

1-1 Word Problem Practice***Variables and Expressions***

1. SOLAR SYSTEM It takes Earth about 365 days to orbit the sun. It takes Uranus about 85 times as long. Write a numerical expression to describe the number of days it takes Uranus to orbit the sun.

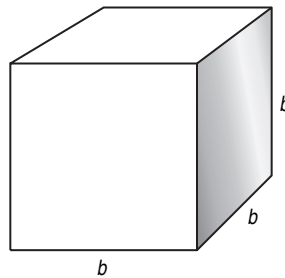
2. TECHNOLOGY There are 1024 bytes in a kilobyte. Write an expression that describes the number of bytes in a computer chip with n kilobytes.

3. THEATER Howard Hughes, Professor Emeritus of Texas Wesleyan College, reportedly attended a record 6136 theatrical shows. Write an expression to represent the average number of theater shows attended if he accumulated the record over y years. Use the expression to find the average number of shows Mr. Hughes attended per year if he went to the theater for 31 years.

4. TIDES The difference between high and low tides along the Maine coast in November is 19 feet on Monday and x feet on Tuesday. Write an expression to show the average rise and fall of the tide for Monday and Tuesday.

BLOCKS For Exercises 5–7, use the following information.

A toy manufacturer produces a set of blocks that can be used by children to build play structures. The product packaging team is analyzing different arrangements for packaging their blocks. One idea they have is to arrange the blocks in the shape of a cube, with b blocks along one edge.



- 5.** Write an expression representing the total number of blocks packaged in a cube measuring b blocks on one edge.
- 6.** The packaging team decides to take one layer of blocks off the top of this package. Write an expression representing the number of blocks in the top layer of the package.
- 7.** The team finally decides that their favorite package arrangement is to take 2 layers of blocks off the top of a cube measuring b blocks along one edge. Write an expression representing the number of blocks left behind after the top two layers are removed.

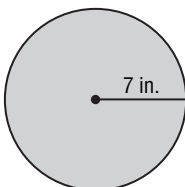
1-2 Word Problem Practice***Order of Operations***

1. SCHOOLS Jefferson High School has 100 less than 5 times as many students as Taft High School. Write and evaluate an expression to find the number of students at Jefferson High School if Taft High School has 300 students.

2. GEOGRAPHY Guadalupe Peak in Texas has an altitude that is 671 feet more than double the altitude of Mount Sunflower in Kansas. Write and evaluate an expression for the altitude of Guadalupe Peak if Mount Sunflower has an altitude of 4039 feet.

3. TRANSPORTATION The Plaid Taxi Cab Company charges \$1.75 per passenger plus \$3.45 per mile for trips less than 10 miles. Write and evaluate an expression to find the cost for Max to take a Plaid taxi 8 miles to the airport.

4. GEOMETRY The area of a circle is related to the radius of the circle such that the product of the square of the radius and a number π gives the area. Write and evaluate an expression for the area of a circular pizza below. Approximate π as 3.14.



5. BIOLOGY Lavania is studying the growth of a population of fruit flies in her laboratory. She notices that the number of fruit flies in her experiment is five times as large after any six-day period. She observes 20 fruit flies on October 1. Write and evaluate an expression to predict the population of fruit flies Lavania will observe on October 31.

CONSUMER SPENDING For Exercises 6–8, use the following information.

During a long weekend, Devon paid a total of x dollars for a rental car so he could visit his family. He rented the car for 4 days at a rate of \$36 per day. There was an additional charge of \$0.20 per mile after the first 200 miles driven.

6. Write an algebraic expression to represent the amount Devon paid for additional mileage only.
7. Write an algebraic expression to represent the number of miles over 200 miles that Devon drove the rented car.
8. How many miles did Devon drive overall if he paid a total of \$174 for the car rental?

1-3

Word Problem Practice

Open Sentences

1. TIME There are 6 time zones in the United States. The eastern part of the U.S., including New York City, is in the Eastern Time Zone. The central part of the U.S., including Dallas, is in the Central Time Zone, which is one hour behind Eastern Time. San Diego is in the Pacific Time Zone, which is 3 hours behind Eastern Time. Write and solve an equation to determine what time it is in California if it is noon in New York.

2. FOOD Part of the Nutrition Facts label from a box of macaroni and cheese is shown below.

Nutrition Facts	
Serving Size 1 cup (228g)	
Servings Per Container 2	
Amount Per Serving	
Calories 250	Calories from Fat 110
% Daily Value *	
Total Fat 12g	18 %
Saturated Fat 3g	15 %
Trans Fat 3g	
Cholesterol 30mg	10 %

Write and solve an inequality to determine how many servings of this item that Alisa can have for lunch if she is restricted no more than 45 grams of cholesterol.

3. CRAFTS You need at least 30 yards of yarn to crochet a small scarf. Cheryl bought a 100-yard ball of yarn and has already used 10 yards. Write and solve an inequality to find how many scarves she can crochet.

4. POOLS There are approximately 202 gallons per cubic yard of water. Write and solve an equation for the number of gallons of water that fill a pool with a volume of 1161 cubic feet. (*Hint:* There are 27 cubic feet per cubic yard.)

VEHICLES For Exercises 5 and 6, use the following information.

Recently developed hybrid cars contain both an electric and a gasoline engine. Hybrid car batteries store extra energy, such as the energy produced by braking. Since the car can use this stored energy to power the car, the hybrid uses less gasoline per mile than cars powered only by gasoline. Suppose a new hybrid car is rated to drive 45 miles per gallon of gasoline.

5. It costs \$40 to fill the gasoline tank with gas that costs \$2.50 per gallon. Write and solve an equation to find the distance the hybrid car can go using one tank of gas.

