four sides the same length

EXAMPLE ***Identify each polygon.***

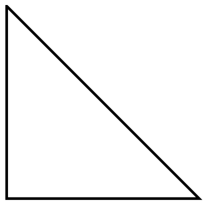


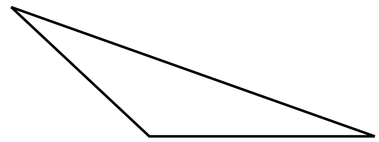
All of the angles are acute and all of the sides are the the same length. This triangle is acute and equilateral.

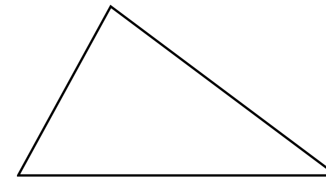


There are two pairs of parallel sides and four right angles. This quadrilateral is a rectangle.

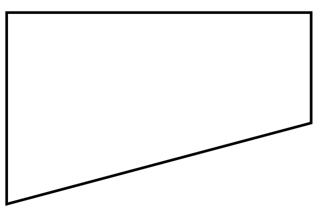
EXERCISES ***Classify each triangle by its sides and by its angles.***

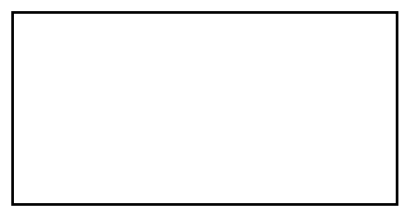
1. 

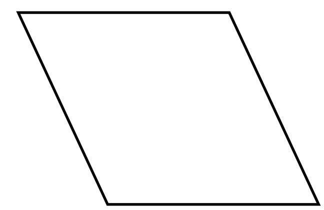
2. 

3. 

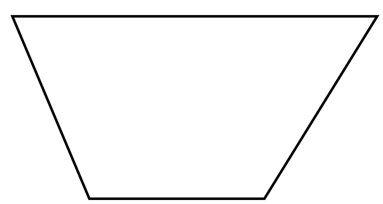
Name every quadrilateral that describes each figure. Then state which name best describes the figure.

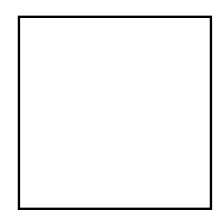
4. 

5. 

6. 

7. 

8. 

9. 

APPLICATIONS ***Find two examples of each figure in your school or home.***

10. square
11. equilateral triangle
12. parallelogram
13. rectangle
14. right scalene triangle
15. trapezoid
16. acute isosceles triangle
17. rhombus
18. obtuse scalene triangle

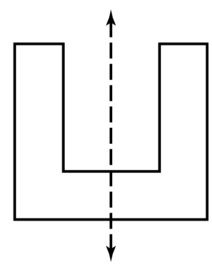
SKILL 4

Name ______________________ Date ____________

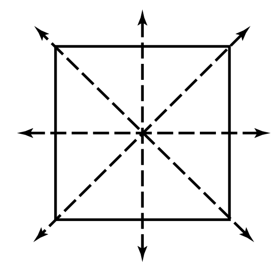
Line Symmetry

If a figure can be folded in half so that the two halves match exactly, the figure has a line of symmetry.

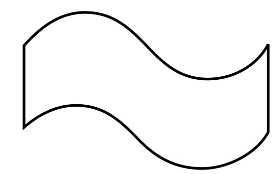
EXAMPLE ***Draw all lines of symmetry for each figure.***



one line of symmetry



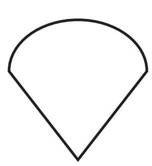
four lines of symmetry



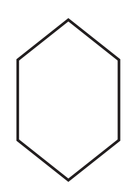
no lines of symmetry

EXERCISES ***Draw all lines of symmetry for each figure.***

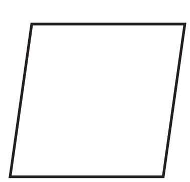
1.



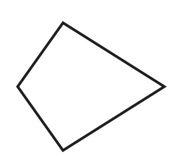
2.



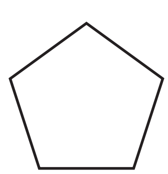
3.



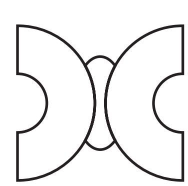
4.



5.

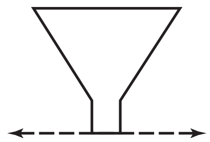


6.

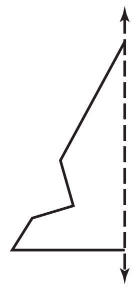


Complete each figure so that the dashed line is a line of symmetry.

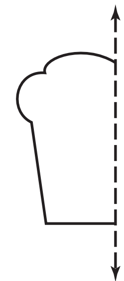
7.



8.

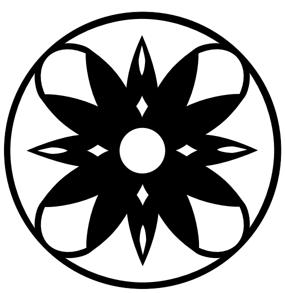


9.

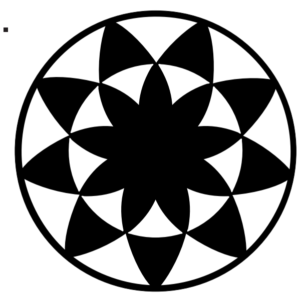


APPLICATIONS *The following are designs from Navaho baskets. Determine the number of lines of symmetry for each of the designs.*

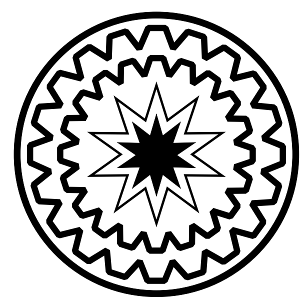
10.



11.



12.



Printers use many fonts or styles of type. For Exercises 13–16, consider block capital letters.

13. List the letters that have a vertical line of symmetry.

14. List the letters that have a horizontal line of symmetry.

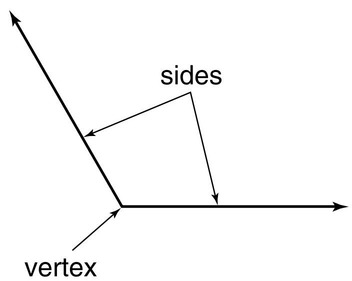
15. List the letters that have no line of symmetry.

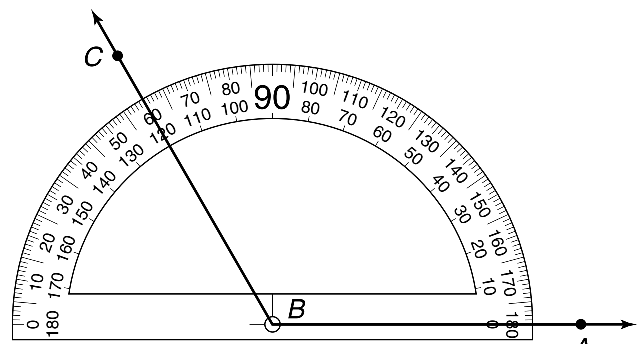
16. List the letters that have more than one line of symmetry.

Name ______________________ **Date** __________

Measuring Angles

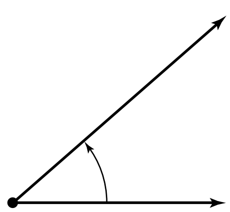
To measure an angle, place the center of a protractor on the vertex of the angle. Place the zero mark of the scale along one side of the angle. Read the angle measure where the other side of the angle crosses the scale.



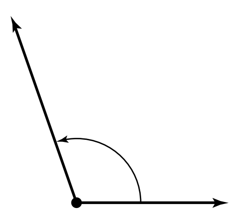


This angle measures 120°.

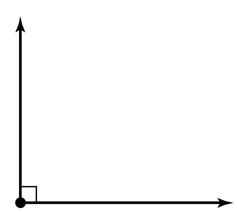
Angles may be classified according to their measure.



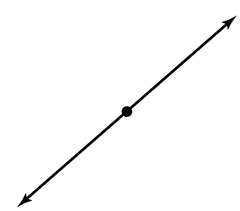
Acute angles measure between 0° and 90°.



Obtuse angles measure between 90° and 180°.



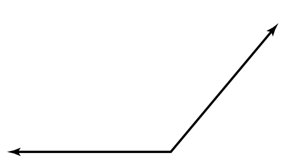
Right angles measure 90°.



Straight angles measure 180°.

EXERCISES ***Classify each angle as acute, right, or obtuse.***

1.



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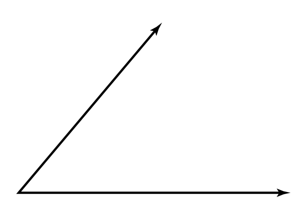

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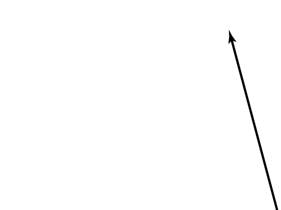

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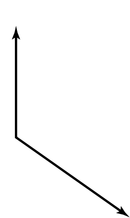

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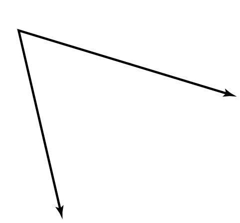
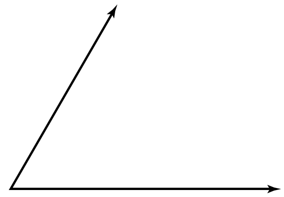
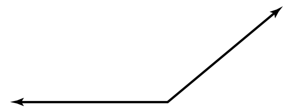


Use a protractor to find the measure of each angle.

7. 

8. 

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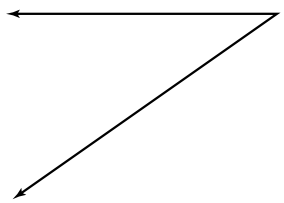
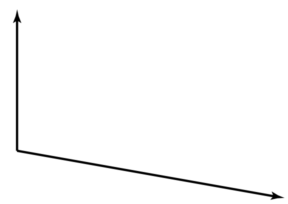
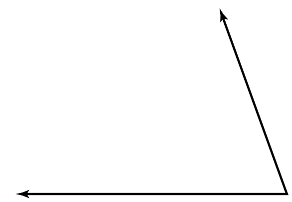
10. 

11. 

12. 

Classify angles having each measure as acute, right, obtuse, or straight.

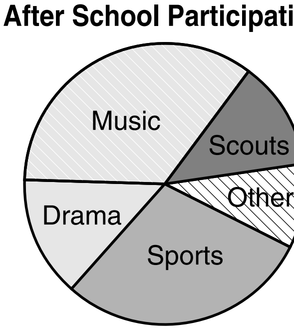
13. 47° **14.** 95° **15.** 180° **16.** 82.9°

17. 90° **18.** 153° **19.** 179° **20.** 25°

APPLICATIONS

21. The circle graph at the right shows the after-school participation of seventh grade students at Moore Middle School. Use the measure of the angles to order the activities from greatest to least involvement.

After School Participation



22. Without a protractor, draw your best estimate of an angle measuring 105°. Check your estimate with a protractor.

SKILL 6

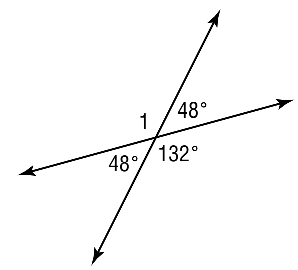
Name ______________________ **Date** ____________

Angle Relationships

When two lines intersect, they form two pairs of opposite angles called vertical angles. Vertical angles have the same measure and are therefore congruent.

EXAMPLE ***Find m∠1.***

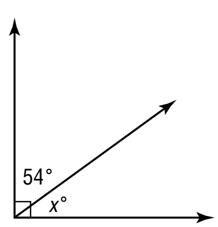
Angle 1 and the angle whose measure is 132° are vertical angles. Therefore, they are congruent.



Thus, $m\angle 1 = 132°$.

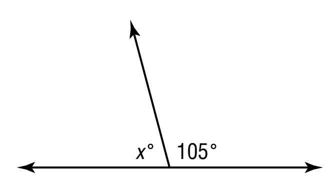
Two angles are **complementary** if the sum of their measures is 90°. Two angles are **supplementary** if the sum of their measures is 180°.

EXAMPLES ***Find x in each figure.***



The two angles form a right angle, which measures 90°. Therefore, the angles are complementary.

$$54 + x = 90$$
$$54 + x - 54 = 90 - 54$$
$$x = 36$$



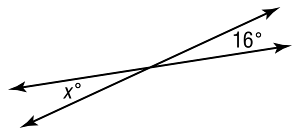
The two angles form a straight line, which measures 180°. Therefore, the angles are supplementary.

$$x + 105 = 180$$
$$x + 105 - 105 = 180 - 105$$
$$x = 75$$

EXERCISES

Find the value of x in each figure.

1.



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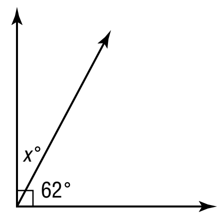

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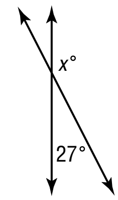

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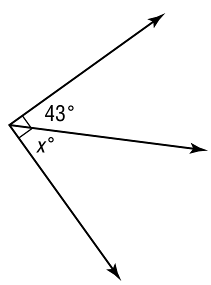

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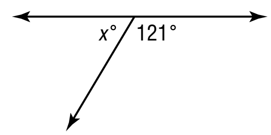

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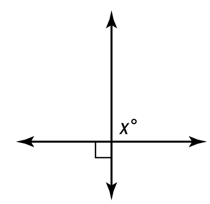


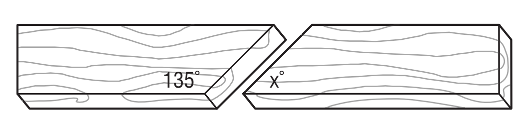
7. Angles A and B are vertical angles. If $m\angle A = 63°$ and $m\angle B = (x + 15)°$, find the value of x.

8. Angles P and Q are supplementary angles. If $m\angle \text{P} = (x - 25)°$ and $m\angle \text{Q} = 102°$, find the value of x.

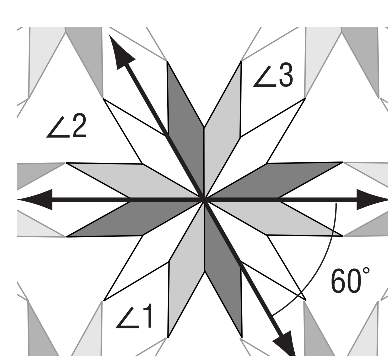
9. Angles Y and Z are complementary. If $M\angle Y = (4x + 2)°$ and $m\angle Z = (5x - 2)°$, find the value of x.

APPLICATIONS

10. A carpenter uses a power saw to cut a piece of lumber at a 135° angle. What is the measure of the other angle formed by the cut?



11. Megan is making a quilt using the pattern shown at the right.



a. What is $m\angle 1$?

b. What is $m\angle 2$?

c. What is $m\angle 3$?

SKILL 7

Name ______________________ Date __________

Circumference of Circles

The formula for the **circumference** of a circle is $C = \pi d$ where C is the circumference and d is the diameter.

EXAMPLE

The diameter of a Ferris wheel at the amusement park is 15 meters. How far does a seat on the Ferris wheel travel in one revolution?

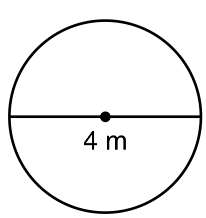
To find the distance traveled by a seat in one revolution, find the circumference of the Ferris wheel. Use the formula $C = \pi d$. Substitute 3.14 for π and 15 for d.

$$C = \pi d$$
$$C \approx 3.14 \cdot 15$$
$$C \approx 47.1$$

The circumference of the Ferris wheel is about 47.1 meters. Thus, a seat travels about 47.1 meters in one revolution.

EXERCISES

In Exercises 1–12, find the circumference of each circle shown or described. Use 3.14 for π.

1.


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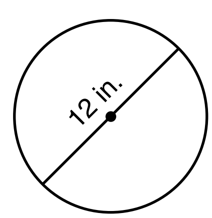

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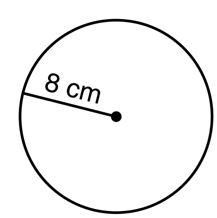

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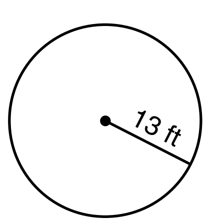

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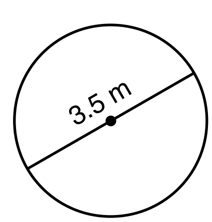

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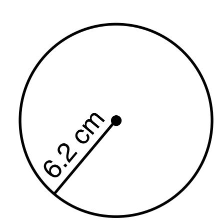


7. The diameter is 16.4 km.

8. The radius is 0.5 m.

9. The radius is 17 ft.

10. The diameter is 4.7 in.

11. **The radius is 1.3 cm.**

12. The diameter is 10 in.

APPLICATIONS ***The Castle Garden is a national monument on Manhattan Island in New York City. It was originally built by the Dutch in the seventeenth century to be used as a fort. It has a diameter of about 236 feet. Use this information to answer Exercises 13–15.***

13. Suppose you are standing in the center of Castle Garden and you walk toward a wall. How far will you walk?

14. You decide to walk completely around the outside wall. How far will you walk, to the nearest foot?

15. You decide to keep walking around the outside wall. About how many times will you need to walk around the wall to walk 1 mile? (Hint: 1 mile = 5,280 feet)

16. The distance around Earth at the equator is about 25,000 miles. What is the approximate diameter of Earth at the equator, to the nearest mile?

17. Ted's town is planning on putting in a bicycle path at the local park. They want the path to be 400 meters long and circular. What should the radius be of the circle formed by the path, to the nearest meter?

SKILL 8

Name ______________________________ Date ____________

Perimeter of Rectangles, Squares, and Parallelograms

The **perimeter** of a figure is the distance around the figure.

EXAMPLE ***Determine how much fence will enclose a rectangular yard with a length of 50 feet and a width of 63 feet.***

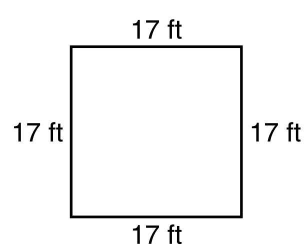
To find the perimeter of a figure, add the measures of its sides.

$$P = 50 + 50 + 63 + 63 \text{ or } 226$$

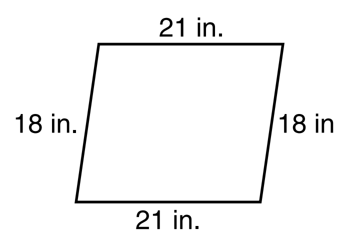
The perimeter or amount of fence needed is 226 feet.

EXERCISES ***Find the perimeter of each figure shown or described below.***

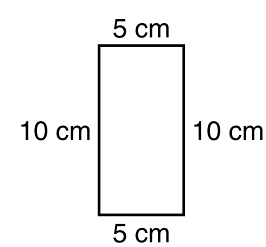
1.



2.



3.



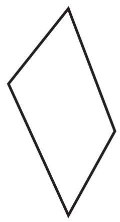
4. rectangle:
$\ell = 3.5$ m
$w = 4$ m

5. square:
$s = 2.5$ in.

6. rectangle:
$\ell = 12.75$ ft
$w = 8.5$ ft

Measure each figure to find the perimeter. Measure to the nearest fourth inch.

7.



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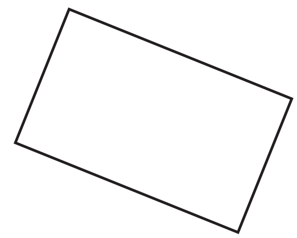

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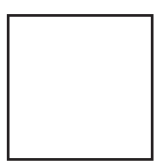


10.

APPLICATIONS

11. A rectangular room is 12 feet long by 9.5 feet wide. How many feet of wallpaper border are needed to put a border around the room?

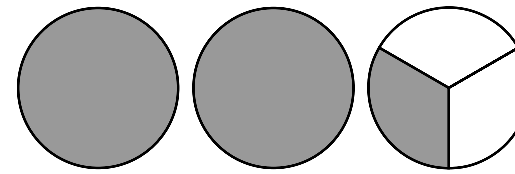
12. Mr. Nichols wants to enclose a rectangular garden with wire fencing. The garden is against his garage so he needs to fence only three sides. How much fence does he need if the perimeter of the whole garden is 86 feet and the side of the garage is 25 feet? Draw and label a diagram of the garden.

13. Draw and label a parallelogram that has a perimeter of 30 inches.

SKILL 9

Name ____________________ Date __________

Mixed Numbers and Improper Fractions

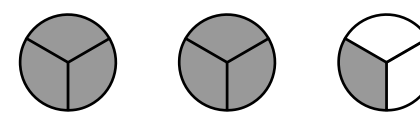


The figure at the right shows 2 whole circles plus $\frac{1}{3}$ of a circle. The **mixed number** $2\frac{1}{3}$ describes the number of circles.

Mixed numbers may be expressed as **improper fractions.** An improper fraction is a fraction in which the numerator is greater than the denominator.

To express a mixed number as an improper fraction, multiply the whole number by the denominator. Add the numerator to the product. Write the sum over the denominator.

EXAMPLE ***Express $2\frac{1}{3}$ as an improper fraction.***



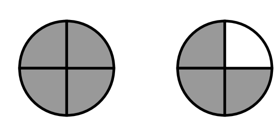
$2\frac{1}{3} = \frac{(2 \times 3) + 1}{3} = \frac{7}{3}$

Therefore, $2\frac{1}{3} = \frac{7}{3}$.

An improper fraction may be written as a mixed number.

To express an improper fraction as a mixed number, divide the numerator by the denominator. Write the quotient as the whole number. Write the remainder over the denominator as the fraction.

EXAMPLE ***Express $\frac{7}{4}$ as a mixed number.***



$7 \div 4 = 1 \text{ R } 3$ or $1\frac{3}{4}$

Therefore, $\frac{7}{4} = 1\frac{3}{4}$.

EXERCISES ***Draw a model and express each mixed number as an improper fraction.***

1. $1\frac{3}{8}$

2. 2

3. $1\frac{5}{6}$

Draw a model and express each fraction as a mixed number. **See students' work.**

4. $\frac{5}{2}$ **5.** $\frac{9}{5}$ **6.** $\frac{15}{4}$

Express each mixed number as an improper fraction.

7. $6\frac{1}{2}$ **8.** $3\frac{7}{8}$ **9.** $2\frac{8}{9}$ **10.** $10\frac{2}{3}$

11. $5\frac{4}{7}$ **12.** $4\frac{5}{6}$ **13.** $9\frac{1}{4}$ **14.** $8\frac{3}{5}$

Express each fraction as a mixed number.

15. $\frac{19}{6}$ **16.** $\frac{27}{4}$ **17.** $\frac{52}{9}$ **18.** $\frac{25}{2}$

19. $\frac{37}{5}$ **20.** $\frac{77}{8}$ **21.** $\frac{41}{3}$ **22.** $\frac{31}{7}$

APPLICATIONS

23. Suppose it snowed 5 inches in 2 days. The improper fraction $\frac{5}{2}$ tells the average daily snowfall. Write the improper fraction as a mixed number.

24. The Windsor Bay Deli sold $2\frac{1}{8}$ apple pies on Wednesday. If each piece was $\frac{1}{8}$ of a pie, how many pieces of pie were sold?

SKILL 10

Name ______________________ Date __________

Ratios as Fractions

Four adults accompany Mr. Goetz's class on a field trip to the municipal court. There are 27 students going on the field trip.

EXAMPLES ***What is the ratio of adults to students?***

$$\frac{\text{number of adults}}{\text{number of students}} = \frac{4}{27}$$

The ratio is $\frac{4}{27}$.

What is the ratio of students to the total number of people going on the field trip?

There are 4 + 27 or 31 people going on the trip.

$$\frac{\text{number of students}}{\text{total number}} = \frac{27}{31}$$

The ratio is $\frac{27}{31}$.

EXERCISES ***Express each ratio as a fraction.***

1. 30 out of 50 doctors

2. 84 students to 3 teachers

3. 22 players to 2 teams

4. 20 wins in 32 games

5. 4 boys to 6 girls

6. $8 for 2 tickets

7. 14 wins to 35 losses

8. 6 hits to 14 times at bat

9. 8 out of 10 people

10. 90 women to 144 men

11. 8 out of 10 bicycles

12. 5 out of 14 weeks

APPLICATIONS ***Ms. McClure's math class took a survey to determine what types of pets members of the class owned. There are 28 students in the class. Use the data at the right to answer Exercises 13–20.***

Number of Class Members Who Own Pets	
Cats	12
Dogs	11
Fish	9
Birds	5
Other	3
None	2

13. What ratio of the class members own a cat?

14. What ratio of the class members own a fish?

15. What ratio of the class members own a bird?

16. What ratio of the class members do *not* own a dog?

17. What ratio of the class members own a dog or no pet at all?

18. What ratio of the class members do *not* own a bird?

19. What ratio of the class members own a pet?

20. Do some of the class members own more than one pet? Explain.

SKILL 11

Name ______________________ Date ____________

Changing Fractions to Decimals

A fraction is another way of writing a division problem. To change a fraction to a decimal, divide the numerator by the denominator.

EXAMPLE

About $\frac{1}{20}$ of the heat in a house is lost through the doors. Write this fraction as a decimal.

$\frac{1}{20}$ means $1 \div 20$ or $20\overline{)1}$.

$$20\overline{)1.00}\quad 0.05$$

So, $\frac{1}{20} = 0.05$.

EXERCISES

Express each fraction as a decimal. Use bar notation if necessary.

1. $\frac{4}{25}$

2. $\frac{3}{5}$

3. $\frac{7}{20}$

4. $\frac{3}{50}$

5. $\frac{9}{10}$

6. $\frac{7}{8}$

7. $\frac{1}{3}$

8. $\frac{14}{16}$

9. $\frac{20}{30}$

10. $\frac{5}{9}$

11. $\frac{19}{20}$

12. $\frac{5}{200}$

13. $\frac{10}{50}$

14. $\frac{13}{20}$

15. $\frac{5}{6}$

16. $\frac{4}{5}$

17. $\frac{7}{10}$

18. $\frac{13}{40}$

19. $\frac{39}{50}$

20. $\frac{2}{25}$

21. $\frac{7}{16}$

22. $\frac{34}{125}$

23. $\frac{16}{25}$

24. $\frac{99}{100}$

25. $\frac{17}{20}$

26. $\frac{3}{150}$

27. $\frac{3}{8}$

28. $\frac{2}{3}$

APPLICATIONS

A mill is a unit of money that is used in assessing taxes. One mill is equal to $\frac{1}{10}$ of a cent or $\frac{1}{1,000}$ of a dollar.

29. Money is usually written using decimals. Express each fraction above as a decimal using the correct money symbol.

30. Find the number of cents and the number of dollars equal to 375 mills.

31. Find the number of cents and the number of dollars equal to 775 mills.

32. Find the number of cents and the number of dollars equal to 1,000 mills.

SKILL 12

Name ______________________ Date __________

Changing Decimals to Fractions

EXAMPLE

Change 1.65 to a fraction. Write the fraction in its simplest form.

First ask yourself, "Does the decimal have a whole number part?" Any numbers to the left of the decimal point stays the same when you convert a decimal to a fraction.

1.65

The fraction will also be 1 and something more.

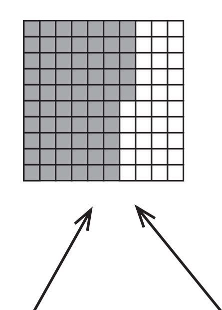
Next, think about place value. The place value of the last digit to the right of the decimal tells you what the denominator of the fraction will be.

1.65

The last digit is in the hundredths place. So the fraction will be some number of hundredths.

How many hundredths does 0.65 represent?

The 6 in the tenths place represents 6 tenths, or 60 hundredths. The 5 in the hundredths place represents another 5 hundredths. So there are 65 hundredths all together.



Write the fraction. $1\frac{65}{100}$

Check. Can the fraction be simplified?

65 and 100 are both divisible by 5, so $\frac{65}{100}$ can be simplified to $\frac{13}{20}$. 13 and 20 do not share a common factor, so this is the simplest form of the fraction.