6. Write and solve an equation to find the cost of gasoline per mile for this hybrid car. Round to the nearest cent.

1-4 Word Problem Practice

Identity and Equality Properties

1. EXERCISE Annika goes on a walk every day in order to get the exercise her doctor recommends. If she walks at a rate of 3 miles per hour for $\frac{1}{3}$ of an hour, then she will have walked $3 \times \frac{1}{3}$ miles. Evaluate the expression and name the property used.

2. MAIL The chart below shows the cost of mailing letters of various weight through the United States Postal Service.

**USPS First Class Mail:
Standard Letter Rates**

Weight (ounces)	Cost
0.25	\$0.39
0.5	\$0.39
0.75	\$0.39
1	\$0.39
1.25	\$0.60
1.5	\$0.60
1.75	\$0.60

Source: www.usps.gov

Write an equation that represents the difference between the cost of mailing a 0.5 ounce and a 1.0 ounce letter. Name the property illustrated.

3. CAPACITY Use the substitution and transitive properties to find how many 1-cup servings there are in 1 gallon of sports drink.

4. PARTY PLANNING Chase is planning a dinner party for 18 guests. He needs to have the same number of place settings as guests, and the same number of water glasses as place settings. What property must be used to determine the number of water glasses he needs for the party? Explain.

TOLL ROADS For Exercises 5 and 6, use the following information.

Some toll highways assess tolls based on where a car entered and exited. The table below shows the highway tolls for a car entering and exiting at a variety of exits. Assume that the toll for the reverse direction is the same.

Entered	Exited	Toll
Exit 5	Exit 8	\$0.50
Exit 8	Exit 10	\$0.25
Exit 10	Exit 15	\$1.00
Exit 15	Exit 18	\$0.50
Exit 18	Exit 22	\$0.75

5. Running an errand, Julio travels from Exit 8 to Exit 5. What property would you use to determine the toll?

6. Gordon travels from home to work and back each day. He lives at Exit 15 on the toll road and works at Exit 22. Write and evaluate an expression to find his daily toll cost. What property or properties did you use?

1-5 Word Problem Practice

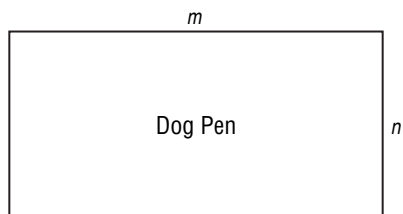
The Distributive Property

1. OPERA Mr. DeLong’s drama class is planning a field trip to see Mozart’s famous opera *Don Giovanni*. Tickets cost \$39 each, and there are 23 students and 2 teachers going on the field trip. Write and evaluate an expression to find the group’s total ticket cost.

2. LIBRARY In Cook County Library’s children’s section there are 7 shelves and 4 tables. Each shelf and table displays 12 books. Write and evaluate an expression to find how many books are in the children’s section.

3. COSTUMES Isabella’s ballet class is performing a spring recital for which they need butterfly costumes. Each butterfly costume is made from $3\frac{3}{5}$ yards of fabric. Use the Distributive Property to find the number of yards of fabric needed for 5 costumes. (*Hint:* a mixed number can be written as the sum of an integer and a fraction.)

4. FENCES Demonstrate the Distributive Property by writing two equivalent expressions to represent the perimeter of the fenced dog pen below.



5. MENTAL MATH During a math facts speed contest, Jamal calculated the following expression faster than anyone else in his class.

$$197 \times 4$$

When classmates asked him how he was able to answer so quickly, he told them he used the Distributive Property to think of the problem differently. Write and evaluate an expression using the Distributive Property that would help Jamal perform the calculation quickly.

INVESTMENTS For Exercises 6 and 7, use the following information.

Letisha and Noel each opened a checking account, a savings account, and a college fund. The chart below shows the amounts that they deposited into each account.

	Checking	Savings	College
Letisha	\$125	\$75	\$50
Noel	\$250	\$50	\$50

6. If Noel used only \$50 bills when he deposited the money to open his accounts, how many \$50 bills did he deposit?

7. If all accounts earn 1.5% interest per year and no further deposits are made, how much interest will Letisha have earned one year after her accounts were opened?

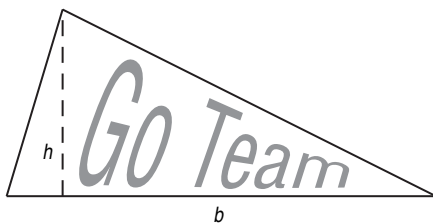
1-6 Word Problem Practice**Commutative and Associative Properties**

- 1. SCHOOL SUPPLIES** At a local school supply store, a highlighter costs \$1.25, a ballpoint pen costs \$0.80, and a spiral notebook costs \$2.75. Use mental math and the Associative Property of Addition to find the total cost if one of each item is purchased.
- 2. BUS STOPS** Mr. McGowan drives a city bus. Occasionally he keeps track of the number of riders for market research. The chart below shows a morning route.

Bus Route	
First stop	12 people got on
Second stop	4 people off; 15 on
Third stop	16 people off; 7 on
Fourth stop	11 people off; 14 on

How many people are on the bus after the fourth stop?

- 3. MENTAL MATH** The triangular banner has a base of 9 centimeters and a height of 6 centimeters. Using the formula for area of a triangle, the banner's area can be expressed as $\frac{1}{2} \times 9 \times 6$. Gabrielle finds it easier to write and evaluate $(\frac{1}{2} \times 6) \times 9$ to find the area. Is Gabrielle's expression equivalent to the area formula? Explain.



- 4. ANATOMY** The human body has 60 bones in the arms and hands, 84 bones in the upper body and head, and 62 bones in the legs and feet. Use the Associative Property to write and evaluate an expression that represents the total number of bones in the human body.

SPORTS For Exercises 5–7, use the following information.

Kim, Doug, and Conner all run on the cross country team. In the last race Doug finished first, Kim finished 3 minutes after Doug, and Conner finished with a time that was twice Doug's time.