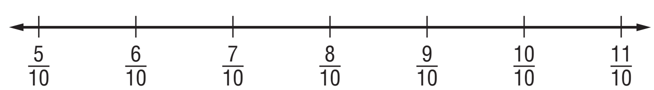
$1\frac{13}{20}$

EXERCISES ***Write each decimal as a fraction in simplest form.***

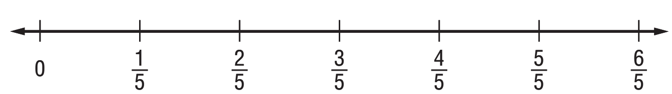
1. 0.17	**2.** 1.203	**3.** 0.45
4. 0.75	**5.** 1.07	**6.** 0.006
7. 1.30	**8.** 1.8	**9.** 0.091
10. **1.15**	**11.** 0.125	**12.** 1.98

APPLICATIONS ***In Exercises 13–16, place each decimal approximately on the number line. Convert the decimals to fractions in orderto compare them to the fractions on the number lines. You may also need to find common denominators so that you can compare fractions to each other.***

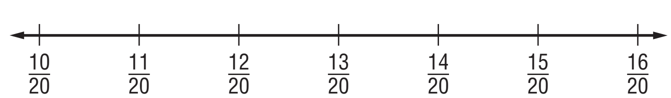
13. 0.53, 1.05, 0.98, 0.78, 0.85, 0.70, 0.59, 0.67



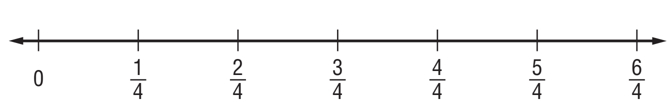
14. 0.4, 1.01, 0.25, 1.13, 0.85, 0.6, 0.57, 0.1



15. 0.6, 0.71, 0.53, 0.64, 0.79, 0.55, 0.67



16. 1.05, 0.5, 0.15, 0.9, 1.2, 0.3, 0.65, 1.45, 0.8



SKILL 13

Name ______________________ **Date** __________

Comparing and Ordering Fractions

As of 1992, the New York Yankees had won 22 of the 33 World Series games in which they had played. The St. Louis Cardinals had won 9 of the 15 World Series games in which they had played.

EXAMPLE ***Which team has a better record in the World Series?***

To answer this question, compare $\frac{22}{33}$ and $\frac{9}{15}$.

One way to compare these fractions is to express them as decimals and then compare the decimals.

$\frac{22}{33} = 0.6666666667$ $\frac{9}{15} = 0.6$

Since $0.6666666667 > 0.6$, $\frac{22}{33} > \frac{9}{15}$.

The New York Yankees have the better record.

EXERCISES ***Fill in each $\square$ with $<$, $>$, or $=$ to make a true sentence.***

1. $\frac{2}{7} \square \frac{3}{8}$

2. $\frac{3}{11} \square \frac{1}{5}$

3. $\frac{11}{21} \square \frac{9}{16}$

4. $\frac{14}{21} \square \frac{10}{15}$

5. $\frac{25}{27} \square \frac{17}{19}$

6. $\frac{3}{10} \square \frac{4}{9}$

7. $1\frac{7}{8} \square 1\frac{4}{5}$

8. $3\frac{7}{9} \square 3\frac{6}{7}$

9. $5\frac{10}{19} \square 5\frac{15}{24}$

Write each set of fractions in order from least to greatest.

10. $\frac{3}{5}, \frac{7}{9}, \frac{4}{5}, \frac{1}{2}$

11. $\frac{3}{8}, \frac{2}{7}, \frac{8}{11}, \frac{5}{16}$

12. $\frac{9}{14}, \frac{6}{7}, \frac{3}{4}, \frac{12}{19}$

13. $\frac{11}{23}, \frac{19}{27}, \frac{7}{10}, \frac{15}{17}$

APPLICATIONS ***The Pittsburgh Pirates have won 14 out of 21 games, and the New York Mets have won 15 out of 23 games. Use this information to answer Exercises 14–17.***

14. Which team has the better record?

15. Suppose the Pirates win 2 of their next three games and the Mets win all of their next 3 games. Which team has the better record?

16. Suppose the Pirates went on to win 21 games after playing 30 games. Is their record better now than it was before? Explain.

17. Suppose the Mets went on to win 16 games after playing 30 games. Is their record better now than it was before? Explain.

18. Larry has $\frac{5}{6}$ yard of material. Does he have enough to make a vest that requires $\frac{3}{4}$ yard of material? Explain.

SKILL 14

Name ____________________ Date ____________

Look for a Pattern

Sergio starts a savings account by depositing $1.00 into his account the first week, $3.00 the second week, $5.00 the third week, $7.00 the fourth week, and so on.

EXAMPLE ***How much money will he have in his savings account on the twentieth week?***

Find the total amount Sergio will have in his account on each of the first four weeks.

Week	1	2	3	4
Deposit	$1	$3	$5	$7
Total	$1	$4	$9	$16

Look for a pattern. The totals are squares of the numbers of the weeks.

$1^2 = 1 \quad 2^2 = 4 \quad 3^2 = 9 \quad 4^2 = 16$

Use the pattern to find the total on the twentieth week.

$20^2 = 400$

Sergio will have $400 in his savings account on the twentieth week.

EXERCISES ***Write the next two numbers in each pattern.***

1. 17, 34, 51, 68, . . .

2. 3, 6, 12, 24, . . .

3. 113, 106, 99, 92, . . .

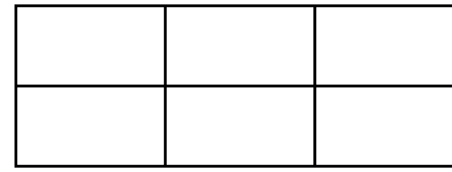
4. 20, 22, 25, 29, 34, . . .

5. $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \ldots$

6. 8, 0, 8, 0, . . .

Solve by finding a pattern.

7. What is the total number of rectangles in the figure at the right?



8. How many diagonals does a ten-sided polygon have?

APPLICATIONS

9. Isabel wants to work up to doing 40 sit-ups a day. She plans to do 7 sit-ups the first day, 10 the second day, 13 the third day, and so on. On what day will she do 40 sit-ups?

10. The NCAA men's basketball tournament starts with 64 teams. After the first round, there are 32 teams left; after the second round there are 16 teams left, and so on. Complete the pattern until there is only one team left. How many rounds does it take to determine a winner?

11. Alfua has a starting salary of $21,500. She receives annual raises equal to $\frac{1}{10}$ of her current salary. How many years must she work to double her salary?

12. The bus leaves downtown for the mall at 7:35 A.M., 8:10 A.M., 8:45 A.M., and 9:20 A.M. If the bus continues to run on this schedule, what time does the bus leave between 10:00 A.M. and 11:00 A.M.?

13. Choose three different digits. Use these digits to make all possible two-digit numbers in which the tens digits and the ones digit are different (six different numbers). Add them. Add the three original digits. Divide the first sum by the second sum. What is the answer? Repeat this procedure three more times, each time using a different group of three digits. What is the pattern in the answers?

SKILL 15

Name ______________________ Date ____________

Prime Factorization

A **prime number** is a whole number greater than 1 that has exactly two factors, 1 and itself.

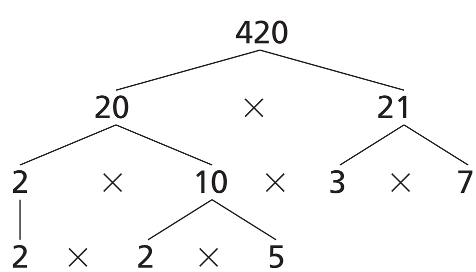
EXAMPLE ***Name two prime numbers.***

7	factors: 1, 7
23	factors: 1, 23

Therefore, 7 and 23 are prime numbers.

A **composite number** is a whole number greater than 1 that has more than two factors. Every composite number can be written as the product of prime numbers. This is called the **prime factorization** of the number.

EXAMPLE ***Write the prime factorization of 420.***



Write 420 as the product of two factors. Keep factoring until all of the factors are prime numbers.

The prime factorization of 420 is $2 \times 2 \times 3 \times 5 \times 7$, or $2^2 \times 3 \times 5 \times 7$.

EXERCISES ***Determine whether each number is composite or prime.***

1. 34 **2.** 77 **3.** 37 **4.** 89

5. 31 **6.** 434 **7.** 97 **8.** 123

Write the prime factorization of each number.

9. 490 **10.** 225 **11.** 900 **12.** 1,105

13. 66 **14.** 306 **15.** 2,475 **16.** 1,024

Find the missing factor.

17. $3^2 \times 5 \times$ _____ $= 315$

18. $2^4 \times$ _____ $\times 7 = 1,008$

19. $3^3 \times$ _____ $= 135$

20. $2^2 \times 3^2 \times$ _____ $= 252$

21. $5^2 \times$ _____ $= 275$

22. $3^3 \times 5^2 \times$ _____ $= 7,425$

APPLICATIONS

23. The first prime number is 2. What is the fourteenth prime number?

24. Two and 3 are consecutive prime numbers. Why aren't there any other pairs of consecutive prime numbers?

25. Evaluate $n^2 + n + 41$ for $n = 0, 1, 2,$ and 3 to find four prime numbers.

SKILL 16

Name ______________________ Date ____________

Greatest Common Factor

The **greatest common factor (GCF)** of two or more numbers is the greatest number that is a factor of each number. One way to find the GCF is to list the factors of each number and then choose the greatest of the common factors.

EXAMPLE ***Find the GCF of 72 and 108.***

factors of 72: **1, 2, 3, 4, 6,** 8, **9, 12, 18,** 24, **36,** 72

factors of 108: **1, 2, 3, 4, 6, 9, 12, 18**, 27, **36**, 54, 108

common factors: 1, 2, 3, 4, 6, 9, 12, 18, 36

The GCF of 72 and 108 is 36.

Another way to find the GCF is to write the prime factorization of each number. Then identify all common prime factors and find their product.

EXAMPLE ***Find the GCF of 210 and 525.***

210

10 × 21

2 × 5 × 3 × 7

525

25 × 21

5 × 5 × 3 × 7

common prime factors: 3, 5, 7

The GCF of 210 and 525 is $3 \times 5 \times 7$, or 105.

EXERCISES ***Find the GCF of each set of numbers by listing the factors of each number.***

1. 12, 18 **2.** 44, 153 **3.** 16, 30

List the common prime factors for each pair of numbers. Then write the GCF.

4. $80 = 2^4 \times 5$
$110 = 2 \times 5 \times 11$

5. $42 = 2 \times 3 \times 7$
$49 = 7 \times 7$

6. $16 = 2^4$
$48 = 2^4 \times 3$

Find the GCF of each pair of numbers by writing the prime factorization of each number.

7. 35, 85

8. 40, 100

9. 42, 23

Find the GCF of each set of numbers.

10. 18, 30

11. 60, 45

12. 24, 72

13. 54, 36

14. 120, 200

15. 81, 153

16. 60, 24, 72

17. 32, 48, 80

18. 90, 120, 180

19. What is the GCF of $2^3 \times 3^2 \times 5$ and $2^2 \times 3^2 \times 5^3$?

APPLICATIONS

20. What is the GCF of all the numbers in the sequence 12, 24, 36, 48, . . .?

21. There are 84 turkey and 63 ham sandwiches to be placed on trays. Each tray should have only one kind of sandwich, and all trays have the same number of sandwiches. What is the greatest number of sandwiches that can be placed on one tray?

SKILL 17

Name ______________________ Date __________

Least Common Multiple

A **multiple** of a number is the product of that number and any whole number. The least nonzero multiple of two or more numbers is the **least common multiple (LCM)** of the numbers.

EXAMPLE ***Find the least common multiple of 15 and 20.***

positive multiples of 15: 15, 30, 45, **60**, 75, 90, 105, **120**, . . .
positive multiples of 20: 20, 40, **60**, 80, 100, **120**, 140, . . .

The LCM of 15 and 20 is 60.

Prime factorization can also be used to find the LCM.

EXAMPLE ***Find the LCM of 8, 12, and 18.***

Find prime factors of each number.

$8 = 2 \times 2 \times 2$
$12 = 2 \times 2 \times 3$
$18 = 2 \times 3 \times 3$

Circle all sets of common factors.

$2 \times 2 \times 2 \times 3 \times 3 = 72$

Multiply the common factors and any other factors.

The LCM of 8, 12, and 18 is 72.

EXERCISES ***Find the LCM of each set of numbers by listing the multiples of each number.***

1. 12, 16 **2.** 15, 24 **3.** 7, 9

Find the LCM of each set of numbers by writing the prime factorization.

4. 18, 27 **5.** 30, 21 **6.** 20, 50

Find the LCM of each set of numbers.

7. 250, 30 **8.** 8, 54 **9.** 30, 65

10. 6, 10, 15 **11.** 2, 16, 24 **12.** 7, 8, 14

13. 6, 8, 36 **14.** 18, 30, 50 **15.** 14, 22

16. Find the GCF and LCM for 12 and 24.

17. Find the two smallest numbers whose GCF is 9 and whose LCM is 54.

18. List the first four multiples of $2n$.

APPLICATIONS

19. James goes to the zoo every six months, he goes to the art museum every 18 months, and he goes to the children's museum every July 1. This year on July 1, he went to all three places. When will be the next time that he happens to go to all three places?

20. On a store's 100th anniversary, every person who enters gets a pin. Every fourth person gets a mug. Every tenth person gets perfume. Every 25th person gets an umbrella, and every 75th person gets a free dinner. Which shopper will be the first to get all 5 gifts?

SKILL 18

Name ______________________________ Date ____________

Metric Units of Measure

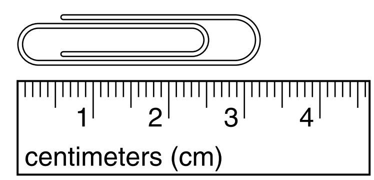
The meter is the basic unit of length in the metric system. Other metric units of length are **millimeters, centimeters**, and **kilometers**. Metric units of length are related in the following ways:

1 millimeter (mm) = 0.001 meter (m)

1 centimeter (cm) = 0.01 meter

1 kilometer (km) = 1,000 meters

EXAMPLE ***The metric ruler shown below can be used to measure the length of the paper clip in centimeters and in millimeters.***



Centimeters:
The distance between two numbered marks is a centimeter. Each centimeter is divided into tenths. Therefore, the paper clip is about 3.2 centimeters long.

Millimeters:
The distance between two smaller marks is a millimeter. There are 10 millimeters in one centimeter. Therefore, the paper clip is about 32 millimeters long.

EXERCISES ***Complete each sentence with the most reasonable unit. Write* millimeters, centimeters, meters, *or* kilometers.**

1. Jack rode 5 ______________________ along the bike trail.

2. The length of the room is about 6 ______________________ .

3. The width of a kite is about 85 ______________________ .

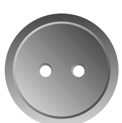
4. The button from your coat is about 5 ______________________ thick.

Circle the best estimate.

5.	length of a river	500 cm	500 m	500 km
6.	length of a quilt	2.5 cm	2.5 m	2.5 km
7.	length of a cassette tape	10 mm	10 cm	10 m
8.	thickness of a rope	9 mm	9 cm	9 m
9.	diameter of a bicycle wheel	65 cm	65 m	65 km
10.	length of a bolt	20 cm	20 m	20 mm
11.	length of a bus route	15 cm	15 m	15 km

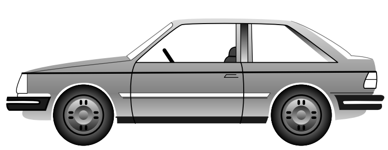
Find the length of each object in centimeters and millimeters.

12.



13.

14.



15.

APPLICATIONS

16. Name three objects whose lengths are between 1 centimeter and 1 meter.

17. Estimate the length of your pencil in centimeters. Then measure to check your estimate.

18. Juan ran 0.5 kilometers and Maria ran 600 meters. Who ran farther?

19. Mrs. Miller bought 2.75 meters of blue ribbon and 3.75 meters of red ribbon. How many meters of ribbon did she buy in all?

SKILL 19

Name ______________________ Date __________

Large Numbers

A light-year is the distance that light travels in one year. It is a measurement used in astronomy. It is approximately equal to 9,460,000,000,000 kilometers.

EXAMPLE ***Read the number of kilometers in a light-year.***

Trillions			Billions			Millions			Thousands			Ones		
Hundred Trillions	Ten Trillions	Trillions	Hundred Billions	Ten Billions	Billions	Hundred Millions	Ten Millions	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones
		9,	4	6	0,	0	0	0,	0	0	0,	0	0	0

There are nine trillion, four hundred sixty billion kilometers in one light year.

EXERCISES ***Write each number in words.***

1. 41,020

2. 3,066

3. 4,800,050

4. 78,500,080,000

5. 6,555,800,090,001

6. 80,450,007,000,000

APPLICATIONS ***The chart below shows the distances from the sun to various planets. Use this information to answer Exercises 7–12.***

	Distance from the Sun in Kilometers		
	Farthest	**Nearest**	**Mean**
Mercury	69,000,000	46,000,000	57,900,000
Venus	109,000,000	107,500,000	108,230,000
Earth	152,106,000	147,103,000	149,597,870
Mars	249,100,000	206,500,000	227,900,000
Jupiter	816,000,000	716,000,000	778,000,000
Saturn	1,503,000,000,000	1,351,000,000,000	1,427,000,000,000

7. Write Mercury's nearest distance from the sun in words.

8. Write Jupiter's mean distance from the sun in words.

9. Write Earth's farthest distance from the sun in words.

10. Write Saturn's nearest distance from the sun in words.

11. Write Saturn's farthest distance from the sun in words.

12. Write Jupiter's nearest distance from the sun in words.

SKILL 20

Name ____________________ Date ____________

Multiplying by Powers of Ten

The exponent in a power of ten is the same as the number of zeros in the number.

Powers of Ten

10^0	1
10^1	10
10^2	100
10^3	1,000
10^4	10,000
10^5	100,000

To multiply by a power of ten, move the decimal point to the right the number of places shown by the exponent or the number of zeros. Annex zeros if necessary.

EXAMPLES ***Find each product.***

0.08×10^4

$0.0800 = 800$ *Move the decimal point 4 places to the right.*

The product is 800.

$6.25 \times 1,000$

$6.250 = 6,250$ *Move the decimal point 3 places to the right.*

The product is 6,250.

EXERCISES ***Choose the correct product.***

1. 2.48×100; 0.0248 or 248

2. 0.9×10^0; 9 or 0.9

3. 0.039×10^2; 3.9 or 39

4. 1.5×10^4; 150,000 or 15,000

Multiply.

5. 15.24×10

6. 0.702×100

7. $5.149 \times 1,000$

8. 0.52×100

9. 2.587×10^0

10. 0.2674×100

11. 6.8×10^2

12. 9.57×10^4

13. 6.2×10^5

Solve each equation.

14. $d = 0.92 \times 100$

15. $12.43 \times 10^3 = h$

16. $h = 3.68 \times 10^6$

17. $a = 0.004 \times 10^2$

18. $0.23 \times 1{,}000 = j$

19. $1.89 \times 10^0 = v$

20. $d = 10{,}000 \times 7.07$

21. $0.014 \times 10^2 = k$

22. $v = 589 \times 10^1$

APPLICATIONS

23. What is the length of the Amazon river if it can be represented by 3.9×10^3 miles long? How much longer is it than the Wood River which is 5.7×10^2?

24. The United States spends 37.3×10^9 dollars on research and development in the military. Germany spends 1.4×10^9 dollars on research and development in the military. How much money do these two countries spend altogether?

25. The diameter of Neptune is about 4.95×10^4 kilometers. The diameter of Venus is about 1.21×10^4 kilometers. About how much greater is Neptune's diameter?

SKILL 21

Name ______________________ Date __________

Dividing by Powers of Ten

The exponent in a power of ten is the same as the number of zeros in the number.

Powers of Ten

10^0	1
10^1	10
10^2	100
10^3	1,000
10^4	10,000
10^5	100,000

To divide by a power of ten, move the decimal point to the left the number of places shown by the exponent or the number of zeros.

EXAMPLES ***Find each quotient.***

$8 \div 10^4 = 0.0008$ *Move the decimal point 4 places to the left.*

The quotient is 0.0008.

$62.5 \div 1{,}000 = 0.0625$ *Move the decimal point 3 places to the left.*

The quotient is 0.0625.

EXERCISES ***Choose the correct quotient.***

1. $2.48 \div 100$; 0.0248 or 248

2. $0.9 \div 10^0$; 9 or 0.9

3. $0.39 \div 10^2$; 0.039 or 0.0039

4. $1.5 \div 10^4$; 0.00015 or 15,000

Divide.

5. $15.24 \div 10$

6. $0.702 \div 100$

7. $514.9 \div 1{,}000$

8. $5.2 \div 100$

9. $2.587 \div 10^0$

10. $267.4 \div 100$

11. $68 \div 10^2$

12. $9.57 \div 10^4$

13. $6{,}245 \div 10^5$

Solve each equation.

14. $d = 92 \div 100$

15. $12.43 \div 10^3 = h$

16. $h = 36.8 \div 10^6$

17. $a = 0.004 \div 10^2$

18. $2{,}358 \div 1{,}000 = j$

19. $1.89 \div 10^0 = v$

20. $d = 76.9 \div 10{,}000$

21. $8{,}714 \div 10^2 = k$

22. $v = 589 \div 10^1$

APPLICATIONS

23. Mr. Fraley bought 1,000 postage stamps for $290 for use in his office. How much did each stamp cost?

24. Mary donated 100 cans of soup to the local food pantry. It cost her $23 to buy the soup. How much did each can of soup cost?

25. George has $245.60 that he wants to split evenly with his 10 nieces and nephews. How much money will each one receive?

26. The planet Saturn is an average distance of about 887,000,000 miles from the sun. If a space ship could travel that distance in 10,000 hours, how fast would it be going?

SKILL 22

Name ______________________ Date __________

Order of Operations

Follow the **order of operations** to evaluate or find the value of an expression.

Order of Operations
1. Do all operations within grouping symbols. Start with the innermost grouping symbol.
2. Do all multiplication and division in order from left to right.
3. Do all addition and subtraction in order from left to right.

EXAMPLE ***Evaluate $15 - 2 \times 4 - (6 - 3)$.***

$15 - 2 \times 4 - (6 - 3) = 15 - 2 \times 4 - 3$ *Do all the operations within grouping symbols.*

$= 15 - 8 - 3$ *Do multiplication and division from left to right.*

$= 4$ *Do addition and subtraction from left to right.*

EXERCISES ***Evaluate each expression.***

1. $(5 + 3) \div 2 + 2$

2. $7 \times 5 - 3 \times 4$

3. $3 \times 6 + 9 \div 3 - 6$

4. $5 \times 13 - 8 \times 5 + 6$

5. $(3 + 6) \div 3 \times 3$

6. $(8 - 3)(12 \div 4) - 5$

7. $[36 - (2 + 4)2]3$

8. $20 \div 4 \times 5 \times 2 \div 10$

9. $125 \div [5(2 + 3)]$

10. $2 \times 8 - 42 \div 7 + 4$

11. $150 \div 10 - 3 \times 5$

12. $4 + (5 - 3)5 + 7$

13. $(16 + 4) \div 4$

14. $56 \div [(5 - 3) \times 4]$

15. $15 - 2 \times 4 - (6 - 3)$

16. $[1 + (5 - 2)] \times 6$

17. $2 + 4 \times 9 \div 12$

18. $45 - 40 + 1 \times 2$

19. $(100 - 25) \times 2 + 25$

20. $(12 - 8) \div 4 + 6$

APPLICATIONS ***Use the prices at the right to write mathematical expressions for each total cost. Evaluate the expression to find the total cost.***

Riverview Theater Prices	
Adult	\$6.00
Student	\$3.00
Senior Citizen	\$5.00

21. 3 adult tickets and 4 student tickets

22. 2 adult tickets, 1 senior-citizen ticket, and 3 student tickets

23. 5 adult tickets and 3 senior-citizen tickets

24. 1 senior-citizen ticket and 5 student tickets with a coupon for \$2 off the total purchase

25. 5 adult tickets and 2 student tickets with a coupon for \$1 off each adult ticket

26. 4 adult tickets and 6 student tickets on a night that offers the special deal that a free ticket is given with each ticket purchased

SKILL 23

Name ______________________ Date __________

Variables and Expressions

Algebra is a language of symbols. In algebra, letters, called **variables**, are used to represent unknown quantities. A combination of one or more variables, numbers, and at least one operation is called an **algebraic expression**.

$x - 9$ means x minus 9.

$7m$ means 7 times m.

ab means a times b.

$\frac{h}{4}$ means h divided by 4.

To **evaluate** an algebraic expression, replace the variable or variables with known values and then use the order of operations.

EXAMPLES ***Evaluate $2c - 7 + d$ if $c = 8$ and $d = 5$.***

$2c - 7 + d = 2(8) - 7 + 5$ *Replace c with 8 and d with 5.*

$= 16 - 7 + 5$ *Multiply.*

$= 9 - 5$ *Subtract.*

$= 14$ *Add.*

EXERCISES ***Evaluate each expression if $x = 9$, $y = 5$, and $z = 2$.***

1. $x + 6$ **2.** $y - 3$ **3.** $z + 11$

4. $23 - x$ **5.** $6z$ **6.** $14 + y$

7. $4z + 5$ **8.** $24 - 2x$ **9.** $3y - 7$

10. $\frac{x}{3}$ **11.** $\frac{14}{z}$ **12.** $\frac{xy}{15}$

13. $4x - 2y$

14. $6z - x$

15. $18 - 2x$

16. $6y - (x + z)$

17. $3x - z$

18. $5(y + 7)$

19. $2x + y - z$

20. $5z - y$

21. $4x - (z + 2y)$

22. $\frac{2x + 3z}{12}$

23. $\frac{7y - y}{x}$

24. $\frac{5y - 7}{x}$

25. $(11 - 3z) + x + y$

26. $7(x - z)$

27. $6y - 9z$

28. $\frac{xy}{3} - z$

29. $\frac{40}{y} + x$

30. $\frac{5y - y}{z}$

31. $3x - 2(y - z)$

32. $(14 - 6z) + x$

33. $10z - (x + y)$

APPLICATIONS

34. The weekly production costs at Jessica's T-Shirt Shack are given by the algebraic expression $75 + 7s + 12t$ where s represents the number of short-sleeve shirts produced during the week and t represents the number of long-sleeve shirts produced during the week. Find the production cost for a week in which 30 short-sleeve and 24 long-sleeve shirts were produced.

35. The perimeter of a rectangle can be found by using the formula $2\ell + 2w$, where ℓ represents the length of the rectangle and w represents the width of the rectangle. Find the perimeter of a rectangular swimming pool whose length is 32 feet and whose width is 20 feet.

SKILL 24

Name ______________________ Date ____________

Writing Expressions and Equations

Translating verbal phrases and sentences into algebraic expressions and equations is an important skill in algebra. Key words and phrases play an essential role in this skill.

The first step in translating a verbal phrase into an algebraic expression or a verbal sentence into an algebraic equation is to choose a variable and a quantity for the variable to represent. This is called **defining a variable**.

The following table lists some words and phrases that suggest addition, subtraction, multiplication, and division. Once a variable is defined, these words and phrases will be helpful in writing the complete expression or equation.

Addition	Subtraction	Multiplication	Division
plus	minus	times	divided
sum	difference	product	quotient
more than	less than	multiplied	per
increased by	subtract	each	rate
in all	decreased by	of	ratio
together	less	factors	separate

EXAMPLES

Translate the phrase "three times the number of students per class" into an algebraic expression.

Words three times the number of students per class

Variable Let *s* represent the number of students per class.

Expression $3s$

Translate the sentence "The weight of the apple increased by five is equal to twelve ounces." into an algebraic equation.

Words The weight of the apple increased by five is equal to twelve ounces.

Variable Let *w* represent the weight of the apple.

Equation $w + 5 = 12$

EXERCISES ***Translate each phrase into an algebraic expression.***

1. seven points less than yesterday's score
2. the number of jelly beans divided into nine piles
3. the morning temperature increased by sixteen degrees
4. six times the cost of the old book
5. two times the difference of a number and eight

Translate each sentence into an algebraic equation.

6. The sum of four and a number is twenty.
7. Fourteen is the product of two and a number.
8. Nine less than a number is three.
9. The quotient of a number and five is eleven.
10. Fifteen less than the product of a number and three is six.

APPLICATIONS

11. Sierra purchased an ice cream cone for herself and three friends. The cost was $8. Define a variable and then write an equation that can be used to find how much Sierra paid for each ice cream cone.

12. Nicholas weighed 83 pounds at his most recent checkup. He had gained 9 pounds since his last checkup. Define a variable and then write an equation to find Nicholas' weight at the previous checkup.

13. There are three times as many people at the amusement park today than there were yesterday. Today's attendance is 12,000. Define a variable and then write an equation to find yesterday's attendance.

SKILL 25

Name ______________________ Date __________

Ratio and Proportion

A **ratio** is a comparison of two numbers by division.

EXAMPLES ***In a class of 25 students there are 12 girls and 13 are boys. Write the relationship of the number of girls to the number of boys as a ratio.***

The ratio of girls to boys can be written as 12 to 13, 12:13, or $\frac{12}{13}$.

A **proportion** is a statement that two ratios are equal. In symbols, this can be shown by $\frac{a}{b} = \frac{c}{d}$. The cross products of a proportion, *ad* and *bc*, are equal.