5. What is the sum of their times?
6. What property or properties did you use?
7. Evaluate the expression if Doug ran the race in 27 minutes.

1-7 Word Problem Practice

Logical Reasoning and Counterexamples

1. KINDERGARTEN Identify the hypothesis and conclusion and write the statement in if-then form.
Helene will go to school when she is five years old.

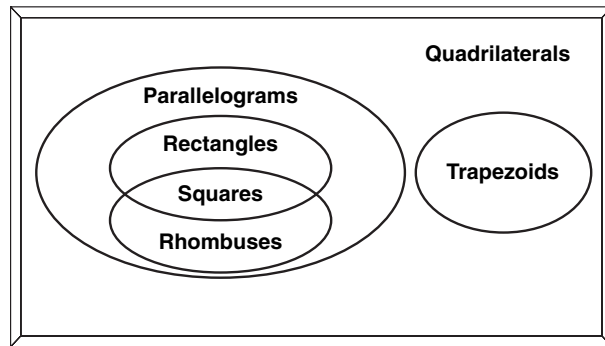
2. GEOMETRY Write a valid conclusion that follows from the statement below for the given condition. If a valid conclusion does not follow, write *no valid conclusion* and explain why.
If the radius of a circle is multiplied by 10, its area is multiplied by 100.
 Circle A has a radius of 5 centimeters and an area equal to 78.5 square centimeters, while circle B has a radius of 50 centimeters.

3. PRIME NUMBERS For centuries, mathematicians have tried to develop a formula to generate prime numbers. Legendre and Euler each came up with a number of polynomial formulas that generate primes. Consider the following conditional statement and find a counterexample to show that it is not always true.
If n is a whole number, $2n^2 + 11$ is a prime number.

4. AUTOMOBILES Is the following conclusion valid? If not, find a counterexample.
If the weather is sunny, it is a good day to wear a T-shirt.

QUADRILATERALS For Exercises 5–7, use the following information.

The Venn diagram shows the relationships of various quadrilaterals.



State whether each statement is valid. If it is not valid, write a new statement that is valid.

- 5.** *If a square is a rhombus and a square is a rectangle, then a rhombus is a rectangle.*
- 6.** *If a quadrilateral is not a parallelogram, it is a trapezoid.*
- 7.** *If a quadrilateral is not a square, it is not a rhombus.*

1-8

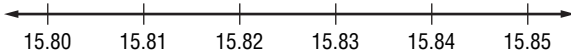
Word Problem Practice

Number Systems

- 1. MATH CLASS** In Mrs. Carson’s math class, students draw numbers to determine the order in which each will solve a problem on the board. If the order is least to greatest value, list the students in order of their turn.

Amanda $\sqrt{97}$	Boyd $\sqrt{2.56}$	Celeste $\frac{23}{8}$
Dominic $\frac{2.56}{7}$	Eve $-\sqrt{49}$	

- 2. SPORTS** Matthew won the 100-yard dash in a photo-finish race with a time of 15.83 seconds. Brady’s time was 15.84 seconds, and he came in third place. Use a number line to graph Matthew’s time, Brady’s time, and the possible time of the person who finished in second place.



- 3. WEATHER** The table shows how the average temperature for each month varied from the normal mean temperature each month for Barrow, Alaska. Graph these values on a number.

Month	Change in Temp. (°F)	Month	Change in Temp. (°F)
Jan.	-3	Jul.	+5
Feb.	-2	Aug.	-1
Mar.	+2	Sep.	-8
Apr.	+13	Oct.	-16
May	+21	Nov.	-16
Jun.	+15	Dec.	-10

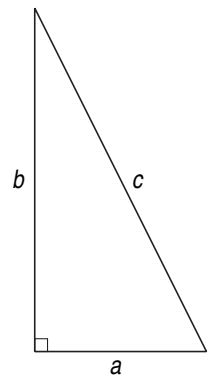
Source: World Almanac 2005, pg 185

- 4. LIGHTING** The brightness of a light bulb depends on the observer’s distance from the bulb. For a 200-watt bulb, the distance D (in inches) from the bulb is given by the equation $D = \sqrt{\frac{318}{B}}$, where B is the brightness (in lumens per square inch). Using a light meter, a product engineer finds the brightness of a 200-watt bulb is 0.244 lumens per square inch. How far is the light meter from the bulb?

GEOMETRY For Exercises 5 and 6, use the following information.

The Pythagorean Theorem is used to find the length of an unknown side of a right triangle when two side lengths are known.

Pythagorean Theorem
 $a^2 + b^2 = c^2$



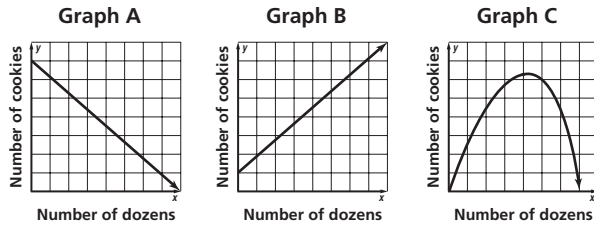
The length of side c can be found by using the following rearrangement of the Pythagorean Theorem: $c = \sqrt{a^2 + b^2}$.

- 5.** Should $c = \sqrt{a^2 + b^2}$ have a \pm symbol in front of the c ?
- 6.** Find the length of the hypotenuse c if $a = 6$ centimeters and $b = 8$ centimeters.

1-9 Word Problem Practice

Functions and Graphs

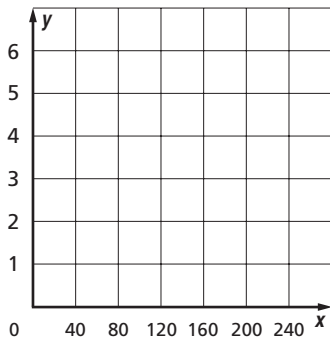
1. BAKING Identify the graph that shows the relationship between the number of cookies and the equivalent number of dozens.



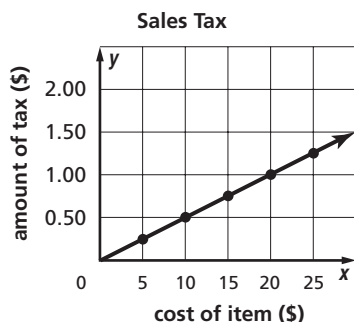
4. AGING A person born in the early 1800s had a life expectancy of about 37 years. With improvements in medical care and pharmaceuticals, life expectancy has increased significantly. In 1900, it rose to 48 years and in 2006 to almost 78 years. Draw a reasonable graph showing the change in life expectancy.

2. NATURE It takes about 40 gallons of sap from maple trees to make 1 gallon of syrup. Let the number of gallons of sap be the independent variable. Draw a reasonable graph showing the number of gallons of syrup produced from a given amount of sap.

Maple Syrup



3. SALES TAX The graph below shows the amount of tax paid on items of a certain cost. Name the independent and dependent variables.



WEATHER For Exercises 5–7, use the following information.

One way to estimate the distance of a thunderstorm is to count the number of seconds that pass from the sight of a flash of lightning until thunder is heard. Divide this number by 5 to get the approximate distance (in miles) of the storm.

- Identify the independent and dependent variables.
- Suppose you can generally hear thunder up to 10 miles away. Identify an appropriate domain and range for this situation.
- Is the function discrete or continuous?

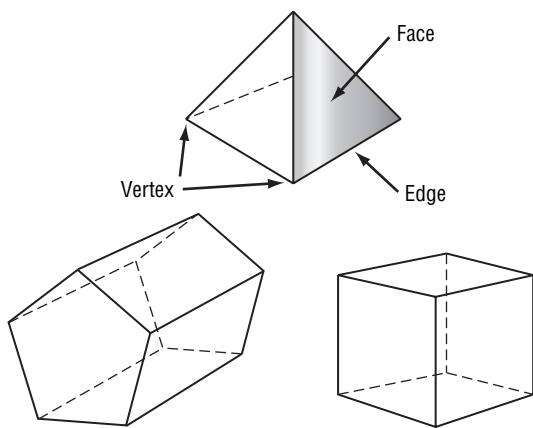
2-1 Word Problem Practice

Writing Equations

1. HOUSES The area of the Hartstein’s kitchen is 182 square feet. This is 20% of the area of the first floor of their house. Let F represent the area of the first floor. Write an equation to represent the situation.

2. FAMILY Katie is twice as old as her sister Mara. The sum of their ages is 24. Write a one-variable equation to represent the situation.

3. GEOMETRY The formula $F + V = E + 2$ shows the relationship between the number of faces F , edges E , and vertices V of a polyhedron, such as a pyramid. Write the formula in words.



4. WIRELESS PHONE Spinfrog wireless phone company bills on a monthly basis. Each bill includes a \$29.95 service fee for 1000 minutes plus a \$2.95 federal communication tax. Additionally, there is a charge of \$0.05 for each minute used over 1000. Let m represent the number of minutes over 1000 used during the month. Write an equation to describe the cost c of the wireless phone service per month.

TEMPERATURE For Exercises 5 and 6, use the table showing degrees Fahrenheit and degrees Celsius temperatures.

Celsius	Fahrenheit
-20°	-4°
-10°	-14°
0°	32°
10°	50°
20°	68°
30°	86°

5. Write a formula for converting Celsius temperatures to Fahrenheit temperatures.

6. Find the Fahrenheit equivalents for 25°C and 35°C.

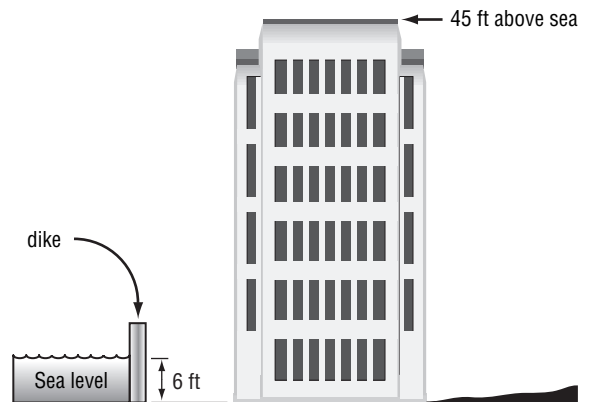
2-2 Word Problem Practice**Solving Equations by Using Addition and Subtraction**

1. SUPREME COURT Chief Justice William Rehnquist served on the Supreme Court for 33 years until his death in 2005. Write and solve an equation to determine the year he was confirmed as a justice on the Supreme Court.

2. SALARY In 2004, the annual salary of the Governor of New Jersey was \$157,000. During the same year, the annual salary of the Governor of Tennessee was \$72,000 less. Write and solve an equation to find the annual salary of the Governor of Tennessee in 2004.

3. WEATHER On a cold January day, Mavis noticed that the temperature dropped 21 degrees over the course of the day to -9°C . Write and solve an equation to determine what the temperature was at the beginning of the day.

4. SEA LEVEL Many parts of the city of Bangkok, Thailand, sit below sea level and the city continues to sink every year. The water is held back by a system of dikes so that the city will remain dry. The base of a building in the center of Bangkok sits at an altitude of -6 feet, meaning that it is 6 feet below sea level. The top of the building is 45 feet above sea level. Write and solve an equation to find the height of the building.



SAVINGS For Exercises 5 and 6, use the following information.

Ophace is saving \$144 to buy three concert tickets. He has already saved \$65.

- 5.** Write and solve an equation to find the amount of money a he still needs to save.
- 6.** Of the three tickets he plans to buy, two are for adults and one is for a child. The adult tickets together cost \$120. Write and solve an equation to find the cost of the child ticket.