EXAMPLES ***Determine if the ratios $\frac{3}{5}$ and $\frac{12}{20}$ form a proportion.***

Find the cross products of $\frac{3}{5} = \frac{12}{20}$.

$\frac{3}{5} \stackrel{?}{=} \frac{12}{20}$ *Write the proportion.*

$3(20) \stackrel{?}{=} 5(12)$ *Cross multiply.*

$60 = 60$ *Simplify.*

So, $\frac{3}{5}$ and $\frac{12}{20}$ form a proportion.

If one term of a proportion is not known, you can use the cross products to set up an equation to solve for the unknown term. This is called **solving the proportion.**

EXAMPLES ***Solve the proportion $\frac{8}{12} = \frac{x}{15}$.***

$\frac{8}{12} = \frac{x}{15}$ *Write the proportion.*

$8(15) = 12(x)$ *Cross multiply.*

$120 = 12(x)$

$\frac{120}{12} = \frac{12(x)}{12}$ *Divide each side by 12.*

$10 = x$

EXERCISES

Express each ratio as a fraction in simplest form.

1. 12 pennies to 18 coins

2. 15 bananas out of 25 fruits

3. 32 footballs to 40 basketballs

4. 6 cups to 14 pints

5. 8 clarinets out of 15 instruments

6. 16 tulips out of 24 flowers

7. 12 novels out of 27 books

8. 9 poodles to 12 beagles

Solve each proportion.

9. $\frac{a}{12} = \frac{3}{9}$

10. $\frac{8}{b} = \frac{12}{21}$

11. $\frac{24}{36} = \frac{c}{15}$

12. $\frac{27}{6} = \frac{18}{d}$

13. $\frac{7}{8} = \frac{e}{56}$

14. $\frac{27}{36} = \frac{6}{f}$

APPLICATIONS

15. If 8 gallons of gasoline cost $11.20, how much would 10 gallons cost?

16. A recipe for punch calls for 4 cups of lemonade for every 6 quarts of fruit juice. How many quarts of fruit juice should Elizabeth use if she has already added 10 cups of lemonade?

17. On a map, the scale is 1 inch equals 160 miles. What is the actual distance if the map distance is $3\frac{1}{2}$ inches?

18. One bag of jelly beans contains 14 red jelly beans. How many red jelly beans would be found in 4 bags of jelly beans?

SKILL 26

Name ______________________ Date __________

Proportional Reasoning

Super Value Grocery has a special on oranges this week. The price is 99¢ for 6 oranges.

EXAMPLES ***How many oranges can Daniel buy for $3.30?***

$$\frac{\text{oranges}}{\text{cost (¢)}} \rightarrow \frac{6}{99} = \frac{x}{330} \leftarrow \frac{\text{oranges}}{\text{cost (¢)}}$$ *Write a proportion.*

$(6)(330) = (99)(x)$ *Cross multiply.*

$1{,}980 = 99x$ *Simplify.*

$\frac{1{,}980}{99} = \frac{99x}{99}$ *Divide each side by 99.*

$20 = x$ *Simplify.*

Daniel can buy 20 oranges.

EXERCISES ***Write a proportion to solve each problem. Then solve.***

1. 32 ounces of juice are required to make 2 gallons of punch.
6 gallons of punch require *n* ounces of juice.

2. 29 students for every teacher.
348 students for *t* teachers.

3. 374 miles driven using 22 gallons of gasoline.
1,122 miles driven using *g* gallons of gasoline.

4. 21 bolts connect 3 panels.
b bolts connect 8 panels.

5. 32 pages for 2 sections of newspaper.
p pages for 5 sections of newspaper.

6. $2.49 for 3 bottles of water.
$8.30 for *w* bottles of water.

7. 3 girls for every 2 boys.
261 girls and *b* boys.

8. 8 packages in 2 cases.
p packages in 7 cases.

9. $11.50 earned in one hour.
d earned in 6.5 hours.

10. 1.5 inches represents 10 feet.
5 inches represents *x* feet.

11. 18 candy bars in 3 boxes.
900 candy bars in *x* boxes.

12. $\frac{1}{2}$ gallon of paint covers 112 square feet.
n gallons of paint covers 560 square feet.

APPLICATIONS

Farmers often express their crop yield in bushels per acre. The table at the right shows Mr. Decker's average yields. Use this data to answer Exercises 13–16.

Mr. Decker's Yield (Bushels per acre)	
Corn	98
Soybeans	48
Wheat	45

13. How many bushels of corn should Mr. Decker harvest from 80 acres?

14. How many bushels of wheat should Mr. Decker expect from 105 acres?

15. If Mr. Decker plants soybeans on 90 acres, how many bushels can he expect to harvest?

16. Ms. Holleran harvested 3,815 bushels of corn from 35 acres. Is this yield more or less than Mr. Decker's yield?

17. Ms. Galvez paid $150 for 600 square feet of roofing. If she needs 240 square feet more, what is the extra cost?

18. A picture measuring 25 centimeters long is enlarged on a copying machine to 30 centimeters long. If the width of the original picture is 15 centimeters, what is the width of the enlarged copy?

SKILL 27

Name ________________________________ Date ____________

Multiplication Properties

The table shows the properties for multiplication.

Property	Examples
Commutative The product of two numbers is the same regardless of the order in which they are multiplied.	$21 \cdot 2 = 2 \cdot 21$ $42 = 42$
Associative The product of three or more numbers is the same regardless of the way in which they are grouped.	$5 \cdot (3 \cdot 6) = (5 \cdot 3) \cdot 6$ $5 \cdot 18 = 15 \cdot 6$ $90 = 90$
Identity The product of a number and 1 is the number.	$81 \times 1 = 81$
Inverse (Reciprocal) The product of a number and its reciprocal is 1.	$\frac{7}{8} \times \frac{8}{7} = 1$
Distributive The sum of two addends multiplied by a number is equal to the sum of the products of each addend and the number.	$2 \cdot (9 + 3) = (2 \cdot 9) + (2 \cdot 3)$ $2 \cdot 12 = 18 + 6$ $24 = 24$

EXERCISES ***Name the multiplicative inverse, or reciprocal, of each number.***

1. $\frac{6}{11}$

2. $\frac{19}{3}$

3. $\frac{1}{8}$

4. 9

Name the property shown by each statement.

5. $67 \cdot 89 = 89 \cdot 67$

6. $1 \cdot 45 = 45$

7. $\frac{11}{12} \cdot 1 = \frac{11}{12}$

8. $\left(\frac{1}{5} \cdot \frac{2}{3}\right) \cdot \frac{5}{9} = \frac{1}{5} \cdot \left(\frac{2}{3} \cdot \frac{5}{9}\right)$

9. $\frac{3}{4} \cdot \frac{5}{6} = \frac{5}{6} \cdot \frac{3}{4}$

10. $\frac{3}{5}\left(\frac{1}{3} + \frac{5}{7}\right) = \left(\frac{3}{5} \cdot \frac{1}{3}\right) + \left(\frac{3}{5} \cdot \frac{5}{7}\right)$

11. $\frac{1}{4} \cdot 4 = 1$

12. $45(23 + 3) = (45 \cdot 23) + (45 \cdot 3)$

13. $\frac{4}{9} \cdot \frac{9}{4} = 1$

14. $\frac{4}{5} \cdot \frac{3}{4} = \frac{3}{4} \cdot \frac{4}{5}$

APPLICATIONS

15. Jill runs for $1\frac{3}{4}$ as long as Eva. Find Jill's running time if Eva runs for 48 minutes.

16. A chihuahua is 6 inches tall. The height of a German shepherd is $3\frac{2}{3}$ the height of the chihuahua. Find the height of the German shepherd.

SKILL 28

Name ______________________________ **Date** ____________

Simplifying Fractions

There are 30 students in the school chorale, and 12 of these students can stay after school today to help prepare the stage for the concert.

EXAMPLE ***What fraction of the students in chorale can stay after school today? Write the fraction in simplest form.***

From the information, $\frac{12}{30}$ of the students can stay after school.

To simplify this fraction, find the greatest common factor of 12 and 30. The GCF is 6. Then divide the numerator and denominator by 6.

$$\frac{12 \div 6}{30 \div 6} = \frac{2}{5}$$

Therefore, $\frac{2}{5}$ of the students can stay after school.

EXERCISES ***Write each fraction in simplest form.***

1. $\frac{14}{20}$ **2.** $\frac{15}{35}$ **3.** $\frac{16}{20}$

4. $\frac{10}{40}$ **5.** $\frac{16}{36}$ **6.** $\frac{45}{48}$

7. $\frac{22}{55}$ **8.** $\frac{49}{56}$ **9.** $\frac{13}{26}$

10. $\frac{16}{32}$ **11.** $\frac{14}{49}$ **12.** $\frac{60}{80}$

13. $\frac{15}{25}$ **14.** $\frac{16}{18}$ **15.** $\frac{24}{36}$

16. $\frac{8}{32}$ **17.** $\frac{18}{81}$ **18.** $\frac{8}{56}$

19. $\frac{75}{100}$ **20.** $\frac{15}{25}$ **21.** $\frac{4}{44}$

22. $\frac{10}{65}$ **23.** $\frac{28}{63}$ **24.** $\frac{42}{52}$

25. $\frac{25}{150}$ **26.** $\frac{81}{90}$ **27.** $\frac{35}{105}$

APPLICATIONS ***Use the data below to answer Exercises 28–35. Write all answers in simplest form.***

1993 U.S. Television Ownership	
Equipment	**Number of Households out of 100**
Television	98
Color Television	97
VCR	80
Two or More Televisions	64
Basic Cable	62
One or More Pay Cable Channels	30
Satellite Dish	4

28. What fraction of U.S. households have a television?

29. What fraction of U.S. households have a color television?

31. What fraction of U.S. households have a VCR?

32. What fraction of U.S. households have two or more televisions?

33. What fraction of U.S. households have basic cable?

34. What fraction of U.S. households have at least one cable channel?

35. What fraction of U.S. households have a satellite dish?

SKILL 29

Name ______________________ Date __________

Adding Fractions

To add fractions with like denominators, add the numerators. Write the sum over the common denominator. Simplify the sum if possible.

EXAMPLE ***Find the sum of $\frac{7}{8}$ and $\frac{5}{8}$.***

$$\begin{array}{r} \frac{7}{8} \\ +\frac{5}{8} \\ \hline \end{array}$$

$\frac{12}{8} = \frac{3}{2}$ or $1\frac{1}{2}$ *simplify the sum.*

The sum of $\frac{7}{8}$ and $\frac{5}{8}$ is $1\frac{1}{2}$.

To add fractions with unlike denominators, rename the fractions with a common denominator. Then add the fractions.

EXAMPLE ***Find the sum of $\frac{1}{9}$ and $\frac{5}{6}$.***

$$\begin{array}{r} \frac{1}{9} = \frac{2}{18} \\ +\frac{5}{6} = \frac{15}{18} \\ \hline \frac{17}{18} \end{array}$$

Use 18 for the common denominator.

The sum of $\frac{1}{9}$ and $\frac{5}{6}$ is $\frac{17}{18}$.

EXERCISES ***Add.***

1. $\begin{array}{r} \frac{4}{7} \\ +\frac{2}{7} \\ \hline \end{array}$

2. $\begin{array}{r} \frac{5}{9} \\ +\frac{4}{9} \\ \hline \end{array}$

3. $\begin{array}{r} \frac{11}{15} \\ +\frac{2}{15} \\ \hline \end{array}$

4. $\frac{11}{15} + \frac{7}{15}$

5. $\frac{6}{7} + \frac{6}{7}$

3. $\frac{11}{12} + \frac{5}{12}$

7. $\frac{1}{8} + \frac{1}{9}$

8. $\frac{1}{3} + \frac{1}{6}$

9. $\frac{3}{5} + \frac{2}{7}$

10. $\frac{7}{16} + \frac{3}{8}$

11. $\frac{7}{10} + \frac{2}{5}$

12. $\frac{3}{14} + \frac{1}{7}$

13. $\frac{5}{12} + \frac{1}{3}$

14. $\frac{1}{6} + \frac{1}{8}$

15. $\frac{1}{6} + \frac{4}{9}$

16. $\frac{3}{8} + \frac{5}{8} + \frac{1}{8}$

17. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$

18. $\frac{2}{3} + \frac{3}{4} + \frac{1}{6}$

APPLICATIONS

19. After running $\frac{7}{8}$ mile in a horse race, a horse ran an additional $\frac{3}{8}$ mile to cool down. How far did the horse run altogether?

20. In 1991, about $\frac{1}{5}$ of the crude oil produced was from North America, and about $\frac{2}{7}$ of the crude oil produced was from the Middle East. What fraction of the crude oil produced was from North America or the Middle East?

21. In 1991, about $\frac{3}{10}$ of the petroleum consumed was in North America, and about $\frac{1}{5}$ of the petroleum consumed was in Western Europe. What fraction of the petroleum consumed was in North America or Western Europe?

SKILL 30

Name ______________________ Date ____________

Subtracting Fractions

To subtract fractions with like denominators, subtract the numerators. Write the difference over the common denominator. Simplify the difference if possible.

EXAMPLE ***Subtract $\frac{5}{12}$ from $\frac{7}{12}$.***

$$\begin{array}{r} \frac{7}{12} \\ -\frac{5}{12} \\ \hline \frac{2}{12} = \frac{1}{6} \end{array}$$

simplify the difference.

The difference is $\frac{1}{6}$.

To subtract fractions with unlike denominators, rename the fractions with a common denominator. Then subtract the fractions.

EXAMPLE ***Subtract $\frac{5}{8}$ from $\frac{5}{6}$.***

$$\begin{array}{r} \frac{5}{6} = \frac{20}{24} \\ -\frac{5}{8} = \frac{15}{24} \\ \hline \frac{5}{24} \end{array}$$

Use 24 for the common denominator.

The difference is $\frac{5}{24}$.

EXERCISES ***Subtract.***

1. $\begin{array}{r} \frac{3}{4} \\ -\frac{1}{4} \\ \hline \end{array}$

2. $\begin{array}{r} \frac{5}{7} \\ -\frac{3}{7} \\ \hline \end{array}$

3. $\begin{array}{r} \frac{11}{15} \\ -\frac{3}{12} \\ \hline \end{array}$

4. $\begin{array}{r} \frac{7}{16} \\ -\frac{3}{16} \\ \hline \end{array}$

5. $\begin{array}{r} \frac{9}{10} \\ -\frac{3}{10} \\ \hline \end{array}$

3. $\begin{array}{r} \frac{11}{12} \\ -\frac{5}{12} \\ \hline \end{array}$

7. $\begin{array}{r} \frac{11}{12} \\ -\frac{1}{3} \\ \hline \end{array}$

8. $\begin{array}{r} \frac{8}{15} \\ -\frac{2}{5} \\ \hline \end{array}$

9. $\begin{array}{r} \frac{4}{5} \\ -\frac{1}{10} \\ \hline \end{array}$

10. $\frac{17}{18} - \frac{2}{9}$

11. $\frac{7}{8} - \frac{1}{3}$

12. $\frac{3}{4} - \frac{2}{5}$

13. $\frac{2}{5} - \frac{1}{6}$

14. $\frac{11}{12} - \frac{2}{3}$

15. $\frac{5}{6} - \frac{5}{8}$

16. $\frac{7}{12} - \frac{3}{10} -$

17. $\frac{7}{9} - \frac{1}{6}$

18. $\frac{4}{7} - \frac{1}{2}$

19. $\frac{3}{4} - \frac{2}{5}$

20. $\frac{7}{8} - \frac{1}{3}$

21. $\frac{2}{3} - \frac{3}{5}$

APPLICATIONS

22. A large orange weighs $\frac{11}{16}$ pounds. A small orange weighs $\frac{5}{16}$ pounds. How much more does the large orange weigh?

23. In 1991, North America produced $\frac{1}{4}$ of the world's coal. The only area that produced more coal was the Far East, Which produced $\frac{3}{8}$ of the coal. How much of the world's coal was produced by the Far East than North America?

24. In 1991, North America consumed about $\frac{1}{5}$ of the coal produced and Western Europe consumed about $\frac{1}{7}$ of the coal produced. How much more coal was consumed by North America than Western Europe?

25. A page of a book has a $\frac{1}{2}$-inch margin on the top and a $\frac{3}{4}$-inch margin on the bottom. How much deeper is the bottom margin than the top margin?

SKILL 31

Name ______________________ Date ____________

Adding and Subtracting Fractions

Lina is making trail mix for a hiking trip. She has $2\frac{1}{2}$ cups of peanuts, $3\frac{1}{4}$ cups of raisins, and $2\frac{2}{3}$ cups of carob chips.

EXAMPLE ***How many cups of trail mix will Lina have?***

$$2\frac{1}{2} = 2\frac{6}{12}$$

$$3\frac{1}{4} = 3\frac{3}{12}$$

$$+\,2\frac{2}{3} = +\,2\frac{8}{12}$$

$$7\frac{17}{12} = 7 + \frac{12}{12} + \frac{5}{12}$$

$$= 7 + 1 + \frac{5}{12}$$

$$= 8 + \frac{5}{12}$$

$$= 8\frac{5}{12}$$

Lina will have $8\frac{5}{12}$ cups of trail mix.

If Lina wants 15 cups of trail mix, how many more cups of trail mix does she have to make?

$$15 = 14 + 1 = 14 + \frac{12}{12} = 14\frac{12}{12}$$

$$15 = 14\frac{12}{12}$$

$$-8\frac{5}{12} = -8\frac{5}{12}$$

$$6\frac{7}{12}$$

She needs to make another $6\frac{7}{12}$ cups of trail mix.

EXERCISES ***Add or subtract. Write each answer in simplest form.***

1. $\frac{7}{12} + \frac{2}{12}$

2. $\frac{9}{10} - \frac{3}{10}$

3. $\frac{7}{9} + \frac{5}{9}$

4. $\frac{7}{16} - \frac{3}{16}$

5. $\frac{1}{6} + \frac{1}{2}$

6. $\frac{2}{3} - \frac{1}{2}$

7. $\frac{1}{4} + \frac{7}{8}$

8. $\frac{9}{10} - \frac{3}{5}$

9. $\frac{4}{5} + \frac{9}{12}$

10. $\frac{11}{15} - \frac{1}{3}$

11. $\frac{1}{9} + \frac{1}{6}$

12. $\frac{1}{2} - \frac{7}{16}$

13. $\frac{3}{10} + \frac{4}{5}$

14. $\frac{4}{5} - \frac{1}{6}$

15. $7\frac{1}{10} + 2\frac{1}{5}$

16. $9\frac{1}{2} - 5\frac{1}{6}$

17. $5\frac{3}{4} + 2\frac{5}{8}$

18. $9\frac{3}{4} - 2\frac{1}{6}$

APPLICATIONS

19. The route from Ramon's house to city hall and then to the school is $\frac{9}{10}$ mile. It is $\frac{3}{10}$ mile from city hall to the school. What is the distance from Ramon's house to city hall?

20. To make a salad, Henry used $\frac{3}{4}$ pound of Boston lettuce and $\frac{2}{3}$ pound of red lettuce. How much lettuce did he use?

21. Donna has $10\frac{3}{4}$ yards of ribbon. She needs $3\frac{1}{2}$ yards of ribbon to make a bow. How much ribbon will she have after she makes the bow?

22. Part of the daily diet of polar bears at the Bronx Zoo is $1\frac{1}{4}$ pounds of apples and a $1\frac{1}{2}$-pound mixture of oats and barley. What is the combined weight of these items?

23. Ani has two chores to do on Saturday. She has to wash the car which will take her $\frac{3}{4}$ hour and rake the leaves which will take her $1\frac{1}{2}$ hours. How much time should she plan to spend on these chores?

24. Mr. Vazquez wants to put a fence around his rectangular vegetable garden. If the garden is $18\frac{3}{4}$ feet long and $10\frac{1}{2}$ feet wide, how much fence will he need?

SKILL 32

Name ______________________________ Date ____________

Multiplying Fractions

To multiply fractions, multiply the numerators. Then multiply the denominators. Simplify the product if possible.

EXAMPLES

Multiply $\frac{4}{7}$ times $\frac{5}{9}$.

$\frac{4}{7} \times \frac{5}{9} = \frac{4 \times 5}{7 \times 9}$ *Multiply the numerators. Multiply the denominators.*

$= \frac{20}{63}$

The product of $\frac{4}{7}$ and $\frac{5}{9}$ is $\frac{20}{63}$.

Multiply $\frac{5}{6}$ times $\frac{3}{5}$.

$\frac{5}{6} \times \frac{3}{5} = \frac{5 \times 3}{6 \times 5}$ *Multiply the numerators. Multiply the denominators.*

$= \frac{15}{30}$ or $\frac{1}{2}$ *Simplify.*

The product of $\frac{5}{6}$ and $\frac{3}{5}$ is $\frac{1}{2}$.

EXERCISES ***Multiply.***

1. $\frac{2}{3} \times \frac{1}{4}$

2. $\frac{3}{7} \times \frac{1}{2}$

3. $\frac{1}{3} \times \frac{3}{5}$

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

5. $\frac{7}{10} \times \frac{5}{7}$

6. $\frac{1}{4} \times \frac{1}{4}$

7. $\frac{1}{3} \times \frac{1}{5}$

8. $\frac{5}{8} \times \frac{1}{2}$

9. $\frac{4}{9} \times \frac{3}{4}$

10. $\frac{2}{3} \times \frac{3}{8}$

11. $\frac{1}{7} \times \frac{1}{7}$

12. $\frac{2}{9} \times \frac{1}{2}$

13. $\frac{3}{5} \times \frac{5}{6}$

14. $\frac{2}{7} \times \frac{1}{3}$

15. $\frac{5}{12} \times \frac{3}{5}$

16. $\frac{1}{2} \times \frac{1}{5}$

17. $\frac{6}{7} \times \frac{8}{15}$

18. $\frac{8}{9} \times \frac{9}{10}$

19. $\frac{4}{5} \times \frac{5}{14}$

20. $\frac{7}{8} \times \frac{4}{9}$

21. $\frac{5}{8} \times \frac{3}{4}$

APPLICATIONS ***Use the recipe for lemon chicken saute below to answer Exercises 22–25.***

6 boneless chicken breasts, rolled in flour	$\frac{1}{3}$ cup teriyaki sauce
1/4 cup butter	$\frac{1}{2}$ teaspoon sugar
3 tablespoons lemon juice	$\frac{1}{8}$ teaspoon pepper
1 teaspoon garlic	

22. If Julie wants to make half of this recipe, how much pepper should she use?

23. If Julie wants to make one-third of this recipe, how much teriyaki sauce should she use?

24. If Julie wants to make two-thirds of this recipe, how much sugar should she use?

25. If Julie wants to make two-thirds of this recipe, how much butter should she use?

26. If about $\frac{1}{3}$ of Earth is able to be farmed and $\frac{2}{5}$ of this land is planted in grain crops, what part of Earth is planted in grain crops?

27. Two fifths of the students at Main Street Middle School are in seventh grade. If half of the students in seventh grade are boys, what fraction of the students are seventh grade boys?

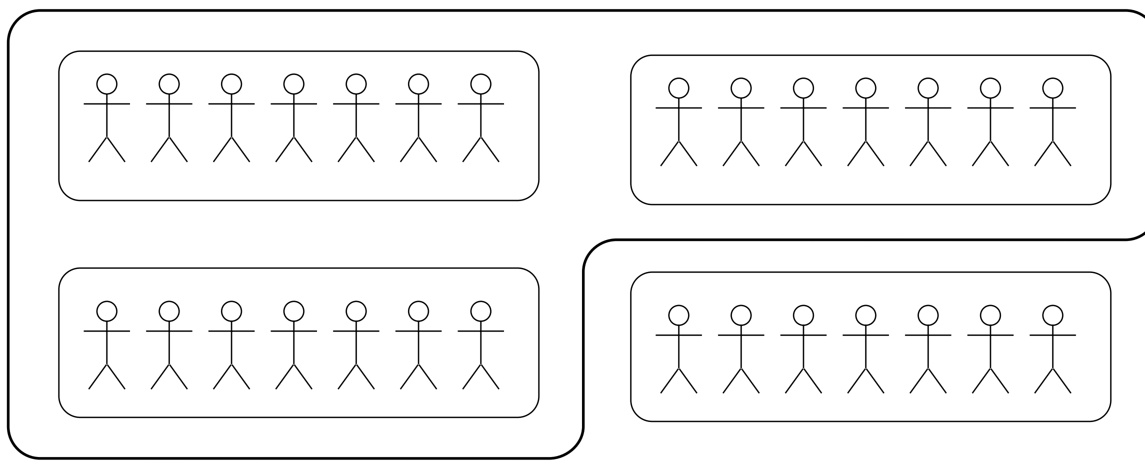
SKILL 33

Name ______________________ Date __________

Multiplying Whole Numbers by Fractions

Mr. Quin's class has 28 students. He has enough computers for $\frac{3}{4}$ of the class members to work on the computers at any given time.

EXAMPLE ***How many students can use the computers at a time?***



$$\frac{3}{4} \times 28 = \frac{3}{4} \times \frac{28}{1}$$
$$= \frac{84}{4}$$
$$= 21$$

Twenty-one students can use the computers at a time.

EXERCISES ***Multiply. Write each product in simplest form.***

1. $\frac{1}{2} \times 50$

2. $\frac{1}{5} \times 30$

3. $\frac{1}{3} \times 6$

4. $\frac{1}{2} \times 9$

5. $7 \times \frac{1}{7}$

6. $15 \times \frac{1}{5}$

7. $\frac{2}{3} \times 9$

8. $\frac{3}{5} \times 10$

9. $16 \times \frac{3}{4}$

10. $\frac{5}{6} \times 8$

11. $14 \times \frac{1}{3}$

12. $24 \times \frac{7}{6}$

13. $\frac{4}{5} \times 25$

14. $18 \times \frac{1}{5}$

15. $16 \times \frac{3}{2}$

16. $20 \times w\frac{5}{4}$

17. $\frac{1}{2} \times 11$

18. $\frac{5}{7} \times 28$

APPLICATIONS ***A Native-American recipe for hickory nut corn pudding is given at the right. Use the recipe to answer Exercises 19–21.***

Hickory Nut Corn Pudding

$1\frac{1}{2}$ cups cooked corn

$\frac{1}{2}$ cup shelled dried hickory nuts, chopped

2 tablespoons nut butter

1 cup boiling water

2 eggs, beaten

2 tablespoons honey

2 tablespoons corn meal

$\frac{1}{4}$ cup raisins

Combine all ingredients into a well-greased casserole dish. Bake at 350°F for 1 hour. Serve hot.

19. How many cups of hickory nuts should be used if the recipe is tripled?

20. How many cups of raisins should be used if the recipe is to be multiplied by 6?

21. How much corn meal should be used if the recipe is to be cut by one third?

22. A meteorologist in a midwestern city checked the weather records for the first 90 days of the year for the past several years. She observed that each year about $\frac{2}{3}$ of these days were sunny. How many of the first 90 days of this coming year should she expect to be sunny?

23. In 1936, Franklin D. Roosevelt won the presidential election with about $\frac{3}{5}$ of the popular vote. There were about 46,000,000 votes cast in that election. About how many popular votes did F.D.R. receive?

24. About $\frac{1}{3}$ of the people living in Africa live in urban areas. In 1992, there were about 681,700,000 people living in Africa. About how many people lived in urban areas?

SKILL 34

Name ______________________ Date __________

Dividing Fractions

To divide by a fraction, multiply by its reciprocal. Simplify the quotient if possible.

EXAMPLES ***Divide $\frac{2}{3}$ by $\frac{5}{7}$.***

$\frac{2}{3} \div \frac{5}{7} = \frac{2}{3} \times \frac{7}{5}$ *Multiply by the reciprocal of $\frac{5}{7}$.*

$= \frac{2 \times 7}{3 \times 5}$ *Multiply the numerators.*
Multiply the denominators.

$= \frac{14}{15}$

The quotient is $\frac{14}{15}$.

Divide $\frac{3}{4}$ by $\frac{9}{10}$.

$\frac{3}{4} \div \frac{9}{10} = \frac{3}{4} \times \frac{10}{9}$ *Multiply by the reciprocal of $\frac{9}{10}$.*

$= \frac{3 \times 10}{4 \times 9}$ *Multiply the numerators.*
Multiply the denominators.

$= \frac{30}{36}$ or $\frac{5}{6}$ *Simplify.*

The quotient is $\frac{5}{6}$.

EXERCISES ***Divide.***

1. $\frac{3}{4} \div \frac{1}{2}$

2. $\frac{4}{5} \div \frac{1}{3}$

3. $\frac{1}{5} \div \frac{1}{4}$

4. $\frac{4}{7} \div \frac{8}{9}$

5. $\frac{3}{8} \div \frac{3}{4}$

6. $\frac{9}{7} \div \frac{3}{14}$

7. $\frac{4}{5} \div \frac{2}{5}$

8. $\frac{7}{8} \div \frac{1}{4}$

9. $\frac{2}{5} \div \frac{5}{8}$

10. $\frac{1}{3} \div \frac{1}{6}$

11. $\frac{5}{8} \div \frac{5}{12}$

12. $\frac{4}{5} \div \frac{2}{7}$

13. $\frac{2}{5} \div \frac{3}{10}$

14. $\frac{5}{7} \div \frac{3}{4}$

15. $\frac{2}{3} \div \frac{4}{9}$

16. $\frac{4}{7} \div \frac{4}{5}$

17. $\frac{5}{6} \div \frac{1}{9}$

18. $\frac{4}{5} \div \frac{2}{3}$

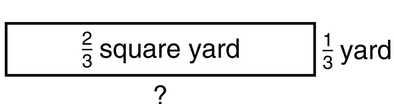
APPLICATIONS

19. About $\frac{1}{20}$ of the population of the world lives in South America. If about $\frac{1}{35}$ of the population of the world lives in Brazil, what fraction of the population of South America lives in Brazil?

20. Three fourths of a pizza is left. If the pizza was originally cut in $\frac{1}{8}$ pieces, how many pieces are left?

The area of each rectangle is given. Find the missing length for each rectangle.

21.



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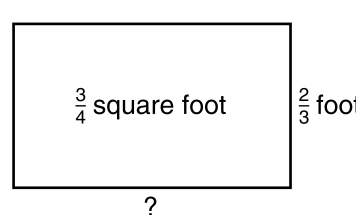

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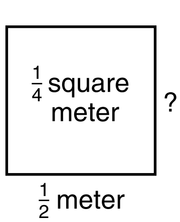

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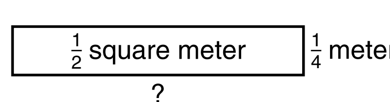


SKILL 35

Name ____________________ Date __________

Multiplying Whole Numbers and Decimals

EXAMPLES ***Multiply 182 by 51.***

$$\begin{array}{r} 182 \\ \times\ 51 \\ \hline 182 \\ 910 \\ \hline 9{,}282 \end{array}$$

The product is 9,282.

Multiply 8.4 by 0.62.

$$\begin{array}{rl} 8.4 & \leftarrow \textit{1 decimal place} \\ \times\ 0.62 & \leftarrow \textit{2 decimal places} \\ \hline 168 & \\ 5\ 04 & \\ \hline 5.208 & \leftarrow \textit{3 decimal places} \end{array}$$

The sum of the decimal places in the factors is 3, so the product has 3 decimal places.

The product is 5.208.

EXERCISES ***Multiply.***

1. $\begin{array}{r} 147 \\ \times\ 6 \\ \hline \end{array}$

2. $\begin{array}{r} 63 \\ \times\ 51 \\ \hline \end{array}$

3. $\begin{array}{r} 182 \\ \times\ 51 \\ \hline \end{array}$

4. $\begin{array}{r} 62 \\ \times\ 12 \\ \hline \end{array}$

5. $\begin{array}{r} 5.84 \\ \times\ 0.08 \\ \hline \end{array}$

6. $\begin{array}{r} 0.33 \\ \times\ 6.5 \\ \hline \end{array}$

7. $\begin{array}{r} 2.48 \\ \times\ 0.66 \\ \hline \end{array}$

8. $\begin{array}{r} 0.55 \\ \times\ 1.7 \\ \hline \end{array}$

9. $\begin{array}{r} 1.2 \\ \times\ 0.003 \\ \hline \end{array}$

10. $\begin{array}{r} 0.52 \\ \times\ 0.03 \\ \hline \end{array}$

11. $\begin{array}{r} 29.1 \\ \times\ 0.29 \\ \hline \end{array}$

12. $\begin{array}{r} 0.0054 \\ \times\ \ 6.1 \\ \hline \end{array}$

APPLICATIONS ***Tonya is reading a map. Use the scale below to answer Exercises 13–15.***

Map Scale
1 centimeter = 34 kilometers

13. What is the distance represented by 16 centimeters on the map?

14. What is the distance represented by 7.4 centimeters on the map?

15. What is the distance represented by 12.8 centimeters on the map?

16. On the average, 130 words are listed on one page of a dictionary. How many words would you expect to be listed on 520 pages?

17. During his professional basketball career, Wilt Chamberlain averaged about 30.06 points per game for 1,045 games. How many points did he score in his career?

18. Stewart buys 2.8 pounds of steak. If the steak costs $5.70 per pound, what is the total cost of the steak?

19. The speed of the spinetailed swift has been measured at 106.25 miles per hour. At that rate, how far can it travel in an hour and a half?

SKILL 36

Name ______________________________ Date ______________

Dividing Decimals

EXAMPLE ***Divide 54.4 by 17.***

```
    3.2
17)54.4
   51
    3 4
    3 4
      0
```

Divide as with whole numbers, placing the decimal point above the decimal point in the dividend.

The quotient is 3.2.

Divide 0.5194 by 0.49.

```
              1.06
0.49.)0.51.94
         49
          2 9
            0
          2 94
          2 94
             0
```

Change 0.49 to 49 by moving the decimal point two places to the right.

Move the decimal point in the dividend the same number of places to the right.

Divide as with whole numbers placing the decimal point above the new point in the dividend.

The quotient is 1.06.

EXERCISES ***Divide.***

1. $5\overline{)125}$ **2.** $8\overline{)992}$ **3.** $24\overline{)43.2}$

4. $11\overline{)3.091}$ **5.** $3\overline{)3.066}$ **6.** $2.4\overline{)0.192}$

7. $0.3\overline{)129}$ **8.** $0.44\overline{)52.8}$ **9.** $4.5\overline{)40.05}$

10. $0.3\overline{)3.066}$ **11.** $4.5\overline{)40.05}$ **12.** $11\overline{)30.91}$

13. $1.4\overline{)121.8}$ **14.** $8\overline{)0.0092}$ **15.** $0.38\overline{)760.38}$

APPLICATIONS ***Herman's Farm Market lists its prices below. Use this information to answer Exercises 16–18.***

Herman's Farm Market	
Tomatoes	3 pounds for $2.16
Corn	1 dozen for $4.20
Potatoes	5 pounds for $2.15

16. What is the price of tomatoes per pound?

17. What is the price of the potatoes per pound?

18. What is the price for one ear of corn?

19. Sue earns $195.20 in a week in which she works 30.5 hours. What is Sue's hourly pay rate?

20. Three friends plan to divide the cost of a birthday gift for another friend. If the cost of the gift is $16.38, what is each person's share of the cost?

21. What is the cost of a gallon of gasoline at a gasoline station where a sale of 6.8 gallons costs a customer $9.18?

22. A dolphin can swim at a speed of about 37 miles per hour. The fastest human swimmer can reach a speed of about 5.2 miles per hour. About how many times faster than humans are dolphins?

SKILL 37

Name ______________________ Date __________

Mean, Median, Mode

You can analyze a set of data by using three measures of center: mean, median, and mode.

EXAMPLE ***Hakeem Olajuwon, 1994's Most Valuable Player in the National Basketball Association, helped the Houston Rockets win the NBA championship. In winning the 7-game series, Olajuwon scored 28, 25, 21, 32, 27, 30, and 25 points. Find the mean, median, and mode of his scores.***

Mean: $\frac{28 + 25 + 21 + 32 + 27 + 30 + 25}{7} \approx 26.857$

The mean is about 27 points.

Median: 21, 25, 25, 27, 28, 30, 32

↑ median

The median is 27.

Mode: The mode is 25 since it is the number that appears the most times.

EXERCISES ***Find the mean, median, and mode for each set of data.***

1. 5, 4, 7, 2, 2, 1, 4, 3

2. 25, 18, 14, 27, 25, 16, 18, 25

3. 13, 11, 7, 9, 12, 5

4. 234, 163, 634, 267, 545, 874

5. 23, 36, 48, 95, 36, 28, 24

6. 299, 100, 237, 492, 333, 263, 295

7. 2,500, 2,366, 1,939, 1,933, 1,835, 2,498, 2,943

8. 9, 2, 5, 7, 8, 9, 4, 4, 6, 4

9. 29, 48, 20, 43, 33, 20, 40, 69, 48

10. 7,899, 4,395, 9,090, 9,588, 4,880, 9,587, 4,756

APPLICATIONS ***The data at the right shows the record high temperatures for several states in the U.S. Use the data to answer Exercises 11–15.***

State	Record High Temperature (°F)
Alabama	112
Alaska	100
Michigan	112
Oklahoma	120
Vermont	105
Wyoming	114

11. What is the mode?
12. What is the median?
13. What is the mean?
14. If each of the high temperatures increased by 1°F, would it change
a. the mode? Why or why not?

b. the median? Why or why not?

c. the mean? Why or why not?

15. If the high temperature for Vermont increased to 112°F, would it change
a. the mode? Why or why not?

b. the median? Why or why not?

c. the mean? Why or why not?

16. Find the hand spans of ten people. Ask each person to spread apart the little finger and thumb of his or her right hand as far as possible. Then measure and record the distance from tip to tip to the nearest centimeter. Find the mean, median, and mode for the data you collected.

SKILL 38

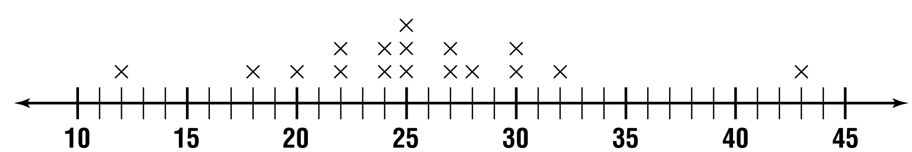
Name ______________________________ Date ____________

Line Plots

Darrell surveyed some kennels to find the cost of grooming his dog. The prices are: $25.00, $27.00, $32.00, $22.00, $43.00, $28.00, $18.00, $24.00, $25.00, $27.00, $30.00, $24.00, $22.00, $30.00, $12.00, $25.00, and $20.00.

EXAMPLE ***Organize this information using a line plot.***

The lowest price is $12.00, and the highest price is $43.00. Draw a number line that includes the numbers 12 to 43. Place an X above the number line to represent each price.



EXERCISES ***Make a line plot for each set of data.***

1. 23, 20, 23, 32, 35, 26, 35, 35, 44

2. 133, 139, 133, 139, 132, 132, 132, 132

3. 400, 600, 600, 200, 400, 1,000, 400

4. 5.3, 5.1, 5.0, 5.0, 6.0, 5.5, 5.3

5. 212, 215, 200, 203, 230, 227, 221, 218, 224

6. $4.30, $4.30, $4.10, $4.30, $4.30, $4.60, $4.10

APPLICATIONS ***Make a line plot for each set of data.***

7. The prices of appetizers at Ralph's Restaurant are listed below
$3.95, $6.95, $4.95, $3.95,
$5.95, $3.95, $4.95, $3.95,
$4.95, $4.95, $5.95, $4.95,
$3.95, $4.95, $4.95, $5.95

8. Miss Allen asked her students during which half-hour they usually wake up on school days. The results are listed below.
5:30, 7:00, 6:30, 6:00, 6:30, 7:00,
6:30, 6:30, 6:30, 7:00, 7:00, 6:30,
6:30, 7:30, 7:00, 6:30, 6:00, 7:00

9. The weights of the junior varsity wrestlers are listed below.
170, 160, 135, 135, 160, 122, 188, 154,
135, 140, 122, 103, 190, 154, 108, 150

10. The scores on a sixty-point history test are listed below.
55, 52, 49, 53, 38, 46, 52, 60, 55, 49,
32, 47, 55, 48, 60, 51, 47, 44, 37, 51

11. Ask your classmates to rate a certain television program from 1 to 10 with 10 being the best. Write down their responses and organize this information into a line plot.

SKILL 39

Name ______________________________ Date ____________

Unit Rate

EXAMPLE

Mr. Lee's car burned 6 gallons of gas when he drove 120 miles. Ms. Mendoza drove her car 100 miles and used 4 gallons of gas. Which car gets more miles per gallon of gas?

Miles per gallon is a *unit rate*. This unit rate means how many miles a car can drive using 1 gallon of gas.

To find the unit rate for each, set up a ratio.

miles driven/gallons of gas

Mr. Lee's Car
120 miles/6 gallons

Ms. Mendoza's Car
100 miles/4 gallons

Divide the numerator by the denominator to find how many miles the car can drive on 1 gallon of gas.

Mr. Lee's Car
120 miles/6 gallons
120 ÷ 6 = 20 miles/gallon

Ms. Mendoza's Car
100 miles/4 gallons
100 ÷ 4 = 25 miles/gallon

Now you can compare the unit rates. Ms. Mendoza's car gets 25 miles per gallon, while Mr. Lee's car gets only 20 mile per gallon. So Ms. Mendoza's car gets more miles per gallons than Mr. Lee's.

EXERCISES ***Calculate a unit rate for each situation.***

1. 5 pounds of apples cost $7.25. How much do apples cost per pound?

2. 245 busses carried 8575 students to school. How many students were there per bus?

3. An airplane flew 1692 miles in 3 hours. What was the plane's speed in miles per hour?

4. T-shirts are on sale at 5 for $33. What is the unit rate per shirt?

EXERCISES ***Use unit rates to solve each problem.***

5. The SuperLaser printer prints 13 pages in 3 minutes. The PhotoFlash printer prints 26 pages in 5 minutes. Find the unit rate per page. Which printer prints faster?

6. At QuickShop, 6 cans of cat food cost $10. At Hopper's Grocery, cat food costs $7.50 for 4 cans. Find the price per can at each store. Which store gives you a better deal?

7. Jane walked 3 miles in 45 minutes. Alexis walked 5 miles in 1 hour and 40 minutes. Find the rate for each walker. Who walked faster?

8. SonicBoom is having a sale on CD's. Buy any 8 CDs for $46. What is the unit rate of each CD?

APPLICATIONS ***At Sheffield Farms, you can pick your own fruit. Strawberries cost $3/quart, raspberries cost $4.50/quart, and blueberries cost $2.50/quart. Mark picked 4 quarts of each kind of berry.***

9. Which cost more: 4 quarts of strawberries, or 4 quarts of raspberries?

10. How much did all 12 quarts cost together?

11. What was the average (mean) price per quart that Mark paid for his berries?

Mark mixed all the berries together and put them in the blender with milk and ice to make smoothies. Each quart of berries made 1.5 quarts of smoothie. He sold the smoothies at his town's Summer Fair. He wanted to make a profit, so he sold the smoothies for more than it cost to make them.

12. How much did it cost Mark to make 1 quart of smoothie?

13. What price should Mark charge for the smoothies in order to make a profit?

14. If Mark sells 3 quarts of smoothie for $7.35, will he make or lose money? Explain your reasoning.

SKILL 40

Name ________________________________ Date ______________

Proportions

A proportion is an equation that shows that two ratios are equivalent. The cross products of a proportion are equal.

EXAMPLE ***Determine if the ratios $\frac{2}{3}$ and $\frac{12}{18}$ form a proportion.***

Find the cross products of $\frac{2}{3} = \frac{12}{18}$.

$$2 \times 18 = 36$$

$$3 \times 12 = 36$$

So, $\frac{2}{3} = \frac{12}{18}$ is a proportion.

If one term of a proportion is not known, you can use cross products to find the term. This is called *solving the proportion.*

EXAMPLE ***Solve $\frac{r}{24} = \frac{7}{8}$.***

$$\frac{r}{24} = \frac{7}{8}$$

$$r \times 8 = 24 \times 7$$ *Find the cross products.*

$$8r = 168$$

$$\frac{8r}{8} = \frac{168}{8}$$ *Divide each side by 8.*

$$r = 21$$

Therefore, r equals 21.

EXERCISES ***Solve each proportion.***

1. $\frac{2}{n} = \frac{5}{10}$

2. $\frac{5}{8} = \frac{m}{24}$

3. $\frac{12}{20} = \frac{k}{15}$

4. $\frac{3.5}{m} = \frac{16}{32}$

5. $\frac{6}{30} = \frac{n}{50}$

6. $\frac{75}{r} = \frac{6}{2}$

7. $\frac{f}{0.8} = \frac{2}{8}$

8. $\frac{15}{120} = \frac{t}{16}$

9. $\frac{7}{9} = \frac{c}{36}$

APPLICATIONS

10. Holly was absent from school 8 out of 36 days. Juan was absent 9 out of 45 days. Do these ratios form a proportion?

11. Denise needed 4 hours to paint 1,280 square feet of wall space. How much time would she need to paint 1,600 square feet of space?

12. On a map, the scale is 1 inch:125 miles. What is the actual distance if the map distance is $4\frac{1}{2}$ inches?

13. If you spend 1.5 hours per day doing homework, how many hours would you spend doing homework in 8 days?

14. Jenny got 3 hits in her first 8 at-bats this season. How many hits must she get in her next 40 at-bats to maintain this ratio?

15. Josh spends 40 cents out of every dollar on snacks and 14 cents out of every dollar on school supplies. He puts the rest in a savings account. If Josh earns $32.00 per week cutting lawns, how much does he save per week?

SKILL 41

Name ______________________ **Date** ____________

Percent of Change

A **percent of change** tells the percent an amount has increased or decreased. When an amount increases, the percent of change is a **percent of increase.**

EXAMPLE

According to the U.S. Department of Labor, there were approximately 126,708,000 people employed in 1996. In 2002, there were about 136,485,000 people employed. Find the percent of increase in the number of people employed.

To find the percent of increase, you can follow these steps.

1. Subtract to find the amount of change.
$136{,}485{,}000 - 126{,}708{,}000 = 9{,}777{,}000$ *new − original*

2. Write a ratio that compares the amount of change to the original amount. Express the ratio as a percent.

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

$$= \frac{9{,}777{,}000}{126{,}708{,}000} \quad \textit{Substitution}$$

$$\approx 0.0772$$

The number of people employed increased about 7.72%.

When the amount decreases, the percent of change is a **percent of decrease.** Percent of decrease can be found using the same steps.

EXAMPLE

A handheld computer that originally sells for $249 is on sale for $219. What is the percent of decrease of the price of the computer?

$249 - 219 = 30$ *original price − new price*

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

$$= \frac{30}{249} \quad \textit{Substitution}$$

$$\approx 0.12$$

The percent of decrease in the price of the handheld computer is about 12%.

EXERCISES

Find the percent of change. Round to the nearest tenth.

1. old: $14.50
new: $13.05

2. old: 237 students
new: 312 students

3. old: 27.4 inches of snow
new: 22.8 inches of snow

4. old: 12,000 cars per hours
new: 14,300 cars per hour

5. old: 2.3 million bushels
new: 3.1 million bushels

6. old: $119.50
new: $79.67

7. old: $7,082
new: $10,189

8. old: 37.5 hours
new: 42.0 hours

9. old: 74.8 million acres
new: 67.5 million acres

10. old: 5.7 liters
new: 4.8 liters

APPLICATIONS

11. At the beginning of the day, the stock market was at 10,120.8 points. At the end of the day, it was at 10,058.3 points. What was the percent of change in the stock market value?

12. An auto manufacturer suggests a selling price of $32,450 for its sport coupe. The next year it suggests a selling price of $33,700. What is the percent of change in the price of the car?

13. The U.S. Consumer Price Index in 1990 was 391.4. By 2000 the Consumer Price Index was 515.8. Find the percent of change.

14. During the past school year, there were 2,856 students at Main High School. The next year there were 3,042 students. What was the percent of change?

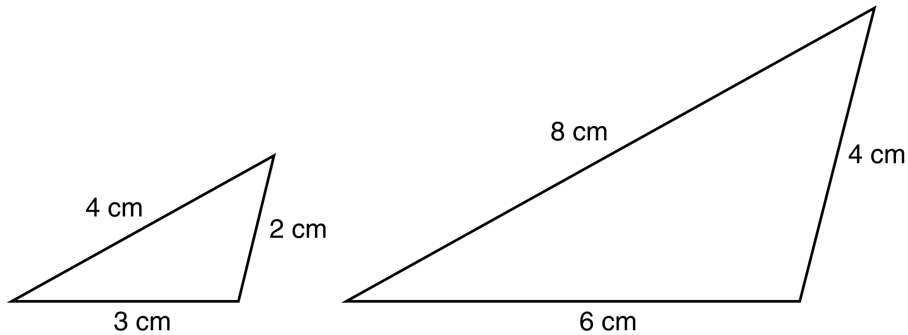
15. During a clearance sale, the price of a television is reduced from $1,099 to $899 the first week. The next week, the price of the television is lowered to $739. What is the percent of change each week? What is the percent of change from the original price to the final price?

SKILL 42

Name ______________________ Date ____________

Similar Triangles

The triangles below are similar.



EXAMPLE

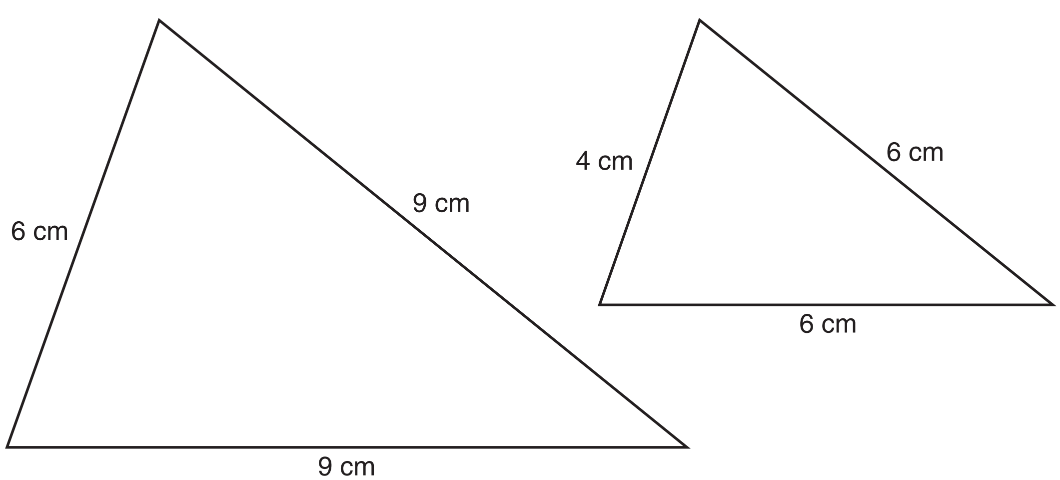
Measure each side of the triangles to the nearest centimeter. Write the ratios of the corresponding sides of the similar triangles. What do you no tice about the ratios of the corresponding sides?

The measures of the sides are marked next to the triangles.

$\frac{\text{side of the first triangle}}{\text{side of the second triangle}}$ $\quad \frac{3}{6} = \frac{1}{2} \quad \frac{2}{4} = \frac{1}{2} \quad \frac{4}{8} = \frac{1}{2}$

The ratios of the corresponding sides all equal $\frac{1}{2}$.

EXERCISES ***Use the similar triangles below to answer Exercises 1–3.***



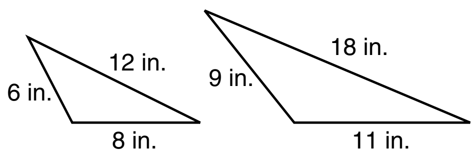
1. Measure each side of each triangle to the nearest centimeter.

2. Find the ratios of the corresponding sides.

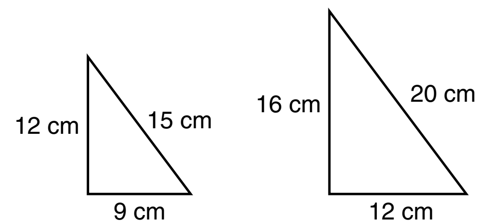
3. What do you notice about the ratios of the corresponding sides?

Determine if each pair of triangles is similar.

4.

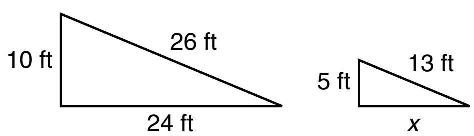


5.

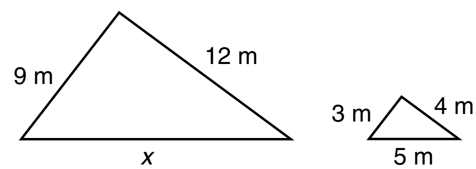


Find the value of x in each pair of similar triangles.

6.

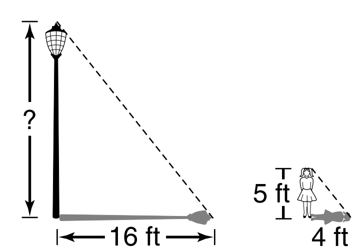


7.

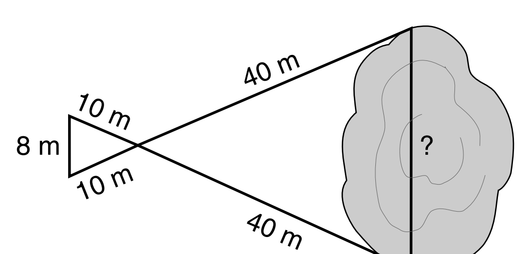


APPLICATIONS

8. A lamppost casts a shadow 16 feet. A girl standing nearby casts a shadow of 4 feet. The two triangles formed are similar. If the girl is 5 feet tall, how tall is the lamppost?



9. Use similar triangles to find the distance across the pond.



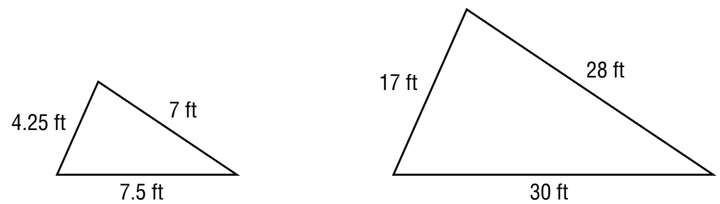
SKILL 43

Name ______________________________ Date __________

Similar Figures

Figures that have the same shape but not necessarily the same size are similar. You can use ratios to determine whether two figures are similar.

EXAMPLE ***Determine if the triangles are similar.***



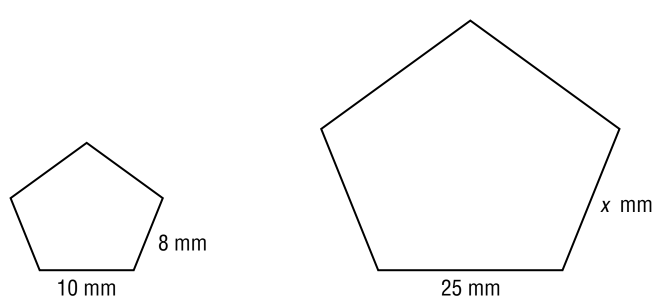
Write ratios comparing the sides of one triangle to the corresponding sides of the other triangle.

$$\frac{\text{side measure of first triangle}}{\text{side measure of second triangle}} \quad \frac{4.25}{17} = \frac{1}{4} \quad \frac{7}{28} = \frac{1}{4} \quad \frac{7.5}{30} = \frac{1}{4}$$

The ratios of the corresponding sides all equal $\frac{1}{4}$. Therefore, the triangles are similar.

Proportions can be used to determine the measures of the sides of similar figures.

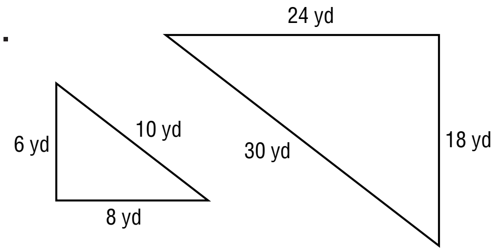
EXAMPLE ***The pentagons are similar. Find the value of x.***



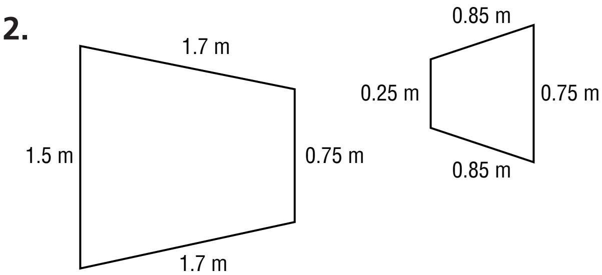
$\frac{10}{25} = \frac{8}{x}$	*Write a proportion.*
$(10)(x) = (25)(8)$	*Cross multiply.*
$10x = 200$	*Simplify.*
$\frac{10x}{10} = \frac{200}{10}$	*Divide each side by 10.*
$x = 20$	*Simplify.*

EXERCISES ***Determine if each pair of figures is similar.***

1.

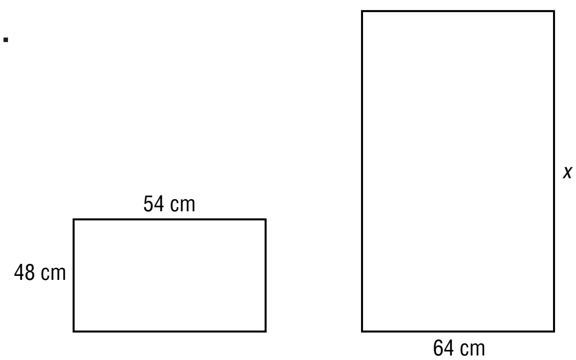


2.