2-3 Word Problem Practice***Solving Equations by Using Multiplication and Division***

1. HEART RATE According to the American Heart Association, the target heart rate during exercise for a healthy 20-year-old person is 150 beats per minute. The target heart rate during exercise for a 70-year-old person is one half of that rate. Write and solve an equation to find the target exercise heart rate for a 70-year-old.

2. TREES A redwood tree can grow to be about six times as tall as a pine tree. Suppose a common pine tree measures about 56 feet tall. Write and solve an equation to find the approximate height of a redwood tree.

3. SHOPPING Raul bought fudge at the candy shop. After he gave his sister $\frac{1}{2}$ of the fudge he bought, he still had $\frac{3}{4}$ of a pound. How much fudge did Raul originally buy?

4. FARMING Mr. Hill's farm is 126 acres. Mr. Hill's farm is $\frac{1}{4}$ the size of Mr. Miller's farm. How many acres is Mr. Miller's farm?

NAUTICAL For Exercises 5 and 6, use the following information.

On the sea, distances are measured in nautical miles rather than miles.

$$1 \text{ nautical mile} = 6080 \text{ feet}$$

$$1 \text{ knot} = \frac{1 \text{ nautical mile}}{\text{hour}}$$

5. If a boat travels 16 knots in 1 hour, how far will it have traveled in feet? Write and solve an equation.

6. About how fast was the boat traveling in miles per hour? Round your answer to the nearest hundredth.

2-4 Word Problem Practice

Solving Multi-Step Equations

1. TEMPERATURE The formula for converting a Fahrenheit temperature to a Celsius temperature is $C = \frac{F - 32^\circ}{1.8}$.

Find the equivalent Celsius temperature for 68°F.

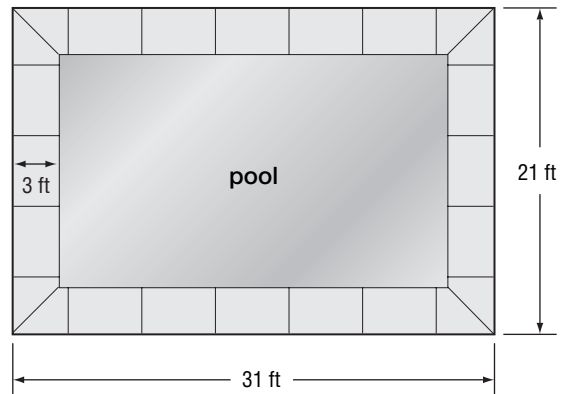
2. HUMAN HEIGHT It is a commonly used guideline that for the average American child, their maximum adult height will be about twice their height at age 2. Suppose that Micah's adult height fits the following equation $a = 2c - 1$, where a represents his adult height and c represents his height at age 2. At age 2 Micah was 35 inches tall. What is Micah's adult height? Write and solve an equation.

3. CHEMISTRY The half-life of a radioactive substance is the time required for half of a sample to undergo radioactive decay, or for the quantity to fall to half its original amount. Carbon-14 has a half-life of 5730 years. Suppose given samples of Carbon-14 weigh $\frac{5}{8}$ of a pound and $\frac{7}{8}$ of a pound. What was the total weight of the samples 11,460 years ago?

4. NUMBER THEORY Write and solve an equation to find three consecutive odd integers whose sum is 3.

GEOMETRY For Exercises 5–7, use the following information.

A rectangular swimming pool is surrounded by a concrete sidewalk that is 3 feet wide. The dimensions of the rectangle created by the sidewalk are 21 feet by 31 feet.



5. Find the length and width of the pool.

6. Find the area of the pool.

7. Write and solve an equation to find the area of the sidewalk in square feet.

2-5 Word Problem Practice***Solving Equations with the Variable on Each Side***

1. OLYMPICS In the 2004 Summer Olympic Games in Athens, Greece, the United States athletes won 2 more than 3 times the number of gold medals won by the French athletes. The United States won 24 more gold medals than the French. Solve the equation $24 + F = 3F + 2$ to find the number of gold medals won by the French athletes.

2. AGE Diego's mother is twice as old as he is. She is also as old as the sum of the ages of Diego and both of his younger twin brothers. The twins are 11 years old. Solve the equation $2d = d + 11 + 11$ to find the age of Diego.

3. GEOMETRY Supplementary angles are angles whose measures have a sum of 180° . Complementary angles are angles whose measures have a sum of 90° . Find the measure of an angle whose supplement is 10° more than twice its complement. Let $90 - x$ equal the degree measure of its complement and $180 - x$ equal the degree measure of its supplement. Write and solve an equation.

4. NATURE The table shows the current heights and average growth rates of two different species of trees. How long will it take for the two trees to be the same height?

Tree Species	Current Height	Annual growth
A	38 inches	4 inches
B	45.5 inches	2.5 inches

NUMBER THEORY For Exercises 5 and 6, use the following information.

Mrs. Simms told her class to find two consecutive even integers such that twice the lesser of two integers is 4 less than two times the greater integer.

5. Write and solve an equation to find the integers.

6. Does the equation have one solution, no solutions, or is it an identity? Explain.

2-6 Word Problem Practice

Ratios and Proportions

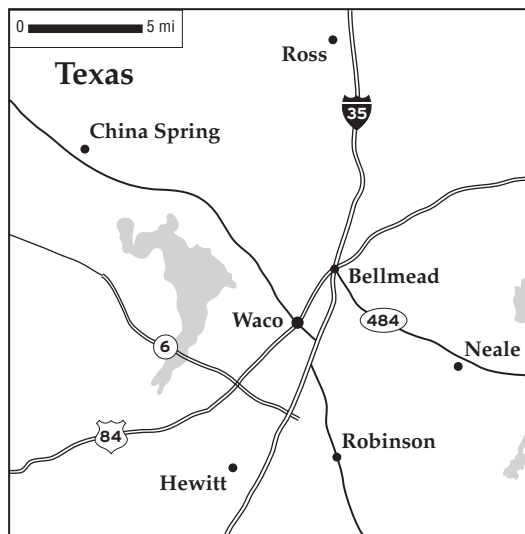
1. **WATER** A dripping faucet wastes 3 cups of water every 24 hours. How much water is wasted in a week?

2. **GASOLINE** In mid-2005 the average price of 5 gallons of regular unleaded gasoline in the United States was \$12.95. What was the price for 16 gallons of gas?

3. **SHOPPING** Stevenson's Market is selling 3 packs of toothpicks for \$0.87. How much will 10 packs of toothpicks cost at this price? Round your answer to the nearest cent.

4. **BUILDINGS** The Sears Tower in Chicago is 1450 feet tall. The John Hancock Center in Chicago is 1127 feet tall. Suppose you are asked to build a small-scale replica of each. If you make the Sears Tower 3 meters tall, what would be the approximate height of the John Hancock replica? Round your answer to the nearest hundredth.

MAPS For Exercises 5–7 use the map below.



5. Use a metric ruler to measure the distances between Robinson and Neale on the map.

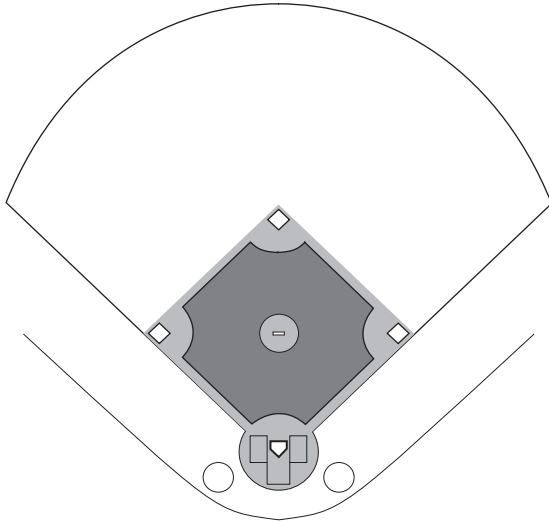
6. Using the scale of the map, find the approximate actual distance by air (not by roads), between Robinson and Neale.

7. Approximately how many square miles are shown on this map?

2-7 Word Problem Practice

Percent of Change

- 1. SPORTS** A regulation girls' fast pitch softball diamond has bases that are 60 feet apart. A regulation professional baseball diamond has bases that are 50% farther apart. Label the distance between the bases on the regulation baseball diamond diagram.



- 2. SALES TAX** Olivia purchases a DVD movie priced at \$21.99. The sales tax is 6.5%. What is the total price of the movie, including tax?
- 3. EDUCATION** The ACT is a college entrance exam taken by high school students. The maximum score that can be earned is 36. The average score in the United States was 20.9 during the 2005 school year. The average score for Vermont students was 8.1% higher than the national average. What was the average ACT score for Vermont students? Round your answer to the nearest tenth.
- 4. CARS** Mr. Thompson plans to purchase a used car priced at \$8400. He will receive a 15% employee discount and then will have to pay a 5.5% sales tax. What will be the final price of the car?

- MUSIC** For Exercises 5–7, use the table below that shows the total number of CDs, cassettes, and DVD music videos sold from 2002 to 2004.

Sales of Recorded Music and Music Videos (millions of units)			
Format	2002	2003	2004
CD	803.3	745.9	766.9
Cassette	31.1	17.2	5.2
DVD video	10.7	17.5	29.01

Source: Recording Industry Association of America

- 5.** Find the percent of change in the number of units sold between 2002 and 2003 and between 2003 and 2004 for each format. Round to the nearest tenth.
- 6.** Tell whether each percent of change in Exercise 5 is a percent of increase or a percent of decrease.
- 7.** Did these trends change from 2003 to 2004? Explain.

2-8 Word Problem Practice**Solving Equations and Formulas**

1. INTEREST Simple interest that you may earn on money in a savings account can be calculated with the formula $I = prt$. I is the amount of interest earned, p is the principal or initial amount invested, r is the interest rate, and t is the amount of time the money is invested for. Solve the formula for p .

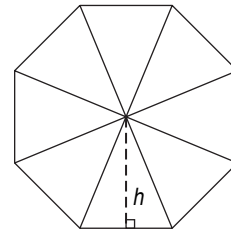
2. DISTANCE The distance d a car can travel is found by multiplying its rate of speed r by the amount of time t that it took to travel the distance. If a car has already traveled 5 miles, the total distance d is found by the formula $d = rt + 5$. Solve the formula for r .

3. GEOMETRY The volume of a rectangular prism is given by the formula $V = \ell \times w \times h$. Suppose a cereal company wants to package 270 cubic inches of cereal in a full box. The width of the box must be 9 inches and the height of the box must be 12 inches to fit on store shelves. Solve the equation for ℓ and find the length of the box.

4. PHYSICS The pressure exerted on an object is calculated by the formula $P = F/A$, where P is the pressure, F is the force, and A is the surface area of the object. Water shooting from a hose has a pressure of 75 pounds per square inch (psi). Suppose the surface area covered by the direct hose spray is 0.442 square inches. Solve the equation for F and find the force of the spray.

GEOMETRY For Exercises 5–7, use the following information.

The regular octagon is divided into 8 congruent triangles. Each triangle has an area of 12 square centimeters. The perimeter of the octagon is 48 centimeters.



5. What is the length of each side of the octagon?

6. Solve the area of a triangle formula for h .

7. What is the height of each triangle?

2-9 Word Problem Practice**Weighted Averages**

1. DRIVING The drive from New York City to Boston is about 240 miles. It took Samir 5 hours to drive one way, but due to severe weather it took him 6.5 hours for the return trip. What was his average speed round trip? Round the answer to the nearest hundredth.