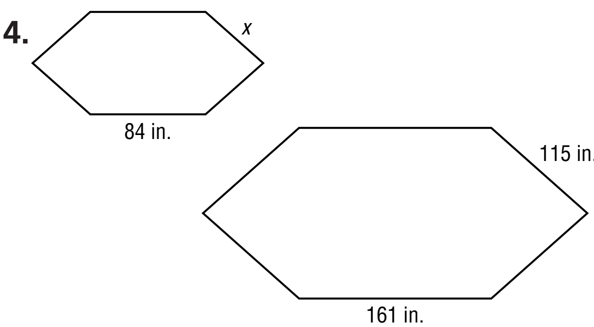


Find the value of x in each pair of similar figures.

3.

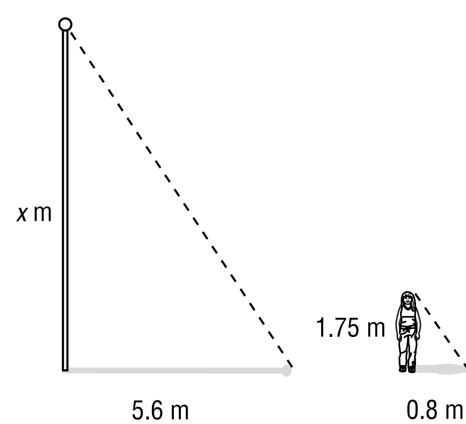


4.

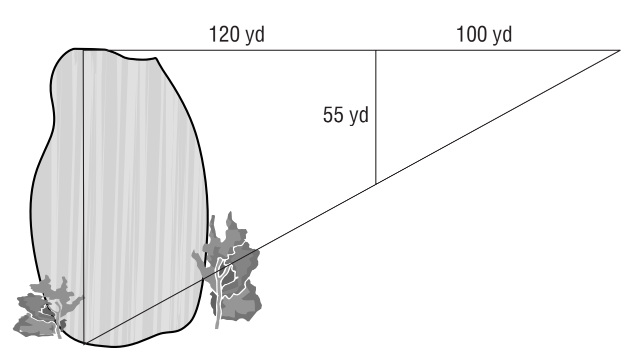


APPLICATIONS

5. A flagpole casts a shadow 5.6 meters long. Isabel is 1.75 meters tall and casts a shadow 0.8 meter long. How tall is the flagpole?



6. Will and Kayla want to know how far it is across a pond. They made the sketch at the right. How far is it across the pond?



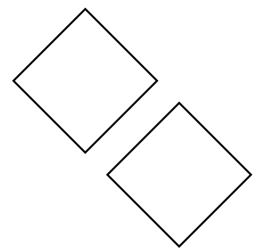
SKILL 44

Name ____________________ Date __________

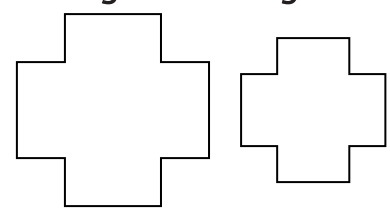
Congruent Figures

Two or more figures that are the same shape and same size are **congruent figures.**

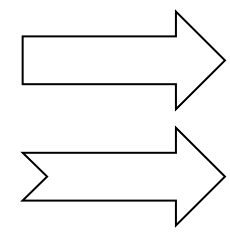
EXAMPLE ***Determine if each pair of figures is congruent.***



The figures are the same size and the same shape. The figures are congruent.



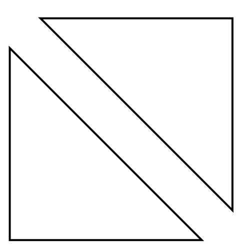
The figures are the same shape, but not the same size. The figures are not congruent.



The figures are the same size, but not the same shape. The figures are not congruent.

EXERCISES ***Detemine if each pair of figures is congruent. Explain.***

1.



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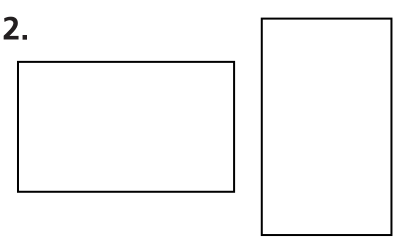

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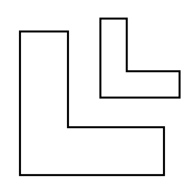

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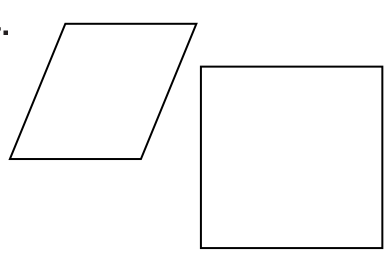

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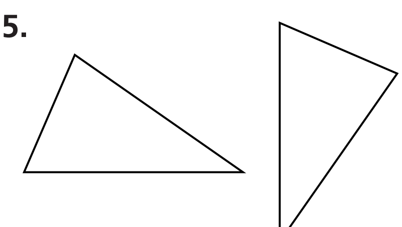
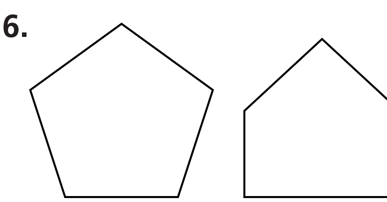
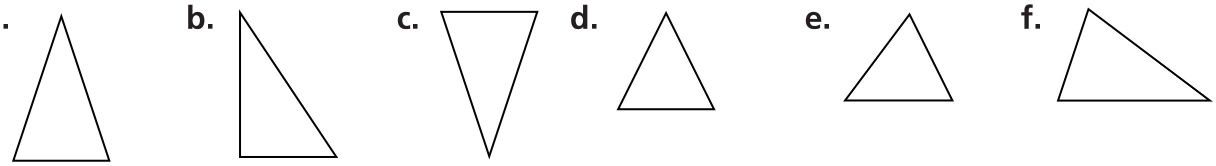


6.



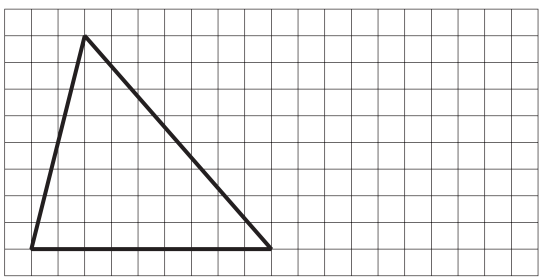
7. List the congruent figures.

a. **b.** **c.** **d.** **e.** **f.**



In Exercises 8–11, use the grid to draw a figure that is congruent to the given figure.

8.



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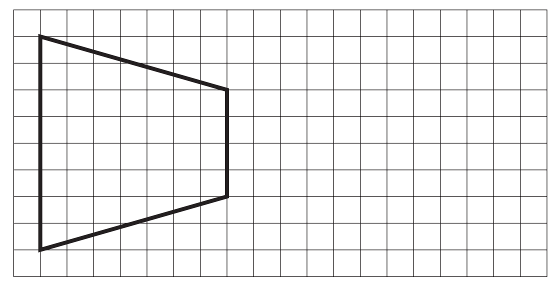

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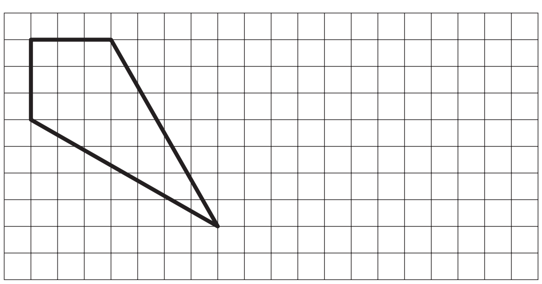
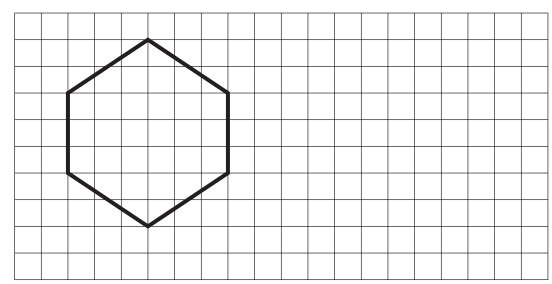
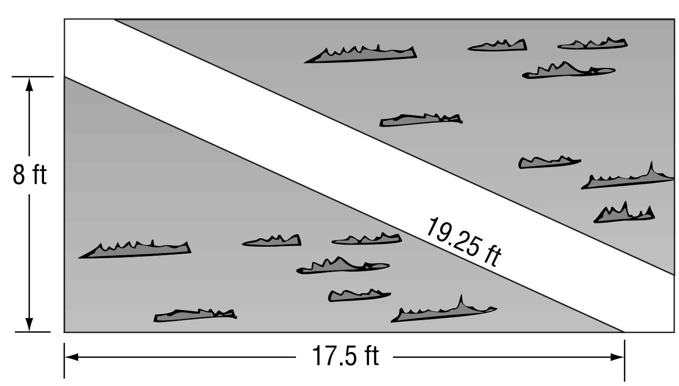


11.

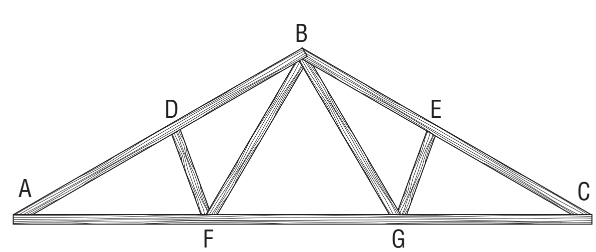


APPLICATIONS

12. Suni is dividing her back yard into two equal-sized gardens with a walkway dividing them. If she wants to put a fence around the outside of Garden 2, how much fencing material will she need.



13. A pattern for a roof truss is shown at the right. Use the labels in the figures and name all the sets of triangles that appear to be congruent.



SKILL 45

Name ______________________ Date ____________

Percents as Fractions and Decimals

To write a percent as a fraction, write a fraction with the percent in the numerator and with a denominator of 100, $\frac{r}{100}$. Then write the fraction in simplest form.

EXAMPLES ***Express each percent as a fraction.***

a. 40%

$$40\% = \frac{40}{100} = \frac{2}{5}$$

Therefore, $40\% = \frac{2}{5}$.

b. $87\frac{1}{2}\%$

$$87\frac{1}{2}\% = \frac{87\frac{1}{2}}{100} = \frac{\frac{175}{2}}{100} = \frac{175}{2} \times \frac{1}{100} = \frac{175}{200} = \frac{7}{8}$$

Therefore, $87\frac{1}{2}\% = \frac{7}{8}$.

To express a percent as a decimal, first express the percent as a fraction with a denominator of 100. Then express the fraction as a decimal.

EXAMPLES ***Express each percent as a decimal.***

a. 51%

$$51\% = \frac{51}{100} = 0.51$$

Therefore, 51% = 0.51.

b. 90.2%

$$90.2\% = \frac{90.2}{100} = \frac{90.2 \times 10}{100 \times 10} = \frac{902}{1{,}000} = 0.902$$

Therefore, 90.2% = 0.902.

EXERCISES ***Express each percent as a fraction.***

1. 75%   **2.** 84%   **3.** 90%   **4.** $18\frac{1}{2}$%

5. 38%   **6.** $33\frac{1}{3}$%   **7.** 56%   **8.** 60%

Express each percent as a decimal.

9. 82%   **10.** 61.5%   **11.** 8.9%   **12.** $48\frac{1}{2}$%

13. 70%   **14.** $27\frac{1}{4}$%   **15.** 3%   **16.** 0.25%

Write each percent as a fraction in simplest form and write as a decimal.

17. 18%   **18.** 22%

19. $82\frac{1}{2}$%   **20.** $\frac{5}{8}$%

21. $91\frac{2}{3}$%   **22.** 19.6%

23. 0.5625%   **24.** 4.9%

APPLICATIONS

25. The average household in the United States spends 15% of its money on food. Express 15% as a decimal.

26. Bananas grow on plants that can be 30 feet tall. A single banana may be 75% water. Express 75% as a fraction and as a decimal.

27. In the United States, showers usually account for 32% of home water use. Express this percent as a fraction and as a decimal.

28. Only 2% of earthquakes in the world occur in the United States. Express this percent as a fraction and as a decimal.

SKILL 46

Name ______________________ Date __________

Percent of a Number

To find the percent of a number, you can either change the percent to a fraction and then multiply, or change the percent to a decimal and then multiply.

EXAMPLE

The old Yankee Stadium in New York had a capacity of about 57,500. If attendance for one baseball game was about 90%, approximately how many people attended the game?

Change the percent to a decimal.

$90\% = \frac{90}{100}$ or 0.9

Multiply the number by the decimal.

$57{,}500 \times 0.9 = 51{,}750$

About 51,750 people attended the game.

EXERCISES ***Find the percent of each number.***

1. 50% of 48

2. 25% of 164

3. 70% of 90

4. 60% of 125

5. 55% of 960

6. 35% of 600

7. 15% of 120

8. 6% of 50

9. 200% of 13

10. 55% of 84

11. 16% of 48

12. 150% of 60

13. 45% of 80

14. 60% of 40

15. 18% of 300

16. 5% of 16

17. 15% of 50

18. 100% of 47

19. 12.5% of 60

20. 0.02% of 80

21. 0.5% of 180

22. 0.1% of 770

23. 1.4% of 40

24. 1.05% of 62

25. $12\frac{1}{2}$% of 70

26. $5\frac{3}{8}$% of 200

27. $2\frac{1}{4}$% of 150

28. $33\frac{1}{3}$% of 45

APPLICATIONS ***Sarah has a part-time job. Each week she budgets her money as shown in the table. Use this data to answer Exercises 29–31.***

Sarah's Budget	
Savings	40%
Lunches	25%
Entertainment	15%
Clothes	20%

29. If Sarah made $90 last week, how much can she plan to spend on entertainment?

30. If Sarah made $105 last week, how much should she plan to save?

31. If Sarah made $85 last week, how much can she plan to spend on lunches?

32. The population of the U.S. was about 290 million people in 2004. The population of the New York Metropolitan area was about 7.3% of the total. About how many people lived in the New York area in 2004?

33. Ninety percent of the seats of a flight are filled. There are 240 seats. How many seats are filled?

34. Of the people Joaquin surveyed, 60% had eaten lunch in a restaurant in the past week. If Joaquin surveyed 150 people, how many had eaten lunch in a restaurant in the past week?

35. A car that normally sells for $25,900 is on sale for 84.5% of the usual price. What is the sale price of the car?

SKILL 47

Name ______________________________ Date ____________

Percent Proportion

You can use the percent proportion to solve problems involving percents.

$\frac{a}{b} = \frac{p}{100}$ $\quad a$ = part $\quad b$ = base $\quad p$ = percent

EXAMPLES

23.4 is what percent of 65?

The part is 23.4 and the base is 65.

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

$$\frac{23.4}{65} = \frac{p}{100}$$

$$23.4 \cdot 100 = 65 \cdot p$$

$$2{,}340 = 65p$$

$$36 = p$$

23.4 is 36% of 65.

55% of what number is 33?

The part is 33 and the percent is 55% or $\frac{55}{100}$.

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

$$\frac{33}{b} = \frac{55}{100}$$

$$33 \cdot 100 = 55 \cdot b$$

$$3{,}300 = 55b$$

$$60 = b$$

55% of 60 is 33.

EXERCISES ***Tell whether each number is the part, base, or percent.***

1. What number is 25% of 20?

2. What percent of 10 is 5?

3. 14% of what number is 63?

4. 7 is what percent of 28?

5. 78% of what number is 50?

6. 72 is 24% of what number?

Write a proportion for each problem. Then solve. Round answers to the nearest tenth.

7. What percent of 25 is 5?

8. 9.3% of what number is 63?

9. 30% of what number is 27?

10. 126 is 39% of what number?

11. 61.6 is what percent of 550?

12. 108 is 18% of what number?

13. What percent of 84 is 20?

14. What percent of 400 is 164?

15. 29.7 is 55% of what number?

16. 18% of 350 is what number?

17. 61.5 is what percent of 600?

18. 72.4 is 23% of what number?

19. What number is 31% of 13?

20. $33\frac{1}{3}$% of what number is 15?

21. Use a proportion to find $12\frac{2}{3}$% of 462. Round to the nearest hundredth.

22. Use a proportion to determine what percent of 512 is 56. Round to the nearest hundredth.

23. Use a proportion to determine 23% of what number is 81.3. Round to the nearest hundredth.

APPLICATIONS

24. There are 18 girls and 15 boys in Tyler's homeroom. What percent of Tyler's homeroom are boys? Round to the nearest tenth.

25. If 32% of the 384 students in the eighth grade walk to school, about how many eighth graders walk to school?

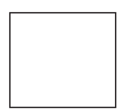
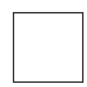
26. At North Middle School, 53% of the students are girls. There are 927 students at the school. How many of the students are girls?

SKILL **48**

Name ______________________ **Date** __________

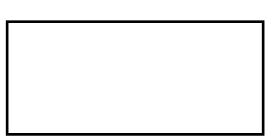
Area of Rectangles, Squares, and Parallelograms

Area is the number of square units needed to cover a surface.

Figure	Rectangle	Square	Parallelogram
Area Formula	$A = (\ell)(w)$ (ℓ = length) (w = width)	$A = s^2$ (s = side)	$A = (b)(h)$ (b = base) (h = height)
Example	 18 in. 20 in. $A = (\ell)(w)$ $A = (20)(18)$ $A = 360$ The area is 360 square inches.	 s = 4.5 ft $A = s^2$ $A = 4.5^2$ $A = 20.25$ The area is 20.25 square feet.	 2 m 12 m $A = (b)(h)$ $A = (12)(2)$ $A = 24$ The area is 24 square meters.

EXERCISES ***In Exercises 1–9, find the area of each figure shown or described.***

1.



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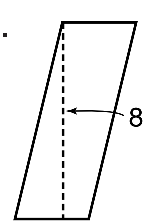
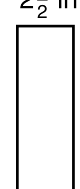


3.

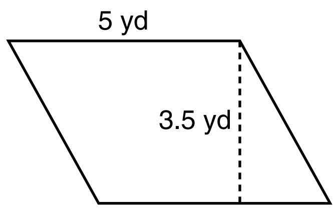


4. parallelogram
b = 15 ft
h = 21 ft

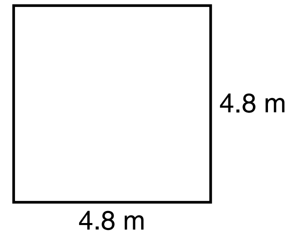
5. rectangle
ℓ = 7.5 cm
w = 12 cm

6. parallelogram
b = 4.7 m
h = 2.2 m

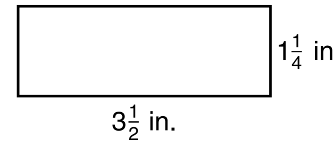
7.



8.



9.



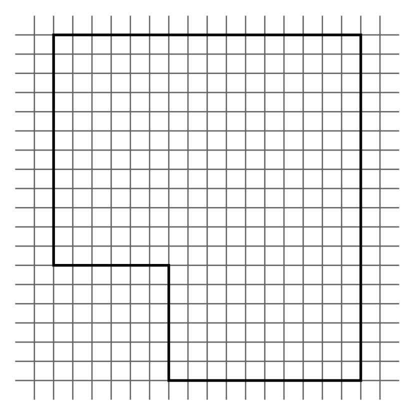
10. Find the area of a regulation-size volleyball court with a length of 59 feet and a width of 29.5 feet.

11. Find the length of a rectangle with an area of 84 square inches and a width of 7 inches.

12. Find the height of a parallelogram with a base of 12 yards and an area of 39 square yards.

APPLICATION

13. The figure at the right is the floor plan of a family room. The plan is drawn on grid paper, and each square of the grid represents one square foot. The floor is going to be covered completely with tiles.



a. What is the area of the floor?

b. Suppose each tile is a square with a side that measures one foot. How many tiles will be needed?

c. Suppose the cost of a 1 foot by 1 foot tile is \$3.50. How much would it cost to tile the entire floor?

d. Suppose the 1 foot by 1 foot tile had a cost of two tiles for \$6.99. How much would it cost to tile the entire floor?

SKILL 49

Name ______________________ Date __________

Area of Circles

The area of a circle is given by the formula $A = \pi r^2$ where A is the area and r is the radius.

EXAMPLE ***Gwen is making a circular rug with a radius of 3 feet. What will the area of the rug be that she is making?***

$A = \pi r^2$

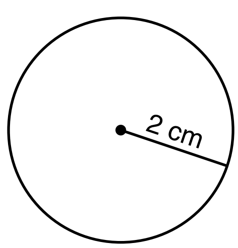
$A \approx 3.14 \cdot 3^2$ *Substitute 3.14 for π and 3 for r.*

$A \approx 3.14 \cdot 9$

$A \approx 28.26$

The area of the rug is about 28.26 square feet.

EXERCISES ***In Exercises 1–12, find the area of each circle shown or described. Use 3.14 for π.***

1.


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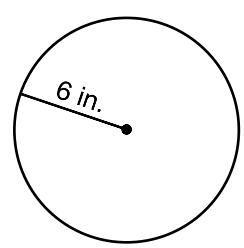
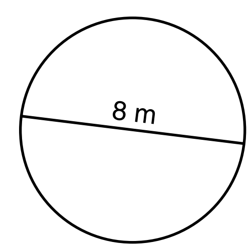


3.


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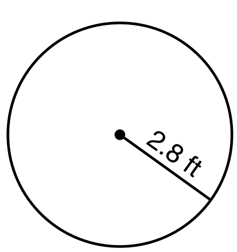

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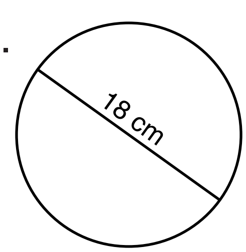

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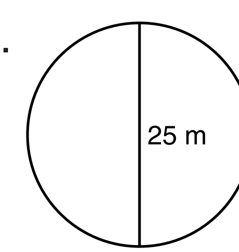


7. The radius is 5 m.

8. The radius is 10 ft.

9. The radius is 3.6 cm.

10. The diameter is 5 in.

11. The radius is 8.4 km.

12. The diameter is 4.6 yd.

APPLICATIONS ***Joani is preparing a circular garden with a diameter of 24 feet. Use this information to answer Exercises 13–16.***

13. What is the area of the garden?

14. She wants to cover the entire area with peat moss. If each bag of peat moss covers 160 square feet, how many bags of peat moss will she need?

15. Next year, she plans on increasing the diameter of the garden by 2 feet. What will the area of the new garden be?

16. How many bags of peat moss will she need to cover the new garden?

17. A large pizza from The Pizza Place has a diameter of 16 inches. A small pizza has a diameter of 10 inches. Which has the reater area, 1 large pizza or 2 small pizzas?

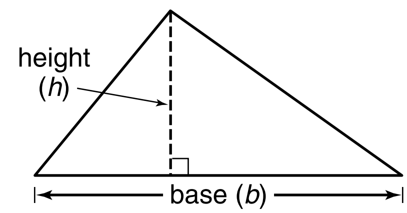
SKILL 50

Name ______________________ Date __________

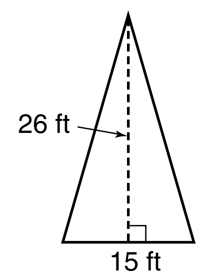
Area of Triangles

The area of a triangle is equal to one half the product of its base *(b)* and height *(h)*.

$$A = \frac{1}{2}bh$$



EXAMPLE ***Find the area of the triangle shown at the right.***



$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2} \times 15 \times 26$$

$$A = 195$$

The area of the triangle is 195 square feet.

EXERCISES ***Find the area of each triangle.***

1. base, 12 inches
height, 7 inches

2. base, 20 centimeters
height, 12 centimeters

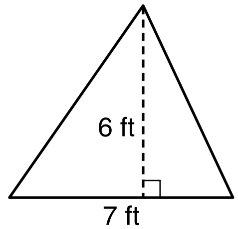
3. base, 8 feet
height, 24 feet

4. base, 17 meters
height, 6 meters

5. base, 6 kilometers
height, 13 kilometers

6. base, 10 yards
height, 20 yards

7.



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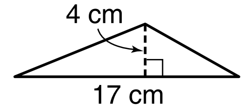

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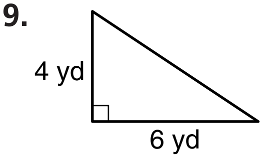

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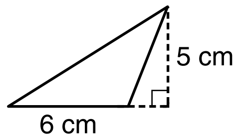

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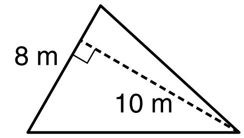

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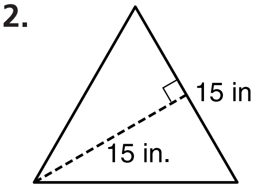

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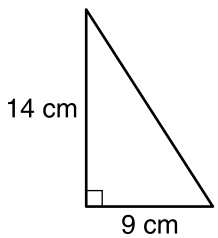

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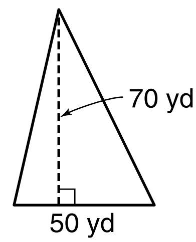

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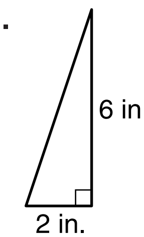
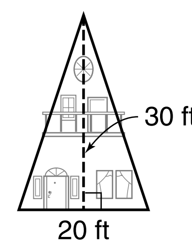
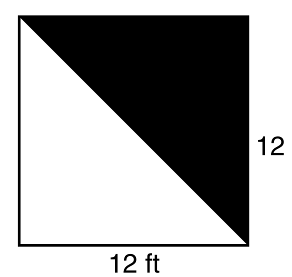


APPLICATIONS

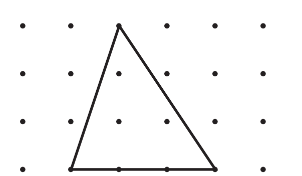
16. Tom Wise has an A-frame cabin. What is the area of the front of the home?



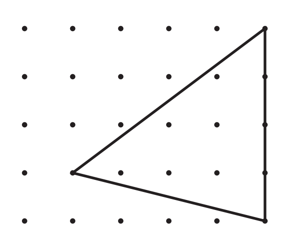
17. Tammy's bedroom is 12 feet by 12 feet. She plans to divide the room into two halves along the diagonal. She plans to carpet one half of the room with black carpet and the other half with white carpet. How many square feet of black carpet will she need?



18. Use a geoboard or dot paper to make the triangle at the right. What is the area of the triangle?



19. Use a geoboard or dot paper to make the triangle at the right. What is the area of the triangle?



20. Make a triangle on a geoboard or dot paper. Find the area of the triangle.

21. Make a triangle on a geoboard or dot paper that has an area of 8 square units.

SKILL 51

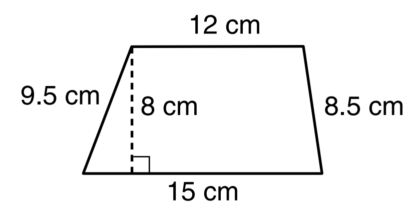
Name ______________________________ Date ______________

Area of Trapezoids

A trapezoid is a quadrilateral with exactly one pair of parallel sides. The area of a trapezoid is equal to the product of half the height and the sum of the bases.

$$A = \frac{1}{2}h(a + b)$$

EXAMPLE ***Find the area of the trapezoid shown at the right.***



$A = \frac{1}{2}h(a + b)$

$A = \frac{1}{2}(8)(15 + 12)$

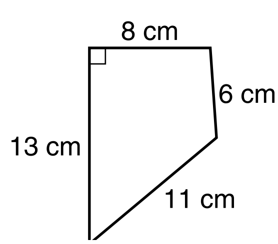
$A = \frac{1}{2}(8)(27)$

$A = 108$

The area of the trapezoid is 108 square centimeters.

EXERCISES ***In Exercises 1–6, find the area of each figure shown or described.***

1.



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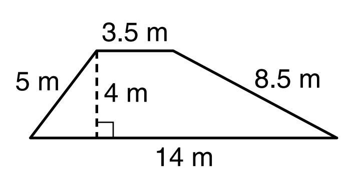

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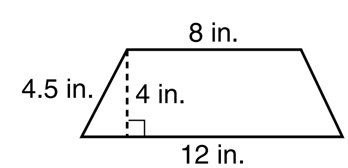
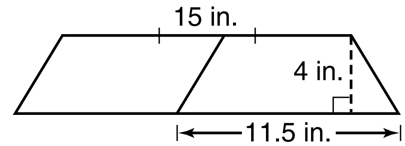


4. bases: 6 m, 9 m
height: 4 m

5. bases: 10 ft, 15 ft
height: 20 ft

6. bases: 7.6 cm, 10 cm
height: 8 cm

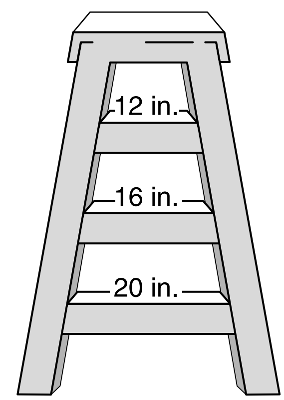
7. Find the area of the figure at the right.



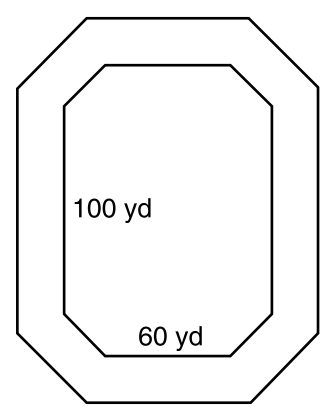
APPLICATIONS

8. Jose received a new entertainment center for his bedroom. It holds his TV, VCR, stereo, CD player, and tapes. It sits on a pedestal base that is the shape of a trapezoid. The two bases of the trapezoid are 36 inches and 28 inches long, and the height is 12 inches. What is the area of the front of the base?

9. Use the figure at the right to determine the area of the three trapezoidal-shaped spaces between the steps of the 4-foot ladder. The bottom base lengths are given for each space. The top base lengths are 2 inches shorter than the bottom base lengths. Each step between the spaces is 4 inches high and the spaces (including the bottom space) are all the same height.



10. Columbus, Montana has a football stadium that is shaped like the figure at the right. The center part is the field, and the outside part is the seats. The longest field length is 140 yards, and the longest field width is 100 yards. Find the area of the field.



SKILL 52

Name ____________________ Date ____________

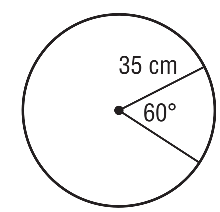
Area of Circle Sectors

A *circle sector* is the piece of the circle enclosed by two radii and the part of the circumference that connects them. It looks like a slice of pizza. The radius of the sector is the same as the radius of the circle. The sector's *central angle* is the angle formed by the two edges (radii) of the sector.

The formula to calculate the area of a circle sector is: $A = \frac{m}{360} \times \pi r^2$

In this formula, A represents the area of the circle sector, m represents the central angle measured in degrees, and r represents the radius.

EXAMPLE ***Calculate the area of the circle sector. Express your answer in terms of π, and as a decimal rounded to the nearest hundredth of a square unit.***



Use the formula to calculate the area. The formula is: $A = \frac{m}{360} \times \pi r^2$

A represents the area of the circle. This is the value you do not know and want to find. The variable m represents the central angle of the circle, measured in degrees. You know the value of m is 60°. You also know the value of r is 35 cm.

Rewrite the formula using the values you know:
$A = \frac{60°}{360°} \times \pi(35 \text{ cm})^2$.

Use the formula to calculate the area. Because all of the steps are either multiplication or division, you can perform the operations in whatever order is most convenient. For example:

$A = \frac{1}{6} \times \pi \times (35 \text{ cm})^2$ (divide 60 by 360)

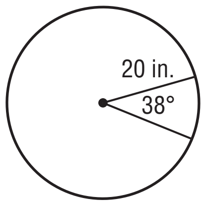
$A = \frac{1}{6} \times 1225\pi \text{ cm}^2$ (square 35 cm)

$A = 204.17\pi \text{ cm}^2$ (multiply $\frac{1}{6}$ by $1225\pi \text{ cm}^2$)

Remember that when you square 35 cm, the units change from centimeters to square centimeters.

EXERCISES ***Calculate the area of each circle sector. Use the units given in each figure. Express your answers in terms of π. Round to the nearest hundredth of a square unit.***

1.



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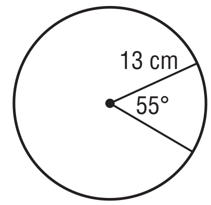

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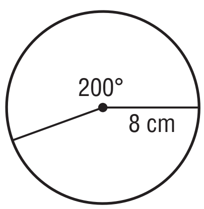

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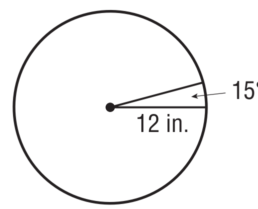


APPLICATIONS ***At Penelope's Pizza Parlour, a small pizza has a radius of 6 inches and is cut into 6 slices. The radius of a large pizza is 9 inches and is cut into 8 slices.***

5. What is the area of one slice of a small pizza?

6. What is the area of one slice of a large pizza?

7. Penelope cut a slice from a large pizza that had the same area as one slice of a small pizza.

a. What was the central angle of that slice?

SKILL 53

Name ______________________________ Date ____________

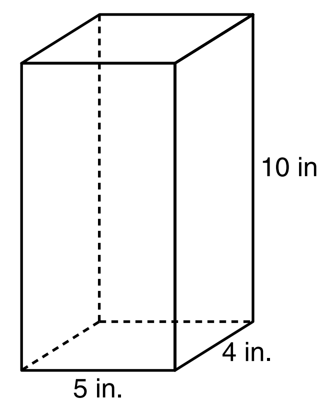
Surface Area of Rectangular Prisms

The **surface area** of a rectangular prism is equal to the sum of the areas of its faces.

EXAMPLE ***Find the surface area of the rectangular prism.***

Find the area of each face.

Front	$5 \times 10 = 50$
Back	$5 \times 10 = 50$
Top	$5 \times 4 = 20$
Bottom	$5 \times 4 = 20$
Right Side	$4 \times 10 = 40$
Left Side	$4 \times 10 = 40$

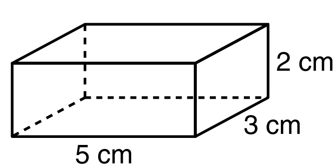


Add the areas.

$50 + 50 + 20 + 20 + 40 + 40 = 220$

The surface area of the rectangular prism is 220 square inches.

EXERCISES ***Find the surface area of each rectangular prism.***

1.


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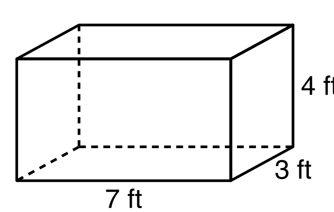

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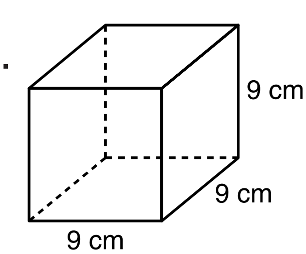

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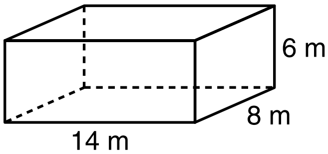

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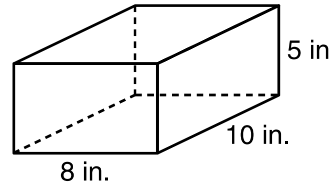

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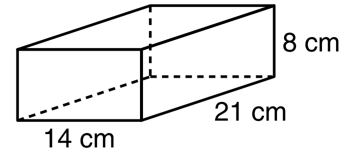

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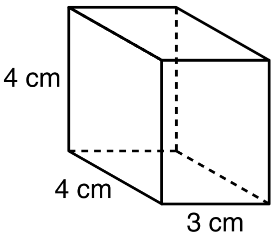

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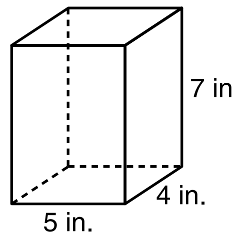

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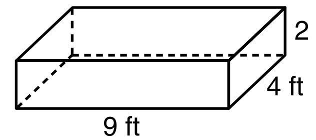

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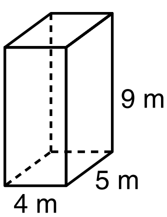

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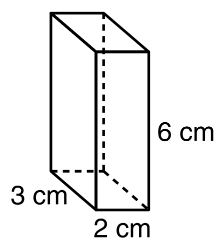

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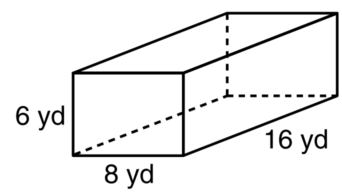


APPLICATIONS

13. A cereal box is 19 centimeters long, 6 centimeters wide, and 28 centimeters high. An artist is trying to create a design for the box. What is the surface area the artist needs to cover?

14. Jackson Middle School has a large storage box that is used for storing balls and other supplies for the physical education classes. Ms. Hubbard wants to paint the outside of the box one of the school colors. If the box is 4 feet long, 3 feet wide, and 2 feet high, what is the total area that needs to be painted?

15. Howard is wallpapering a room that is 18 feet long, 14 feet wide, and 8 feet high. How much wallpaper is needed to cover the walls, not taking into account doorways or windows?

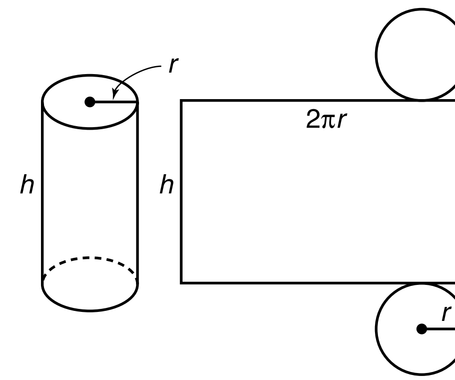
16. One gallon of paint covers about 400 square feet of wall. If paint costs $17.99 a gallon and the sales tax is 5%, how much will it cost to put two coats of paint on the walls of your classroom?

SKILL 54

Name ______________________________ Date ____________

Surface Area of Cylinders

To find the surface area of a cylinder, find the sum of the areas of the two circular bases and the area of the rectangular face.

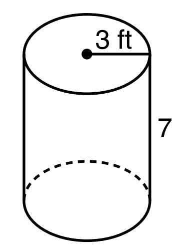


area of each circle = πr^2
area of both circles = $2\pi r^2$

The length of the rectangle is equal to the circumference of the circle. So the area of the rectangle is $2\pi r \times h$.

The surface area of a cylinder is $2\pi r^2 + 2\pi rh$.

EXAMPLE ***Find the area of the cylinder shown at the right.***

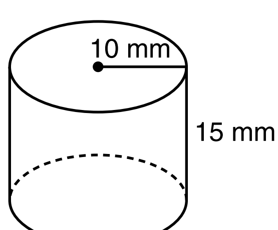


$A = 2\pi r^2 + 2\pi rh$
$A \approx (2 \times 3.14 \times 3^2) + (2 \times 3.14 \times 3 \times 7)$
$A \approx 56.52 + 131.88$
$A \approx 188.40$

The surface area of the cylinder is 188.40 square feet.

EXERCISES ***Find the surface area of each cylinder. Use 3.14 for p.***

1.



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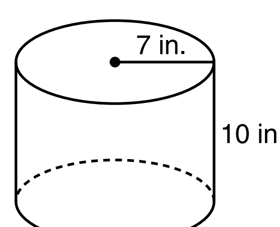

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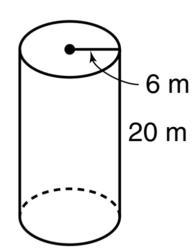

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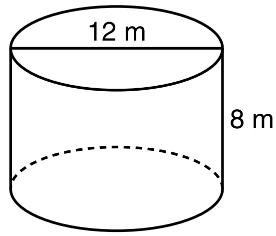

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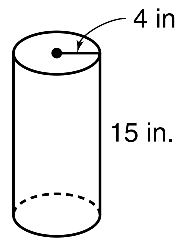

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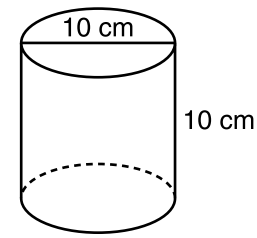

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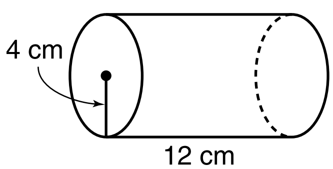

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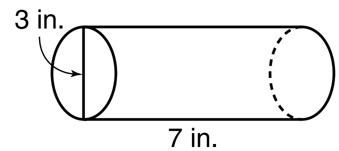

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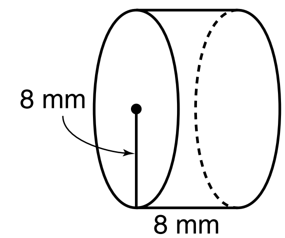


APPLICATIONS

10. A wheel of cheese is sealed in a wax covering. The wheel of cheese is in the shape of a cylinder that has a diameter of 10 inches and a height of 5 inches. What is the surface area of the cheese that needs to be covered in wax?

11. A storage tank is in the shape of a cylinder that has a radius of 2 feet and a height of 8 feet. The tank needs to be painted. What is the surface area of the tank?

12. A biologist is conducting an experiment to determine the amount of beetle infestation in the bark of elm trees. She believes that the beetles are fairly evenly distributed throughout the lower portions of the tree's bark. A sample of one square foot of bark from one tree two feet in diameter had 20 beetles. Consider the tree trunk to be a cylinder and determine how many beetles are probably in the first 10 feet of the tree's bark.

SKILL 55

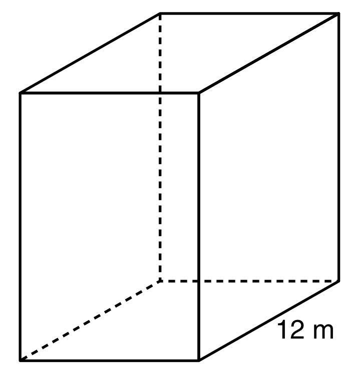
Name ______________________________ **Date** ____________

Volume of Rectangular Prisms

The **volume** of an object is the amount of space that a solid contains. Volume is measured in cubic units. The volume (V) of a rectangular prism is equal to the product of the length (ℓ) times the width (w) times the height (h).

$$V = \ell wh$$

EXAMPLE ***Find the volume of the rectangular prism at the right.***

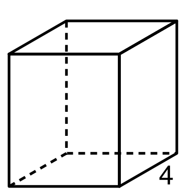


The length of the rectangular prism is 10 meters, the width is 12 meters, and the height is 15 meters.

$V = \ell wh$
$V = 10 \times 12 \times 15$
$V = 1{,}800$

The volume of the rectangular prism is 1,800 cubic meters.

EXERCISES ***Find the volume of each rectangular prism.***

1.


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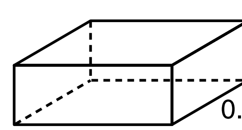

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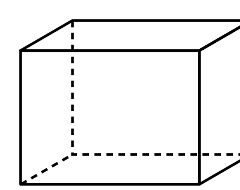

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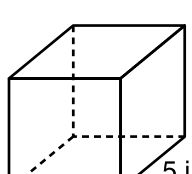

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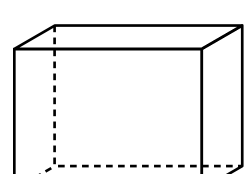

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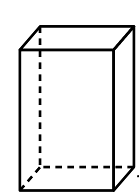

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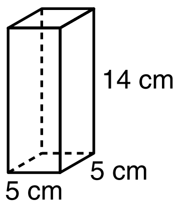

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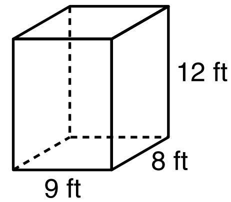

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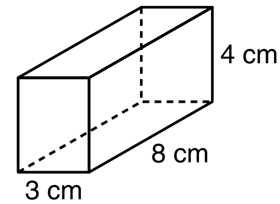


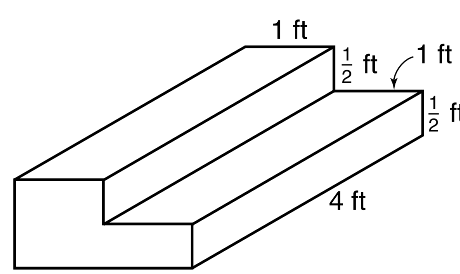
APPLICATIONS

10. The Pomerantz family have a small rectangular pond in their flower garden. The pond is 6 feet long and 4 feet wide. If the water in the pond is 2 feet deep, what is the volume of the water?

11. Water weighs about 62 pounds per cubic foot. What is the weight of the water in the pond in Exercise 10?

12. Janine keeps her jewelry in a jewelry box that measures 9 inches by 4.5 inches by 3 inches. What is the volume of the jewelry box?

13. The diagram at the right shows the dimensions of concrete stairs. What is the volume of the concrete?



14. Use 20 cubes to form rectangular prisms. How many different rectangular prisms can you make if you use all of the cubes for each prism?

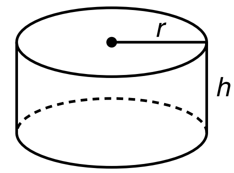
SKILL 56

Name ______________________ Date __________

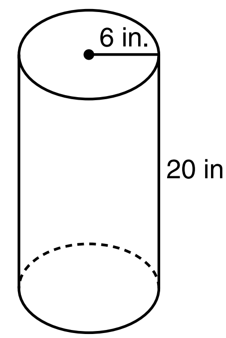
Volume of Cylinders

The volume of a cylinder is found by multiplying the area of the base (πr^2) times the height (h).

$$V = \pi r^2 h$$



EXAMPLE ***Find the volume of the cylinder at the right.***



This cylinder has a radius of 6 inches and a height of 20 inches.

$V = \pi r^2 h$

$V = \pi(6)^2(20)$

$V = \pi(36)(20)$

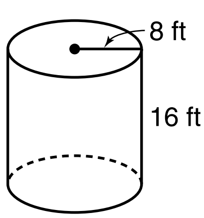
$V \approx 3.14(36)(20)$ *Use 3.14 for* π.

$V \approx 2{,}260.8$

The volume of the cylinder is about 2,260.8 cubic inches.

EXERCISES ***Find the volume of each cylinder. Use 3.14 for*** π.

1.



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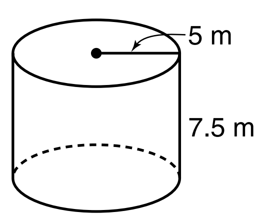

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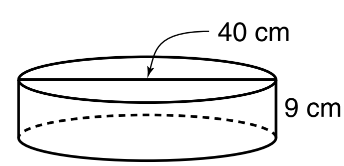

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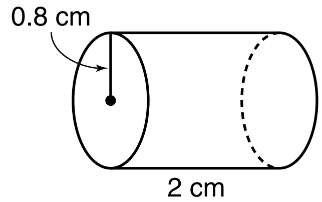

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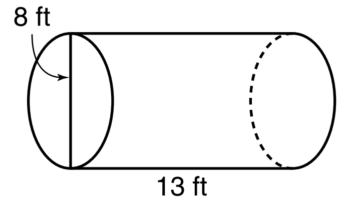

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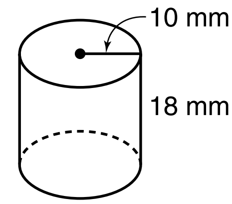

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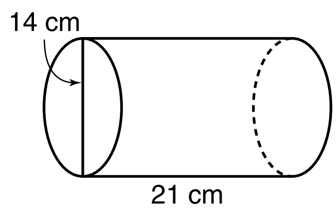

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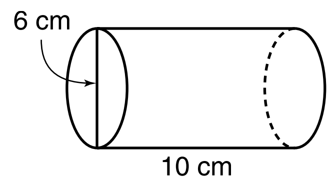

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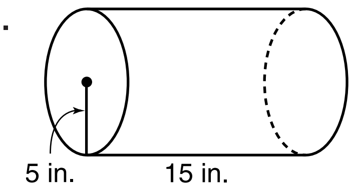


APPLICATIONS

10. A cylindrical water tank on the Okida family farm is 30 feet in diameter and 20 feet high. Find the volume of the tank.

11. The Okida family has 250 cows, and each cow drinks about 8 gallons of water per day. How many days will the tank in Exercise 10 provide the cows with water? (Hint: One cubic foot is about 7.5 gallons.)

12. The Okida family stores their wheat in cylindrical grain elevators that are each 20 feet in diameter and 60 feet high. What is the volume of each grain elevator?

13. The Okida family harvested 900 acres of wheat that yielded 40 bushels per acre. How many of the grain elevators in Exercise 12 are needed for the harvest? (Hint: One cubic foot of wheat is about 0.8 bushels.)

14. A coffee can is 6.5 inches high and has a diameter of 5 inches. Find the volume of the can.

SKILL 57

Name ______________________ Date __________

Capacity

This table shows the relationship among different units of capacity in the U.S. Customary system.

	Cups	Pints	Quarts	Gallons
1 cup	1 cup	$\frac{1}{2}$ pint	$\frac{1}{4}$ quart	$\frac{1}{16}$ gallon
1 pint	2 cups	1 pint	$\frac{1}{2}$ quart	$\frac{1}{8}$ gallon
1 quart	4 cups	2 pints	1 quart	$\frac{1}{4}$ gallon
1 gallon	16 cups	8 pints	4 quarts	1 gallon

This table shows the relationship among different units of capacity in the metric system.

	Milliliters	Centiliters	Deciliter	Liter	Decaliter	Hectoliter	Kiloliter
1 milliliters	1 milliliters	0.1 centiliter	0.01 deciliter	0.001 Liter	0.0001 decaliter	0.00001 hectoliter	0.000001 kiloliter
1 centiliter	10 milliliters	1 centiliter	0.1 deciliter	0.01 Liter	0.001 decaliter	0.0001 hectoliter	0.00001 kiloliter
1 deciliter	100 milliliters	10 centiliters	1 deciliters	0.1 Liter	0.01 decaliter	0.001 hectoliter	0.0001 kiloliter
1 Liter	1,000 milliliters	100 centiliters	10 deciliters	1 Liter	0.1 decaliter	0.01 hectoliter	0.001 kiloliter
1 decaliter	10,000 milliliters	1,000 centiliters	100 deciliters	10 Liters	1 decaliter	0.1 hectoliter	0.01 kiloliter
1 hectoliter	100,000 milliliters	10,000 centiliters	1,000 deciliters	100 Liters	10 decaliters	1 hectoliter	0.1 kiloliter
1 kiloliter	1,000,000 milliliters	100,000 centiliters	10,000 deciliters	1000 Liters	100 decaliters	10 hectoliters	1 kililoter

EXAMPLES ***Convert each capacity into the units given.***

1. 3 gallons = ____ cups = ____ pints

2. 2 quarts = ____ pints = $\frac{1}{2}$ gallons

3. 6 cups = ____ pints = $\frac{1}{2}$ quarts

4. 5 pints = $2\frac{1}{2}$ quarts = ____ cups

5. $3\frac{3}{4}$ quarts = ____ cups = $7\frac{1}{2}$ pints

6. $1\frac{1}{2}$ gallons = ____ quarts = ____ cups

EXERCISES ***Convert each capacity into the units given.***

1. $4\frac{1}{2}$ pints = ___cups = _____ quarts

2. 27 cups = _____ gallons = _____ pints

3. 5,000 milliliters = _____ centiliters = _ Liters

4. 33 Liters = _______ centiliters = _______ kiloliters

5. 750 milliliters = ____ deciliters = _____ Liters

6. 253 kiloliters = __________ Liters = ________ hectoliters

7. 549,000 centiliters = _____ hectoliters = _______ Liters

8. 9 kiloliters = _______ Liters = ___________ milliliters

APPLICATIONS **Use the conversion tables on the front to solve the following exercises.**

9. Kerri bought 60 Liters of dish soap from a wholesale catalogue. She poured it into 500-milliliter bottles. How many bottles did she fill?

10. Bill mixed some juice from concentrate. The instructions on the concentrate said to use one cup of concentrate for every quart of water. Bill used one gallon of concentrate. How many gallons of water did he use?

a. How many gallons of juice (water + concentrate) did he end up with?

b. How many guests could he serve if each guest drank 2 cups of juice?

11. The showers at Jackie's Gym use 5.5 Liters of water each minute they are turned on.

a. How many Liters of water are used for a 10-minute shower?

b. During the month of May, customers at the gym took a total of 3,500 10-minute showers. How many kiloliters of water were used?

12. Maria bought an 18-gallon fish tank. She used a jug to carry water from the sink to the fish tank. The capacity of the jug was 3 pints. How many trips did she make to fill the fish tank all the way?

SKILL 58

Name ______________________________ Date ____________

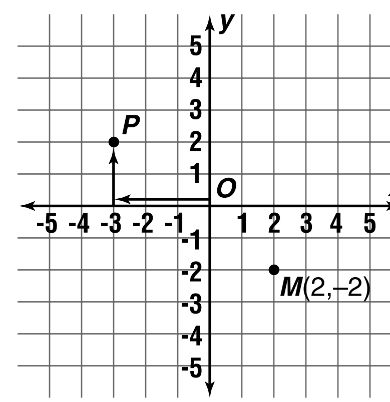
The Coordinate System

The **coordinate system** is used to graph points in a plane. The horizontal line is the **x-axis.** The vertical line is the y-axis. Their intersection is called the **origin**.

Points are located using **ordered pairs.** The first number in an ordered pair is the *x*-coordinate; the second number is the *y*-coordinate.

EXAMPLES ***Name the ordered pair for point P.***

Start at the origin.
Move 3 units to the left along the *x*-axis.
Move 2 units up on the *y*-axis.
The ordered pair for point *P* is (–3, 2).



Graph the point M(2, –2).

Start at the origin.
Move 2 units to the right along the *x*-axis.
Move 2 units down on the *y*-axis.
Draw a point and label it *M*.

EXERCISES ***Name the ordered pair for each point on the coordinate plane.***

1. *A*

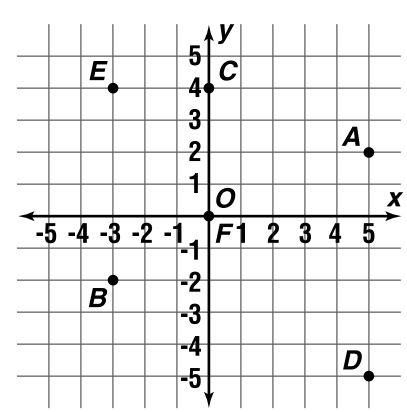
2. *B*

3. *C*

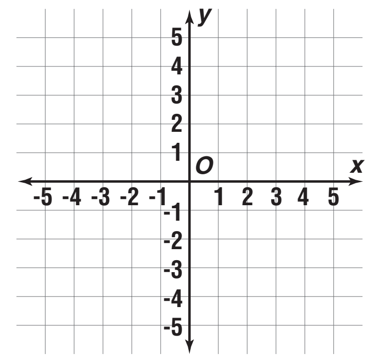
4. *D*

5. *E*

6. *F*



Graph and label each point on the coordinate plane.



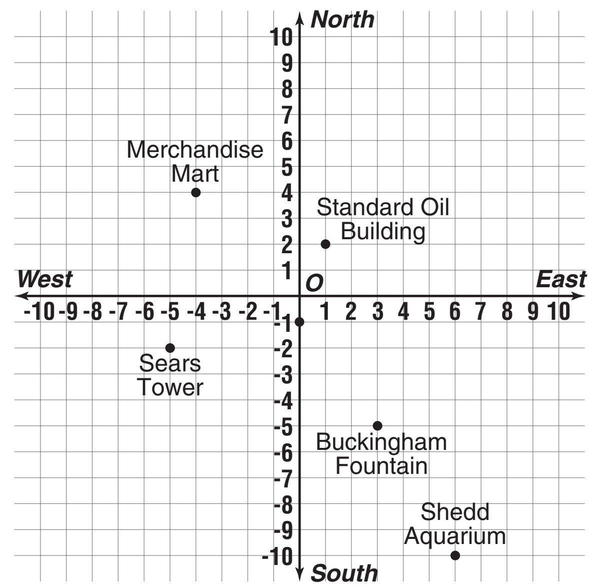
7. $N(-1, 3)$ **8.** $V(2, -4)$

9. $M(-2, 0)$ **10.** $K(-1, 5)$

11. $A(5, -1)$ **12.** $T(-3, 3)$

APPLICATIONS

Chicago was planned in such a way that a rectangular coordinate system can describe locations very well. If a block is the distance between major streets, then the Sears Tower, the world's largest building, is located at the coordinates (−5, −2).



13. Start at the Sears Tower and graph the point where you would be if you walked 3 blocks north and 1 block east. Label the point "13." What are its coordinates?

For Exercises 14–18, start at point 13. Label each point and name its coordinates.