2. GRADES In math classes at Gorbine High School, all tests are given double the weight of a quiz or homework score when calculating grades. Use Donna's grade record sheet to determine her average grade so far this term.

Assignment	Grade
Homework chapter 1	95
Quiz chapter 1	80
Test chapter 1	92
Homework chapter 2	93
Quiz chapter 2	96
Test chapter 2	81

3. MIXTURE Keith wants to create a drink that is 40% juice. How much of a 10% juice solution should he add to 100 milliliters of 100% grape juice to obtain the 40% mixture?

4. BUSINESS Mrs. Winship sells chocolate fudge for \$7.50 per pound and peanut butter fudge for \$7.00 per pound. The total number of pounds sold on Saturday was 146 and the total amount of money collected was \$1065. How many pounds of each type of fudge were sold?

TRAINS For Exercises 5–7, use the following information.

Two trains are 5000 feet apart, heading toward each other, but on separate parallel straight tracks, Train A is traveling at 45 miles per hour and Train B is traveling at 24 miles per hour.

5. Change 45 miles per hour and 24 miles per hour into feet per second.

6. About how far will each train travel before they meet? Round your answers to the nearest hundredth.

7. In how many seconds will the trains meet?

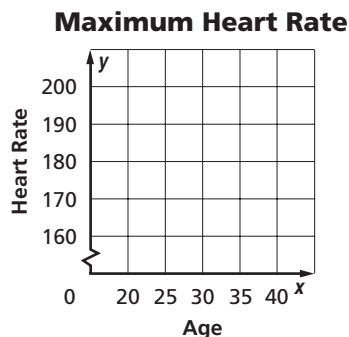
3-1 Word Problem Practice

Representing Relations

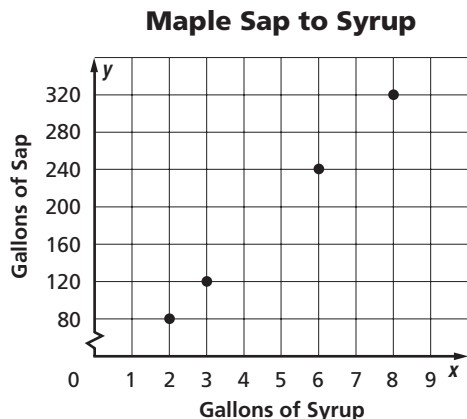
1. HEALTH The American Heart Association recommends that your target heart rate during exercise should be between 50% and 75% of your maximum heart rate. Use the data in the table below to graph the approximate maximum heart rates for people of given ages.

Age (years)	20	25	30	35	40
Maximum Heart Rate (beats per minute)	200	195	190	185	180

Source: www.americanheart.org



2. NATURE Maple syrup is made by collecting sap from sugar maple trees and boiling it down to remove excess water. The graph shows the number of gallons of tree sap required to make different quantities of maple syrup. Express the relation as a set of ordered pairs and then write the inverse.

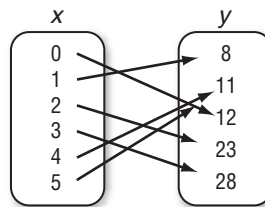


Source: www.vermontmaple.org

3. COOKING A chocolate chip cookie recipe calls for $2\frac{1}{4}$ cups of flour for each batch of 30 cookies. Draw a mapping to show the relation between cups of flour, c , and number of cookies, n , for 1, 2, 3, and 4 batches.

DATA COLLECTION For Exercises 4–6, use the following information.

Margaret collected data to determine the number of books her schoolmates were bringing home each evening. She recorded her data as a set of ordered pairs. She let x be the number of textbooks brought home after school, and y be the number of students with x textbooks. The relation is shown in the mapping.

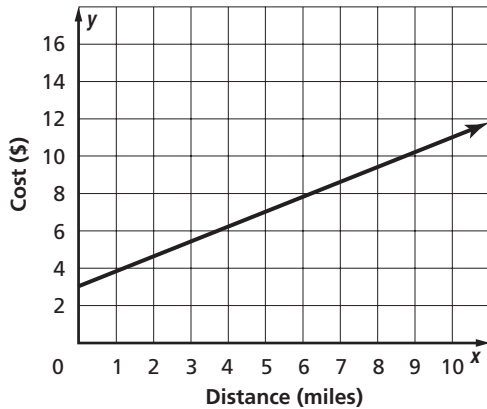


- Express the relation as a set of ordered pairs.
- What is the domain of the relation?
- What is the range of the relation?

3-2 Word Problem Practice

Representing Functions

- 1. TRANSPORTATION** The cost of riding in a cab is \$3.00 plus \$0.75 per mile. The equation that represents this relation is $y = 0.75x + 3$, where x is the number of miles traveled and y is the cost of the trip. Look at the graph of the equation and determine whether the relation is a function.



- 2. TEXT MESSAGING** Many cell phones have a text messaging option in addition to regular cell phone service. The function for the monthly cost of text messaging service from Noline Wireless Company is $f(x) = 0.10x + 2$, where x is the number of text messages that are sent. Find $f(10)$ and $f(30)$, the cost of 10 text messages in a month and the cost of 30 text messages in a month.

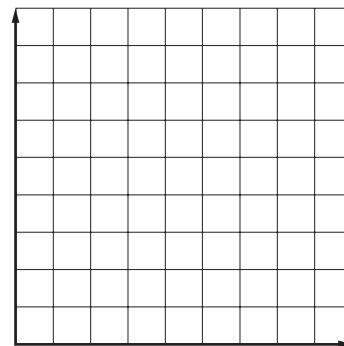
- 3. GEOMETRY** The area for any square is given by the function $y = x^2$, where x is the length of a side of the square and y is the area of the square. Write the equation in function notation and find the area of a square with a side length of 3.5 inches.

- 4. TRAVEL** The cost for cars entering President George Bush Turnpike at Beltline road is given by the relation $x = 0.75y$, where x is the dollar amount for entrance to the toll road and y is the number of passengers. Determine if this relation is a function. Explain.