14. 4 blocks east and 2 blocks south

15. 2 blocks north and 1 block east

16. 7 blocks west and 6 blocks north

17. 3 blocks north

18. How many blocks would you need to walk to get back to the Sears Building without cutting corners?

Locate these Chicago landmarks by naming their coordinates.

19. Shedd Aquarium **20.** Buckingham Fountain

21. Standard Oil Building **22.** Merchandise Mart

SKILL 59

Name ______________________ Date __________

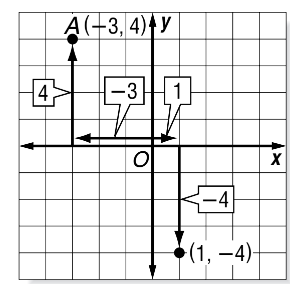
Ordered Pairs and the Coordinate Plane

A horizontal number line and a vertical number line meet at their zero points to form a **coordinate plane**. The horizontal line is the ***x*-axis** and the vertical line is the ***y*-axis**.

Points are located using ordered pairs. The first number in an ordered pair is the ***x*-coordinate**, and the second number is the ***y*-coordinate**.

EXAMPLES

Name the ordered pair for point A.



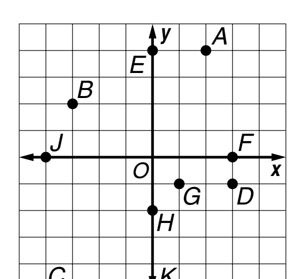
Start at *O*. Move along the *x*-axis until you are under point *A*. Then move up until you reach point *A*. Since you moved 3 units to the left and 4 units up, the ordered pair for point *A* is (−3, 4).

Graph point (1, −4).

Start at *O*. Move 1 unit to the right on the *x*-axis. Then move 4 units down parallel to the *y*-axis to locate the point.

EXERCISES

Name the ordered pair for each point.



1. *A* **2.** *B*

3. *C* **4.** *D*

5. *E* **6.** *F*

7. *G* **8.** *H*

9. *J* **10.** *K*

Graph and label each point.

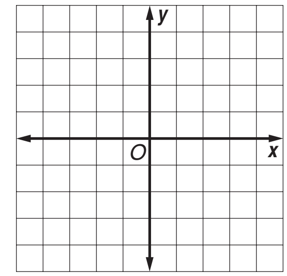
11. $M(-4, 2)$ **12.** $N(3, -3)$

13. $P(2, 2)$ **14.** $Q(-3, -4)$

15. $R(0, -4)$ **16.** $S(-1, 3)$

17. $T(-1, -1)$ **18.** $U(3, 4)$

19. $W(1, -2)$ **20.** $Z(-4, 0)$



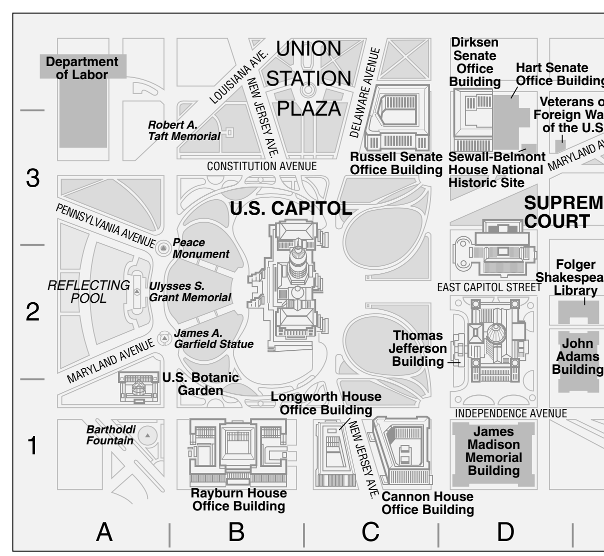
APPLICATIONS ***Maps often use a grid system to help locate places on the map. Use the map of Washington D.C. to answer Exercises 21–24.***

21. What is located at (B, 1)?

22. What is located at (A, 2)?

23. Where is the Supreme Court Building located?

24. In which section is Union Station Plaza located?



25. Use a local map to find an ordered pair to represent each of the following.

a. your house **b.** your school

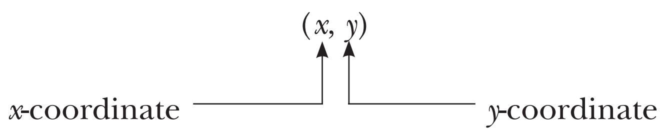
c. a friend's house **d.** your favorite store

SKILL 60

Name ______________________ **Date** __________

Ordered Pairs

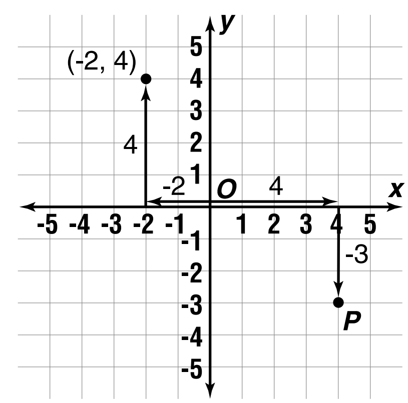
A horizontal number line and a vertical number line meet at their zero points to form a **coordinate system**. The horizontal line is the ***x*-axis**. The vertical line is the ***y*-axis**. The location of a point in the coordinate system can be named using an ordered pair of numbers.



EXAMPLES

Name the ordered pair for point P.

Start at *O*. Move along the *x*-axis until you are above point *P*. Then move down until you reach point *P*. Since you moved 4 units to the right and 3 units down, the ordered pair for point *P* is (4, –3).

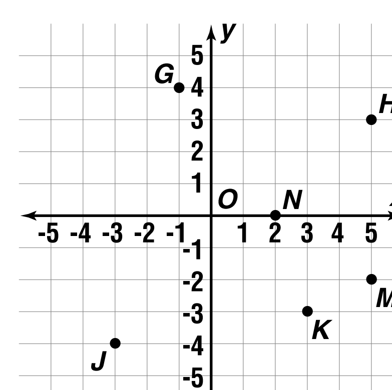


Graph point (–2, 4).

Start at *O*. Move 2 units left on the *x*-axis. Then move 4 units up parallel to the *y*-axis to locate the point.

EXERCISES

Name the ordered pair for each point.



1. *G*

2. *H*

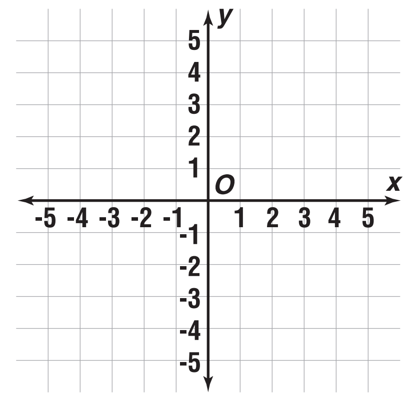
3. *J*

4. *K*

5. *M*

6. *N*

Graph and label each point.



7. *A*(–5, 5)

8. *B*(2, 4)

9. *C*(0, 5)

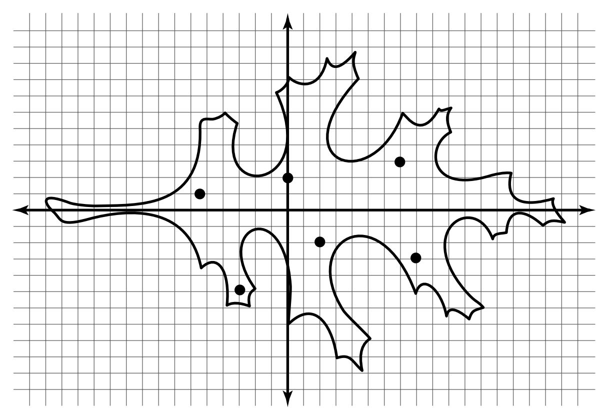
10. *D*(–4, 0)

11. *E*(2, 2)

12. *F*(4, –3)

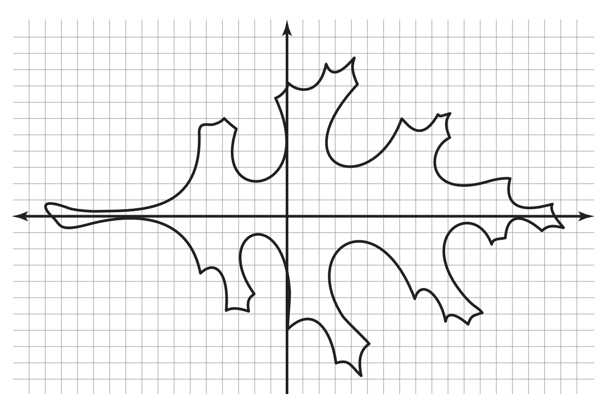
APPLICATIONS ***A botanist is interested in what part of a certain leaf is being infested by an insect that leaves black spots. She places a clear coordinate plane over several leaves that are about the same size and shape. Complete each of the following.***

13. Find the coordinates of the black spots on the leaf at the right.



14. Draw and label the spots having the following coordinates on the leaf at the right.

A(2, –3) *B*(3, –2) *C*(0, –4) *D*(–4, 0)
E(–5, 3) *F*(10, 2) *G*(2, 7) *H*(0, 5)



SKILL 61

Name ______________________ Date __________

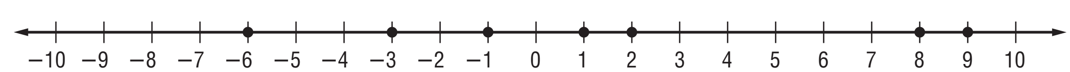
Integers

Numbers greater than zero are called **positive numbers**. Numbers less than zero are called **negative numbers**. The set of numbers that includes positive and negative numbers, and zero are called **integers**.

EXAMPLE

Emily recorded the temperature at noon for a week. The temperatures she recorded were 9°F, 8°F, −6°F, −3°F, −1°F, 2°F, and 1°F. What was the lowest and highest temperature recorded?

To answer the question, locate the temperatures on a number line.



On a number line, values increase as you move to the right.

Since −6 is furthest to the left, −6°F is the coldest temperature. 9 is the farthest number to the right, so 9°F is the highest temperature.

The **absolute value** of a number is the positive number of units a number is from zero on a number line.

EXAMPLE

Refer to the table. Which city's population changed the most?

Population Change, 1990–2000	
Atlanta, GA	+22,457
Baltimore, MD	−84,860
Columbus, OH	+78,560
Detroit, MI	−76,704
Indianapolis, IN	+49,974
Philadelphia, PA	−68,027

Find the absolute value of each number.

$|+22{,}457| = 22{,}457$
$|-84{,}860| = 84{,}860$
$|+78{,}560| = 78{,}560$
$|-76{,}704| = 76{,}704$
$|+49{,}974| = 49{,}974$
$|-68{,}027| = 68{,}027$

Since the absolute value of −84,860 is the greatest, Baltimore, Maryland, had the greatest population change.

EXERCISES ***Fill in each blank with $<$, $>$, or $=$ to make a true sentence.***

1. 5 ____ −5 **2.** −4 ____ 3 **3.** 0 ____ −2

4. −6 ____ −12 **5.** −35 ____ −16 **6.** 19 ____ −22

7. 34 ____ 21 **8.** 23 ____ 23 **9.** −45 ____ −52

Write each set of integers in order from least to greatest.

10. {45, −23, 55, 0, −12, −37}

11. {56, −22, 34, −34, 12, −12}

12. {−450, −100, 254, 564, −356}

13. {1,276, −3,456, −943, −237, −467}

Find the absolute value.

14. $|-3|$ **15.** $|-5|$ **16.** $|16|$ **17.** $|27|$

18. $|156|$ **19.** $|-359|$ **20.** $|-821|$ **21.** $|1{,}436|$

APPLICATIONS ***Write an integer to describe each situation.***

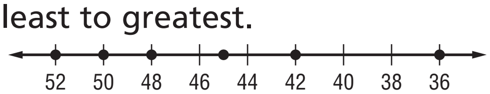
22. Julio finished the race 3 seconds ahead of the second place finisher.

23. Matthew ended his round of golf 4 under par.

24. Denver is called the Mile High City because its elevation is 5,280 feet above sea level.

For Exercises 25–27, refer to the table.

25. Use a number line to order the temperatures from least to greatest.



26. The record low temperature for Michigan is −51°F. Which states have higher record low temperatures?

27. Indiana's record low temperature is −36°F. Which states in the table have lower record low temperatures?

Record Low Temperatures	
California	−45°F
Illinois	−36°F
Maine	−48°F
Nevada	−50°F
New York	−52°F
Pennsylvania	−42°F
Washington	−48°F

SKILL 62

Name ______________________ Date __________

Classify Information

Some problems may contain too much information. Other problems may not contain the information you need to solve them.

EXAMPLE

Hartford, New Britain, Middletown, and Bristol form a large metropolitan area in Connecticut. In 1990, the population of Hartford was 767,841, the population of New Britain was 148,188, the population of Middletown was 90,320, and the population of Bristol was 79,488. What was the combined population of Middletown and Bristol in 1990?

What is the question?
What was the combined population of Middletown and Bristol in 1990?

What information is needed?
The populations of Middletown and Bristol in 1990 are needed.

What information is *not* needed?
The populations of Hartford and New Britain are *not* needed.

Solve the problem.

$$\begin{array}{r} 90{,}320 \\ +\ 79{,}488 \\ \hline 169{,}808 \end{array}$$

In 1990, the combined population of Middletown and Bristol was 169,808.

EXERCISES

Solve, if possible. Classify information in each problem by writing "not enough information" or "too much information."

1. If the difference of 135 and 98 is 37, what is the sum of the numbers?

2. If the sum of two numbers is 35, what is their product?

3. Find the sum of 57, 84, and another number.

4. If the product of a number and 10 is 150 and the sum of the number and 10 is 25, what is the number?

APPLICATIONS

5. Walt has 84 stamps to share with his friends. How many should he give each one?

6. Movie tickets cost $5.00 at night and $3.50 in the afternoon. Popcorn costs $2.75 and a fruit drink costs $1.75. How much does it cost to see a movie at night and buy popcorn and a fruit drink?

7. Dana's father saved $3,496 for a down payment for a new car. He bought a 6-cylinder, 4-door sedan with power steering, air conditioning, cruise control, and a stereo cassette player. The car costs an additional $9,379. What is the cost of the car?

8. There are 250 different kinds of sharks. The smallest is the black and white shark, which grows to only 6 inches long. The largest is the whale shark, which can grow to more than 40 feet long. The mako shark can swim up to speeds of 40 miles per hour. How much faster is the mako shark than the black and white shark?

9. Yosemite National Park is 759,000 acres. Zion National Park is 143,000 acres. Kings Canyon National Park is 462,000 acres. How much larger is Yosemite National Park than Kings Canyon National Park?

10. One kind of greeting card costs $2.50, while a second kind costs $1.00. If Phil bought 5 greeting cards, how much did he spend?

SKILL 63

Name ______________________ Date ____________

Determine Reasonable Answers

Nestor has a 48-meter by 61-meter plot of land in which he wants to plant grass. He needs about one pound of seed for each 100 square meters.

EXAMPLE ***Should Nestor buy 3 or 30 pounds of seed?***

To find the amount of seed Nestor needs to buy, first estimate the area of the plot of land. The area of a rectangle is found by multiplying the length by the width.

48	rounds to	50
$\times$ 61	rounds to	$\times$ 61
		3,000

The area is about 3,000 square meters. Divide 3,000 by 100 to find the approximate number of pounds of seed needed for the plot of land.

$$3{,}000 \div 100 = 30$$

Nestor should buy 30 pounds of seed.

EXERCISES ***Determine whether the answers shown are reasonable.***

1. $45 + 76 = 121$

2. $73 - 19 = 44$

3. $18 \times 33 = 494$

4. $972 \div 27 = 46$

5. $475 + 856 = 1{,}031$

6. $782 - 686 = 96$

7. $204 \times 57 = 11{,}628$

8. $3{,}708 \div 36 = 83$

9. $946 + 789 = 1{,}735$

10. $1{,}030 - 789 = 341$ **11.** $77 \times 499 = 38{,}423$ **12.** $767 \div 13 = 59$

13. $879 + 65 = 944$ **14.** $807 - 455 = 452$ **15.** $904 \times 66 = 49{,}664$

APPLICATIONS ***Solve by determining reasonable answers.***

16. There are 25 paper plates in a package. If 160 students are expected to attend a picnic, should the picnic committee buy 7 or 9 packages of plates?

17. The 20 members of the drama club are taking a trip to see a play. The cost of the trip is $450. They want to share the cost equally. Should each member contribute $20 or $23?

18. How many audio cassettes at $8.88 each can Ken expect to buy with a $50 bill?

19. Pauline buys 6 boxes of tissues containing 75 tissues each, and Mike buys 2 boxes containing 175 tissues each. Pauline guesses that she has about twice as many tissues as Mike. Is her guess reasonable?

20. A telephone call costs $0.40 for the first minute and $0.31 for each additional minute. Is $5.00 enough to pay for a 12-minute call?

21. The Parker family drove an average of 220 miles per day on their 2-week vacation. Did they travel about 3,000 miles or about 30,000 miles on their vacation?

22. Daisuke took $20.00 to the store to buy school supplies. He wants to buy 4 notebooks at $1.98 each, 2 pens at $0.89 each, 5 packages of notebook paper at $1.50 each, an eraser at $0.39, and 4 pencils at $0.10 each. Does he have enough money to buy all of these items?

SKILL 64

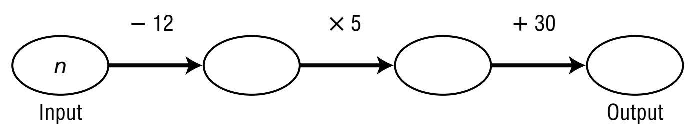
Name ______________________ Date __________

Work Backward

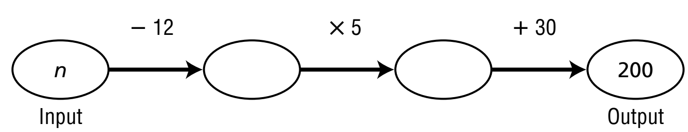
Some problems start with the end result and ask for something that happened earlier. The strategy of **working backward**, or **backtracking**, can be used to solve problems like this. To use this strategy, start with the end result and undo each step.

EXAMPLE ***A number is decreased by 12. The result is multiplied by 5, and 30 is added to the new result. The final result is 200. What is the number?***

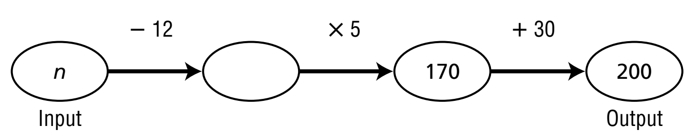
Use a flowchart to show the steps in the computation.



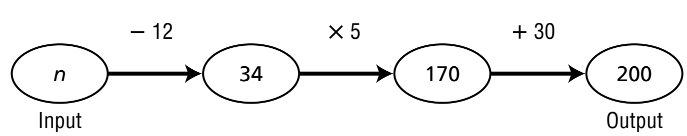
Find the solution by starting with the output.



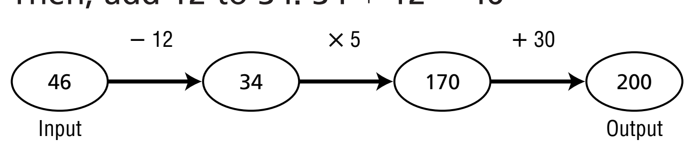
Since 30 was added to get 200, subtract 30. $200 - 30 = 170$



Next, divide 170 by 5. $170 \div 5 = 34$



Then, add 12 to 34. $34 + 12 = 46$



Thus, the number is 46.

EXERCISES *Solve by working backward.*

1. A number is added to 12, and the result is multiplied by 6. The final answer is 114. Find the number.

2. A number is divided by 3, and the result is added to 20. The result is 44. What is the number?

3. A number is divided by 8, and the result is added to 12. The final answer is 78. Find the number.

4. Twenty five is added to a number. The sum is multiplied by 4, and 35 is subtracted from the product. The result is 121. What is the number?

5. A number is divided by three, and 14 is added to the quotient. The sum is multiplied by 7. The product is doubled. The result is 252. What is the number?

APPLICATIONS

6. A bacteria population doubles every 8 hours. If there are 1,600 bacteria after 2 days, how many bacteria were there at the beginning?

7. Each school day, Alexander takes 35 minutes to get ready for school. He takes 5 minutes to walk to Jaaron's house. The two boys take 15 minutes to walk from Jaaron's house to school. School starts at 8:10 A.M. If the boys want to get to school at least 10 minutes before school starts, what is the latest Alexander must get out of bed?

8. A fence is put around a dog pen 10 feet wide and 20 feet long. Enough fencing is left over to also fence a square garden with an area of 25 square feet. If there are 3 feet left after the fencing is completed, how much fencing was available at the beginning?

SKILL 65

Name ____________________ Date __________

Solve Equations Involving Addition

To solve an equation means to find a value for the variable that makes the equation true. To solve an equation, you need to get the variable by itself.

Subtraction Property of Equality: If you subtract the same number from each side of an equation, the two sides remain equal.

EXAMPLE

Solve $t + 12.2 = 25.1$.

$$t + 12.2 = 25.1$$
$$t + 12.2 - 12.2 = 25.1 - 12.2 \quad \textit{Subtract 12.2 from each side.}$$
$$t = 12.9$$

Check:
$$t + 12.2 = 25.1$$
$$12.9 + 12.2 \stackrel{?}{=} 25.1 \quad \textit{Replace t with 12.9.}$$
$$25.1 = 25.1 \ \checkmark$$

The solution is 12.9.

EXERCISES

Solve each equation. Check your solution.

1. $b + 7 = 22$ **2.** $r + 0.4 = 11.5$ **3.** $45 = t + 17$

4. $17 + k = 62$ **5.** $146 + j = 199$ **6.** $17.2 = h + 4.9$

7. $n + 2\frac{1}{3} = 4\frac{2}{3}$ **8.** $5\frac{2}{5} + v = 7\frac{1}{2}$ **9.** $x + 7\frac{1}{2} = 20$

10. $18.42 + t = \mathbf{63}$ **11.** $e + 12.2 = 40$ **12.** $m + 18 = 78$

APPLICATIONS

13. Cicely is saving money to buy a computer printer that costs \$399. She has already saved \$150. If y stands for the amount she still needs to save, which equation could you solve to find the amount she still needs to save?

a. $150 + 399 = y$
b. $399 + y = 150$
c. $150 + y = 399$
d. none of these

14. The George Washington Carver National Monument is 263 acres smaller than the 473-acre Casa Grande National Monument. Solve the equation $g + 263 = 473$ to find the size of the George Washington Carver National Monument.

15. Wayne bought a share of stock at $29\frac{3}{4}$. A year later, the stock was selling for $42\frac{1}{8}$. How much would Wayne have gained if he had sold his stock then?

16. Jamal delivers 60 papers each day after school. Today he has already delivered 22 papers. Find how many more papers he must deliver by writing an equation and solving it.

17. For Jane's girl scout troop, she needs to volunteer a total of 150 hours in order to earn her Community Service patch. She has volunteered 67 hours already. Find how many more hours she must volunteer by writing an equation and solving it.

18. There are 28 students in art class. Seven students in the class wear glasses or contact lenses. How many students do *not* wear glasses or contact lenses?

SKILL 66

Name ______________________ Date ____________

Solve Equations Involving Subtraction

To solve an equation means to find a value for the variable that makes the equation true. To solve an equation, you need to get the variable by itself.

Addition Property of Equality: If you add the same number to each side of an equation, the two sides remain equal.

EXAMPLE ***Solve $t - 12.2 = 25.1$.***

$$t - 12.2 = 25.1$$

$$t - 12.2 + 12.2 = 25.1 + 12.2 \quad \textit{Add 12.2 to each side.}$$

$$t = 37.3$$

Check: $t - 12.2 = 25.1$

$$37.3 - 12.2 \stackrel{?}{=} 25.1 \quad \textit{Replace t with 37.3.}$$

$$25.1 = 25.1 \ \checkmark$$

The solution is 37.3.

EXERCISES ***Solve each equation. Check your solution.***

1. $8.9 = p - 3.3$ **2.** $j - 4.5 = 1.7$ **3.** $y - 9 = 29$

4. $p - 23\frac{4}{5} = 35\frac{7}{10}$ **5.** $w - 6\frac{1}{2} = 18$ **6.** $f - 19 = 77$

7. $m - 9.4 = 15.7$ **8.** $153 = k - 23$ **9.** $u - 27 = 12$

10. $p - 58 = 73$ **11.** $x - 4.9 = 12.2$ **12.** $105 = y - 17$

APPLICATIONS

13. Madaline was filling balloons with helium for a party. She filled 24 balloons. While she was filling those, she filled 7 others too full and they burst. If t stands for the total number of ballons that she filled, which equation could you solve to find the total number of balloons that she filled?

a. $24 - 7 = t$
b. $24 - t = 7$
c. $t - 7 = 24$
d. none of these

14. Joe and José have a painting business. Joe spent 3.75 hours painting three rooms of the Dutton's house. This was 6.75 hours less than the total time it took to do the job. Find how much time it took to paint the three rooms by writing an equation and solving it.

15. Ryan and Nick went to the fair. When they rode the carousel, Ryan counted 10 horses that were stationary. This was 24 less than the total number of horses on the carousel. Find how many total horses were on the carousel by writing an equation and solving it.

16. Ben has an insect and spider collection. Fifteen of the bugs are spiders. This is 8 less than the total number of bugs that he has. Find how many bugs Ben has in his collection by writing an equation and solving it.

17. Pat spent $575 buying blankets for the homeless shelter. Cash Mart said that they would match the number of blankets that all of Pat's friends brought to the shelter. Pat's friends brought 23 blankets, but Cash Mart actually gave 45 blankets. A total of 100 blankets were donated. How many blankets were donated by people other than Cash Mart and Pat's friends?

SKILL 67

Name ______________________________ Date ____________

Solve Equations Involving Multiplication

You can use equations to solve multiplication problems. When a variable is multiplied by a number, divide each side of the equation by that number to set the variable by itself.

Division Property of Equality: If you divide each side of an equation by the same nonzero number, the two sides remain equal.

EXAMPLE ***Solve 48.6 = 6c.***

$48.6 = 6c$

$\frac{48.6}{6} = \frac{6c}{6}$ *Divide each side by 6.*

$8.1 = c$

Check: $48.6 \overset{?}{=} 6c$

$48.6 = 6 \times 8.1$ *Replace c with 8.1.*

$48.6 = 48.6$ ✓

The solution is 8.1.

EXERCISES ***Solve each equation. Check your solution.***

1. $5r = 45$

2. $180 = 9v$

3. $17v = 289$

4. $5.1p = 61.2$

5. $6.4t = 64$

6. $91 = 13k$

7. $2.4(1.8) = w$

8. $\$8.46h = \$54.99$

9. $504 = 2.8m$

10. $9n = -45$

11. $5m = -35$

12. $-72 = 6r$

Write an equation for each of the following.

13. A bingo prize of $125 had to be split evenly among five people. How much did each person receive?

14. There are twice as many dogs as there are cats on Sheila's street. If there are six dogs, how many cats are there?

15. Each household on Tremont Street has two cameras. There are 370 cameras on this street. How many houses are there?

16. One hundred fifty six students in Barrington School own a moped. This is four times as many students as owned one three years ago. How many students owned one three years ago?

APPLICATIONS

17. The sum of the measures of the interior angles of a pentagon is 540°. The five angles all have the same measure. Solve the equation $5x = 540$ to find the measure of each angle.

18. At one gas station, one fourth of the customers buy premium gasoline. In one hour, 12 customers bought premium gasoline. What was the total number of customers for the hour?

19. Manuel's weekly pay check is $450. What is his annual salary?

20. A triangle has a base of 6 feet and an area of 9 square feet. What is its height? Remember the area of a triangle is half the base times the height.

21. What is the length of a rectangle with an area of 40 square feet and a width of 5 feet?

SKILL 68

Name ______________________________ Date ____________

Solve Equations Involving Division

You can use equations to solve division problems. When a variable is divided by a number, multiply each side of the equation by that number to get the variable by itself.

Multiplication Property of Equality: If you multiply each side of an equation by the same number, the two sides remain equal.

EXAMPLE ***Solve*** $\frac{w}{5} = 2.3$.

$$\frac{w}{5} = 2.3$$

$$\frac{w}{5} \times 5 = 2.3 \times 5 \qquad \textit{Multiply each side by 5.}$$

$$w = 11.5$$

Check:

$$\frac{w}{5} \stackrel{?}{=} 2.3$$

$$\frac{11.5}{5} = 2.3 \qquad \textit{Replace w with 11.5.}$$

$$2.3 = 2.3 \checkmark$$

The solution is 11.5.

EXERCISES ***Solve each equation. Check your solution.***

1. $\frac{1}{2}y = 7$

2. $30 = \frac{1}{5}k$

3. $\frac{x}{7} = 3$

4. $24 = \frac{r}{2.5}$

5. $\frac{w}{6} = 0.6$

6. $\frac{1}{3}c = \frac{3}{4}$

7. $\frac{y}{5} = 3.5$

8. $\frac{f}{1.1} = 7$

9. $\frac{1}{2} = \frac{1}{8}c$

10. $3.5 = \frac{m}{4}$

11. $\frac{y}{5} = 2.4$

12. $\frac{s}{8} = 9.6$

13. Solve $z \div \frac{1}{3} = \frac{6}{7}$.

a. $\frac{6}{21}$ **b.** $\frac{18}{7}$ **c.** $\frac{11}{21}$ **d.** $\frac{2}{7}$

14. Solve $w \div \frac{1}{5} = \frac{3}{4}$.

a. $\frac{1}{2}$ **b.** $\frac{15}{4}$ **c.** $\frac{3}{20}$ **d.** $\frac{2}{12}$

15. The quotient when the number *e* is divided by 18 is 8. Find the number.

16. The quotient when the number *x* is divided by 19 is 7. Find the number.

APPLICATIONS

17. Hisako can stay in the sun for 0.5 hours without burning. If she uses NEW LONGER TAN, that has a sun-protection factor of 30, she can safely bask in the sun three times as long. Use the equation $m \div 0.5 = 3$ to determine the number of hours Hisako can stay in the sun using NEW LONGER TAN.

18. One-half of the students who participated in the Walk-a-Thon got a T-shirt. If 28 T-shirts were given out, how many students participated in the Walk-a-Thon?

SKILL 69

Name ____________________ Date __________

Guess and Check

There are 33 members of the Kennedy Middle School Math Club. There are 7 more girl members than boy members.

EXAMPLE ***How many boys and girls are members of the club?***

Use the guess-and-check strategy to solve this problem. Suppose your first guess is 10 boys and 17 girls.

$$10 + 17 = 27$$

This guess is too low. Try 15 boys and 22 girls.

$$15 + 22 = 37$$

This guess is too high. Try 13 boys and 20 girls.

$$13 + 20 = 33$$

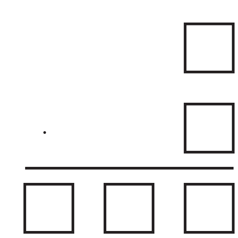
The club has 13 boys and 20 girls.

EXERCISES ***Solve by using the guess-and-check strategy.***

1. A number plus half the number is 33. Find the number.

2. What is the only number you can multiply by itself and get a product of 1,296?

3. Fill in the boxes at the right with the digits 2, 3, 4, 5, 6, and 8 to make this multiplication work. Use each digit exactly once.



4. The length of a rectangle is 4 more meters than the width. The perimeter is 40 meters. Find the length.

5. The sum of two numbers is 56. The difference is 22. What are the two numbers?

APPLICATIONS

6. In the 1992 Summer Olympic Games, the Unified Team, the United States, and Germany won 115 gold medals. The Unified Team won 45 gold medals, and the United States won 4 more gold medals than Germany. How many gold medals did the United States win? How many did Germany win?

7. The Sanchez family bought tickets to the Science Museum. Admission is $8 for adults and $5 for children under 12. They spent $49 for admission. How many adult tickets and how many student tickets did the Sanchez family buy?

8. Zachary and Aimee are in a teen bowling league. The total of their bowling averages is 172. Zachary's average is 14 points higher than Aimee's average. What is Zachary's bowling average?

9. Andy has $2.80 worth of quarters and dimes in his pocket. If the number of quarters equals the number of dimes, how many quarters does he have?

10. Mei-yu bought some pens for $0.89 each and some pencils for $0.19 each. She spent $5.02. How many pens and how many pencils did she buy?

SKILL 70

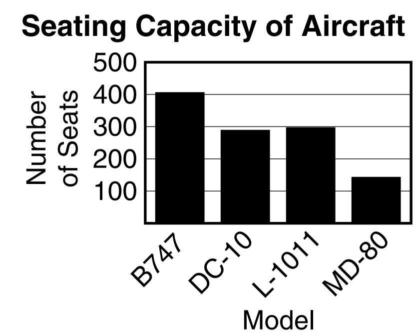
Name ______________________ **Date** __________

Statistical Graphs

There are different types of statistical graphs. Three types of statistical graphs are bar graphs, circle graphs, and line graphs. A **bar graph** is used to compare quantities. A **circle graph** is used to compare parts to the whole. A **line graph** is used to show change.

EXAMPLE ***What type of graph should you use to compare the seating capacity of various aircraft?***

A bar graph is used to compare quantities, so a bar graph should be used. The graph at the right compares the capacity of the B747, the DC-10, the L-1011 and the MD-80. From the graph, it is easy to see that the B747 has the most seating capacity of these aircraft and the MD-80 has the least.



EXERCISES ***Determine whether you would use a bar graph, a circle graph, or a line graph to show the information.***

1. average temperature in Sacramento for each month of the year

2. average temperature in January of five California cities

3. land area of the continents

4. percentages of the total land area each continent represents

5. number of CD players sold each year from 1981 to 1994

6. weight of a baby in each month from birth to one year of age

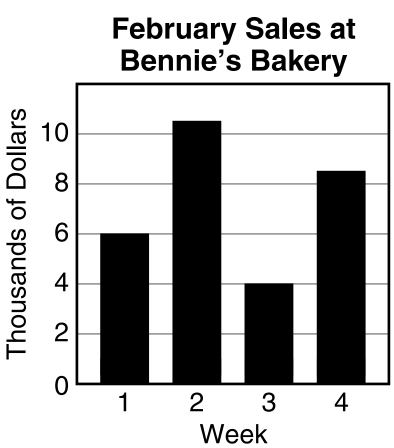
7. percentages of sources of fuel in the United States

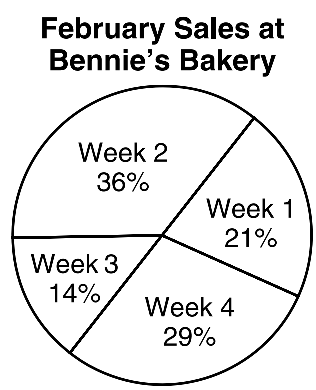
8. height of the five tallest buildings in the world

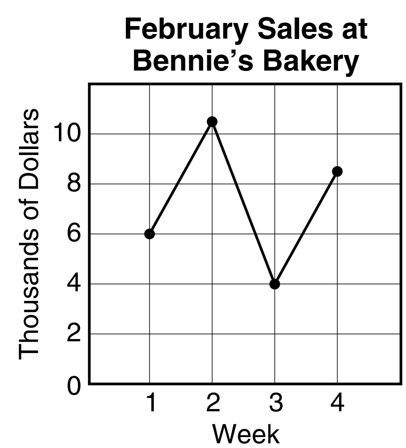
9. Zawodniak family budget

10. average weekly attendance at five different theaters

APPLICATIONS ***The following graphs show the weekly sales at Bennie's Bakery for the month of February. Use the graphs to answer Exercises 11–13.***







11. Which graph best shows how the sales for each week compare to each other?

12. Which graph best shows the changes in the sales over the four weeks?

13. Which graph best shows what part of February's sales each week represents?

SKILL 71

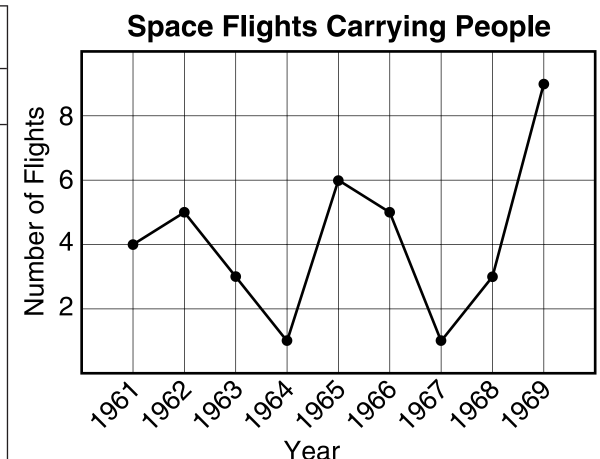
Name ______________________ Date __________

Line Graphs

A **line graph** is usually used to show the change and direction of change over time. All line graphs should have a graph title, a vertical-axis label, and a horizontal-axis label.

EXAMPLE ***Make a line graph for the data on the number of space flights carrying people during the 1960's.***

Space Flights Carrying People	
Year	**Number**
1961	4
1962	5
1963	3
1964	1
1965	6
1966	5
1967	1
1968	3
1969	9



EXERCISES ***Make a line graph for each set of data.***

1.

Sid's Daily Jogging Time for Three Miles	
Day	**Time in Minutes**
1	32
2	29
3	28
4	26
5	28
6	33
7	27

2.

Traffic on Maple Drive	
Day	Number of Vehicles
Monday	7,200
Tuesday	8,050
Wednesday	10,500
Thursday	5,900
Friday	9,990
Saturday	3,400
Sunday	900

3.

Recorded Number of Hurricanes	
Month	Number
June	23
July	36
August	149
September	188
October	95
November	21

4.

Evans Family Electric Bill	
Month	Amount
March	$129.90
April	$112.20
May	$105.00
June	$88.50

5.

Home Runs by Hank Aaron 1967 to 1976	
Year	Number
1967	39
1968	29
1969	44
1970	38
1971	47
1972	34
1973	40
1974	20
1975	12
1976	10

SKILL 72

Name ______________________ Date __________

Bar Graphs

Bar graphs are used to compare numbers. All bar graphs should have a graph title, a vertical-axis label, and a horizontal-axis label.

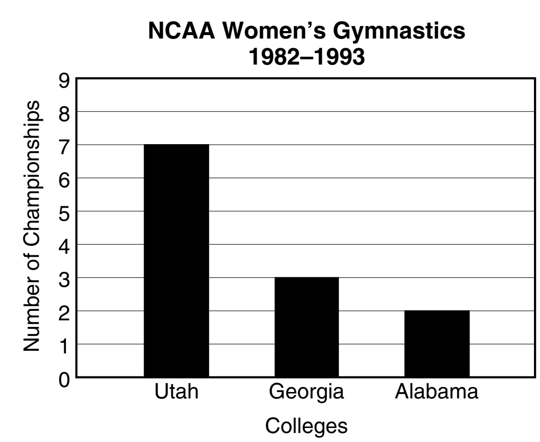
EXAMPLE ***Make a bar graph for the data on women's NCAA gymnastics championships between 1982 and 1993.***

NCAA Women's Gymnastics	
Year	**Champion**
1982	Utah
1983	Utah
1984	Utah
1985	Utah
1986	Utah
1987	Georgia
1988	Alabama
1989	Georgia
1990	Utah
1991	Alabama
1992	Utah
1993	Georgia

Make a tally.

Utah	~~||||~~ ||
Georgia	|||
Alabama	||

Make a bar graph.



EXERCISES ***Make a bar graph for each set of data.***

1.

Preference for Brands	
Brand	**Number of Students**
A	15
B	35
C	30
D	25

2.

NCAA Women's Volleyball	
Year	**Champion**
1981	Southern California
1982	Hawaii
1983	Hawaii
1984	UCLA
1985	Pacific
1986	Pacific
1987	Hawaii
1988	Texas
1989	California State, Long Beach
1990	UCLA
1991	UCLA
1992	Stanford

3.

NCAA Women's Cross Country	
Year	**Champion**
1981	Virginia
1982	Virginia
1983	Oregon
1984	Wisconsin
1985	Wisconsin
1986	Texas
1987	Oregon
1988	Kentucky
1989	Villanova
1990	Villanova
1991	Villanova
1992	Villanova

APPLICATIONS

4. Survey the students in your math class to find out their favorite movie. Use this data to make a bar graph.

5. Survey your friends to find out their favorite television show. Use this data to make a bar graph.

SKILL 73

Name ______________________ Date ____________

Histograms

A **histogram** is a bar graph with no spaces between the bars. It shows data that has been organized into equal intervals.

EXAMPLE ***Make a histogram for the test scores on the Spanish exam.***

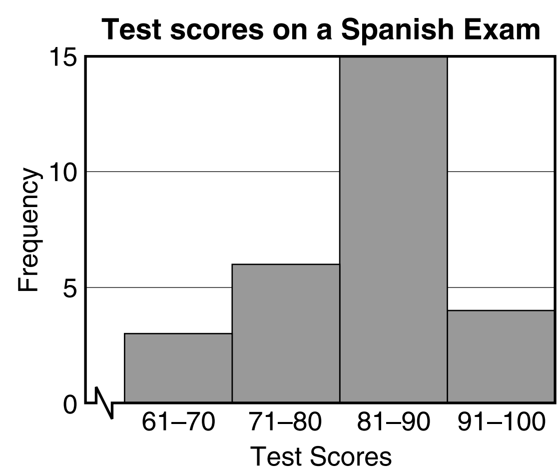
Test Scores on a Spanish Exam						
72	84	88	86	88	72	70
90	98	82	80	86	90	76
100	86	88	84	88	78	96
68	62	82	88	86	80	92

The scores range from 62 to 100. One possible interval that can be used to make the histogram is an interval of 10. Divide the data into the intervals 61–70, 71–80, 81–90, and 91–100.

Make a frequency chart.

Scores	Frequency
61–70	|||
71–80	~~||||~~ |
81–90	~~||||~~ ~~||||~~ ~~||||~~
91–100	||||

Draw a histogram.



EXERCISES ***List possible intervals that could be used in making a histogram for each set of data.***

1. 782, 544, 729, 327, 489, 472, 634, 473, 379, 399, 732, 744, 799, 356, 724, 566, 532, 688, 679, 465

2. 77.3, 75.6, 76.4, 77.9, 75.8, 75.2, 76.9, 76.0, 77.3, 77.6, 76.1, 76.5, 77.5, 75.3, 75.0, 76.4, 76.2, 77.8

3. 12, 4, 6, 8, 15, 9, 2, 3, 16, 14, 7, 9, 3, 13, 14, 17, 1

APPLICATIONS ***Plan the scales and intervals for each set of data. Then make a histogram.***

4.

Height in Inches of Sells Middle School Volleyball Team							
68	69	72	64	74	56	62	58
69	65	70	59	71	67	66	64
73	78	70	52	61	68	67	66

5.

Scores on a 70-Point Science Quiz									
50	48	58	67	60	56	54	46	52	56
50	56	62	68	65	57	64	62	58	55

6.

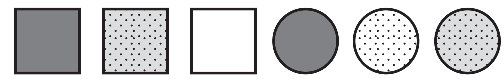
Ages of People Visiting the Museum							
23	35	26	37	24	38	29	27
22	35	30	28	19	20	26	30
25	18	22	27	16	17	20	23

SKILL 74

Name ______________________ Date ____________

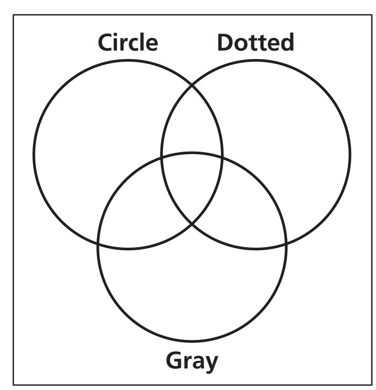
Venn Diagrams

Create a Venn diagram to categorize these shapes based on their similarities and differences.

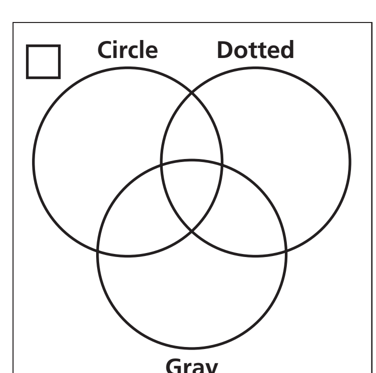


EXAMPLE ***Identify all the categories you need to represent in the Venn diagram. The shapes have three attributes: shape (circle or square), color (white or gray), and pattern (clear or dotted).***

Draw a circle to represent each category. Each circle represents one value of one of the attributes. Make sure the circles overlap. Label each circle with the attribute value it represents.



Put the items into the appropriate section of the Venn diagram. All the objects inside a circle must have the characteristic indicated by the label of that circle. If an object has characteristics that belong to more than one of the circles, it goes into the area where those circles overlap.



EXERCISES

1. Kate's Hair Salon offers haircuts, hair coloring, and perms. This table shows which services customers received at the salon this week. Use the data from the table to complete the Venn diagram.

Cut	Color	Perm	Cut + Color	Cut + Perm	Color + Perm	All 3
21	13	6	17	8	3	4

APPLICATIONS

Draw a Venn diagram to represent the data in the following problem.

2. Murphy's Cars sells cars with three optional features. This table shows how many cars they sold this month with the various features.

Power Windows	Navigation System	Heated Seats	Windows & Navigation	Windows & Seats	Navigation & Seats	All 3	None
8	9	5	12	5	0	0	5

SKILL 75

Name ______________________________ Date ______________

Make a Table

The employees of Lake Products Corporation earn the following yearly salaries.

$14,500	$26,000	$43,200	$23,700	$33,400
$15,500	$28,900	$31,100	$56,300	$41,000
$35,000	$24,700	$16,300	$20,000	$63,000
$8,100	$22,800	$9,700	$32,200	$19,300

EXAMPLE ***Organize this information in a frequency table.***

Use intervals of $10,000 to make the frequency table.

Employee Salaries		
Salary	Tally	Frequency
$60,000–$69,999	|	1
$50,000–$59,999	|	1
$40,000–$49,999	||	2
$30,000–$39,999	||||	4
$20,000–$29,999	~~||||~~ |	6
$10,000–$19,999	||||	4
0–$9,999	||	2

EXERCISES ***Organize the information in a frequency table.***

1. Number of subscriptions sold on the first day of the club's fund-raising campaign:
3, 0, 4, 2, 1, 0, 1, 1, 2, 4, 2, 3, 5, 0, 2, 1, 3, 1, 1, 2

2. The Stanley Cup champions from 1977–1994:

1977 Montreal Canadiens	1986 Montreal Canadiens
1978 Montreal Canadiens	1987 Edmonton Oilers
1979 Montreal Canadiens	1988 Edmonton Oilers
1980 New York Islanders	1989 Calgary Flames
1981 New York Islanders	1990 Edmonton Oilers
1982 New York Islanders	1991 Pittsburgh Penguins
1983 New York Islanders	1992 Pittsburgh Penguins
1984 Edmonton Oilers	1993 Montreal Canadiens
1985 Edmonton Oilers	1994 New York Rangers

APPLICATIONS

3. The results of your survey of your classmates' favorite movies

4. The results of your survey of your classmates' favorite pizza toppings

SKILL 76

Name ______________________________ Date ____________

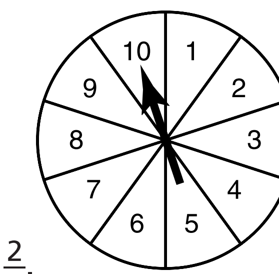
Probability

The **probability** of an event is the ratio of the number of ways an event can occur to the number of possible outcomes.

$$\text{Probability of an event} = \frac{\text{number of ways the event can occur}}{\text{number of possible outcomes}}$$

EXAMPLE

On the spinner below, there are ten equally likely outcomes. Find the probability of spinning a number less than 5.



Numbers less than 5 are 1, 2, 3 and 4.
There are 10 possible outcomes.

Probability of number less than 5 $= \frac{4}{10}$ or $\frac{2}{5}$.

The probability of spinning a number less than 5 is $\frac{2}{5}$.

EXERCISES

A box of crayons contains 3 shades of red, 5 shades of blue, and 2 shades of green. If a child chooses a crayon at random, find the probability of choosing each of the following.

1. a green crayon

2. a red crayon

3. a blue crayon

4. a crayon that is *not* red

5. a red or blue crayon

6. a red or green crayon

A card is chosen at random from a deck of 52 cards. Find the probability of choosing each of the following.

7. a red card

8. the jack of diamonds

9. an ace

10. a black 10

11. a heart

12. *not* a club

A cooler contains 2 cans of grape juice, 3 cans of grapefruit juice, and 7 cans of orange juice. If a person chooses a can of juice at random, find the probability of choosing each of the following.

13. grapefruit juice

14. orange juice

15. grape juice

16. orange or grape juice

17. *not* orange juice

18. *not* grape juice

APPLICATIONS

Businesses use statistical surveys to predict customers' future buying habits. A department store surveyed 200 customers on a Saturday in December to find out how much each customer spent on their visit to the store. Use the results at the right to answer Exercises 19–21.

Amount Spent	Number of Customers
Less than $2	14
$2–$4.99	36
$5–$9.99	42
$10–$19.99	32
$20–$49.99	32
$50–$99.99	22
$100 or more	22

19. What is the probability that a customer will spend less than $2.00?

20. What is the probability that a customer will spend less than $10.00?

21. What is the probability that a customer will spend between $20.00 and $100.00?

SKILL 77

Name ______________________ Date __________

Counting Outcomes

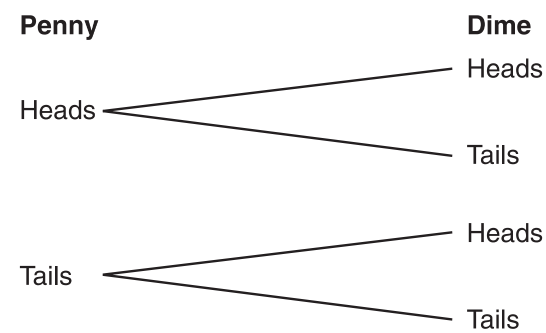
Fundamental Counting Principle
If an event M can occur in *m* ways and it is followed by event N that can occur in *n* ways, then the event M followed by event N can occur in *mn* ways.

EXAMPLE ***Use three different methods to find the number of outcomes if a penny and a dime are tossed.***

Make a list.

penny, dime
heads, heads
heads, tails
tails, heads
tails, tails

Make a tree diagram.



Use the Fundamental Counting Principle.

outcomes for penny × outcomes for dime = possible outcomes

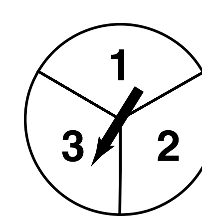
$2 \times 2 = 4$

There are 4 possible outcomes if a penny and a dime are tossed.

EXERCISES ***Make a list to find the number of outcomes for each situation.***

1. A coin and a number cube are tossed.

2. This spinner is spun twice.



Draw a tree diagram to find the number of outcomes for each situation.

3. Three coins are tossed.

4. A coin is tossed and the spinner in Exercise 2 is spun.

Use the Fundamental Counting Principle to find the number of outcomes for each situation.

5. Shirts come in 4 colors and 3 sizes.

6. Donna has a choice of 6 entrees and 4 beverages.

APPLICATIONS

7. The nursery has 14 different-colored tulip bulbs. Each color comes in dwarf, average, or giant size. How many possible selections are there?

8. The type of bicycle Elena wants comes in 12 different colors with 12 different colors of trim. There is also a choice of curved or straight handle bars. How many possible selections are there?

9. At a banquet, guests were given a choice of 4 entrees, 3 vegetables, soup or salad, 4 beverages, and 4 desserts. How many different selections were possible?

10. Ms. Nitobe is setting the combination lock on her briefcase. If she can choose any digit 0-9 for each of the 6 digits in the combination, how many possible combinations are there?

SKILL 78

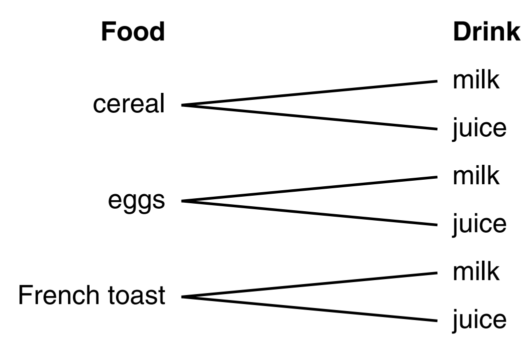
Name ______________________ Date __________

Tree Diagrams

The breakfast special at Dion's Place is a choice of cereal, eggs, or French toast with a choice of milk or juice for $1.99.

EXAMPLE ***If someone wishes to order a breakfast special at Dion's Place, how many choices does he or she have?***

To answer this question, make a tree diagram.



There are 6 choices for the breakfast special.

EXERCISES ***For each situation, draw a tree diagram to show all the outcomes.***

1. A number cube is rolled and a coin is tossed. What is the number of possible outcomes?

2. A penny, a nickel, and a dime are tossed. What is the number of possible outcomes?

APPLICATIONS

3. Ernie can order a small, medium, or large pizza with thick or thin crust. How many possible ways can he order the pizza?

4. Tina has a choice of a sports jersey in blue, white, gray, or black in sizes small, medium, or large. How many choices does she have?

5. José, Kara, and Beth are running for class president. Tony, Lou, and Fay are running for vice-president. How many different pairs of officers can be elected?

6. A snack food company makes chewy fruit shapes of lions, monkeys, elephants, and giraffes in red, green, purple,and yellow. How many different fruit shapes are made?

SKILL 79

Name ______________________________ Date __________

Odds

The odds for an event can be found using the following ratio.

$$\text{odds for an event} = \frac{\text{number of ways the event can occur}}{\text{number of ways the event cannot occur}}$$

EXAMPLE ***Carol picks a marble out of a bag containing 2 red marbles, 3 blue marbles, and 5 white marbles. What are the odds that she will choose a blue marble? What are the odds against choosing a blue marble?***

The number of ways a blue marble *can* be chosen is 3. The number of ways a blue marble *cannot* be chosen is 7.

$$\text{odds of choosing a blue marble} = \frac{3}{7}$$

$$\text{odds against choosing a blue marble} = \frac{7}{3}$$

The odds of choosing a blue marble are $\frac{3}{7}$.

The odds against choosing a blue marble are $\frac{7}{3}$.

EXERCISES ***A coin is tossed. Find the odds for each of the following.***

1. tails

2. heads

3. against tails

4. against heads

A number cube is rolled. Find the odds for each of the following.

5. 1

6. 5

7. against a 1

8. against a 5

9. a prime number

10. a number less than 3

11. a number greater than 3

12. an odd number

13. not an odd number

14. a number less than 6

APPLICATIONS ***Brenda estimates that the probability that she will pass her next test is $\frac{9}{10}$. She also estimates that the probability that she will fail the course is $\frac{1}{100}$.***

15. What are the odds for Brenda passing the test?

16. What are the odds against Brenda passing the test?

17. What are the odds for Brenda passing the course?

18. What are the odds against Brenda passing the course?

19. Do you think probability or odds tell you more about how likely Brenda is to pass the test and the course? Explain.

SKILL 80

Name ______________________ Date __________

Theoretical and Experimental Probability

The **theoretical probability** of an event is the ratio of the number of ways the event can occur to the number of possible outcomes.

The **experimental probability** of an event is the ratio of the number of successful trials to the number of trials.

EXAMPLE ***Sean wants to determine the probability of getting a sum of 7 when rolling two number cubes. The sample space, or all possible outcomes, for rolling two number cubes is shown below.***

1, 1	1, 2	1, 3	1, 4	1, 5	1, 6
2, 1	2, 2	2, 3	2, 4	2, 5	2, 6
3, 1	3, 2	3, 3	3, 4	3, 5	3, 6
4, 1	4, 2	4, 3	4, 4	4, 5	4, 6
5, 1	5, 2	5, 3	5, 4	5, 5	5, 6
6, 1	6, 2	6, 3	6, 4	6, 5	6, 6

What is the theoretical probability of rolling a sum of 7? What is the experimental probability of rolling a sum of 7 if Sean rolls the number cubes 20 times and records 4 sums of 7?

There are 6 sums of 7 shown in the sample space above. So, the theoretical probability of rolling a sum of 7 is $\frac{6}{36}$ or $\frac{1}{6}$.

Since Sean rolled 4 sums of 7 on 20 rolls, the experimental probability is $\frac{4}{20}$ or $\frac{1}{5}$.

EXERCISES ***Find the theoretical probability of each of the following.***

1. getting tails if you toss a coin

2. getting a 6 if you roll a number cube

3. getting a sum of 2 if you roll two number cubes

4. getting a sum less than 6 if you roll two number cubes

5. Amanda rolled one number cube 30 times and got 8 sixes.

   a. What is her experimental probability of getting a six?

   b. What is her experimental probability of *not* getting a six?

6. Ramón rolled two number cubes 36 times and got 3 sums of 11.

   a. What is his experimental probability of getting a sum of 11?

   b. What is his experimental probability of *not* getting a sum of 11?

APPLICATIONS ***While playing a board game, Akira rolled a pair of number cubes 48 times and got doubles 10 times.***

7. What was his experimental probability of rolling doubles?

8. How does his experimental probability compare to the theoretical probability of rolling doubles?

9. How do you think the experimental probability compares to the theoretical probability in most experiments?

10. Do you think the experimental probability is ever equal to the theoretical probability? Explain?