CONSUMER CHOICES For Exercises 5–7, use the following information.

Aisha just received a \$40 paycheck from her new job. She spends some of it buying music online and saves the rest in a bank account. Her savings is given by $f(x) = 40 - 1.25x$, where x is the number of songs she downloads at \$1.25 per song.

5. Graph the function.



6. Find $f(3)$, $f(18)$, and $f(36)$. What do these values represent?

7. How many songs can Aisha buy if she wants to save \$30?

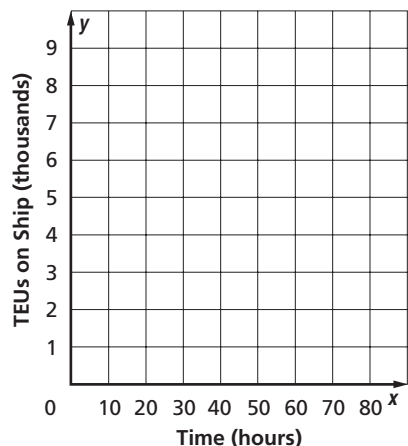
3-3 Word Problem Practice

Linear Functions

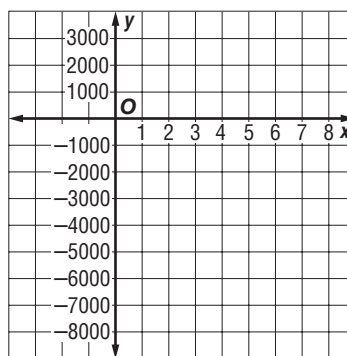
1. FOOTBALL One football season, the Texas Tech Red Raiders won 4 more games than they lost. This can be represented by $y = x + 4$, where x is the number of games lost and y is the number of games won. Write this linear equation in standard form.

2. TOWING Pick-M-Up Towing Company charges \$40 to hook a car and \$1.70 for each mile that it is towed. The equation $y = 1.7x + 40$ represents the total cost y for x miles towed. Determine the x -intercept and y -intercept. Describe what these values mean.

3. SHIPPING The *OOCL Shenzhen*, one of the world's largest container ships, carries 8,063 TEUs (1280 cubic feet containers). Workers can unload a ship at a rate of a TEU every minute. Using this rate, write and graph an equation to determine how many hours it will take the workers to unload half of the containers from the *Shenzhen*.



4. BUSINESS The equation $y = 1000x - 5000$ represents the monthly profits of a start-up dry cleaning company. Time in months is x and profit in dollars is y . The first date of operation is when time is zero. However, preparation for opening the business began 3 months earlier with the purchase of equipment and supplies. Graph the linear function for x -values from -3 to 8.



BONE GROWTH For Exercises 5–7, use the following information.

The height of a woman can be predicted by the equation $h = 81.2 + 3.34r$, where h is her height in centimeters and r is the length of her radius bone in centimeters.

5. Is this a linear function? Explain.

6. What are the x - and y -intercepts of the equation? Do they make sense in the situation? Explain.

7. Use the function to find the approximate height of a woman whose radius bone is 25 centimeters long.

3-4 Word Problem Practice**Arithmetic Sequences**

- 1. POSTAGE** In 2002, the price for first class mail was raised to 37 cents for the first ounce and 23 cents for each additional ounce. The table below shows the cost for weights up to 5 ounces.

Weight (ounces)	1	2	3	4	5
Postage (cents)	37	60	83	106	129

Source: www.prc.gov

How much did a letter weigh that cost \$1.98 to send?

- 2. SPORTS** Wanda is the manager for the soccer team. One of her duties is to hand out cups of water at practice. Each cup of water is 4 ounces. She begins practice with a 128-ounce cooler of water. How much water is remaining after she hands out the 14th cup?
- 3. THEATER** A theater has 20 seats in the first row, 22 in the second row, 24 in the third row, and so on for 25 rows. How many seats are in the last row?

- 4. NUMBER THEORY** One of the most famous sequences in mathematics is the Fibonacci sequence. It is named after Leonardo de Pisa (1170-1250) or Filius Bonacci, alias Leonardo Fibonacci. The first several numbers in the Fibonacci sequence are:
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...
Does this represent an arithmetic sequence? Why or why not?

SAVINGS For Exercises 5 and 6, use the following information.

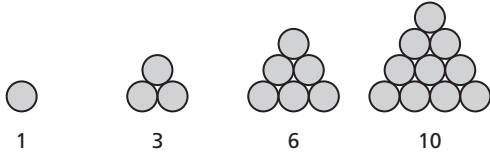
Inga's grandfather decides to start a fund for her college education. He makes an initial contribution of \$3000 and each month deposits an additional \$500. After one month he will have contributed \$3500.

- 5.** Write an equation for the n^{th} term of the sequence.
- 6.** How much money will Inga's grandfather have contributed after 24 months?

3-5 Word Problem Practice

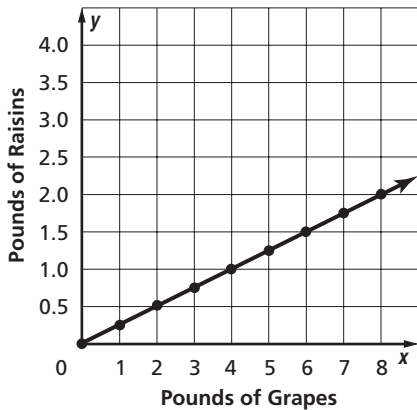
Describing Number Patterns

1. **GEOMETRY** A number that can be represented by a triangular array is called a triangular number.



What are the next three numbers in the pattern?

2. **FOOD** It takes about four pounds of grapes to produce one pound of raisins. The graph shows the relation for the number of pounds of grapes needed, x , to make y pounds of raisins. Write an equation in function notation for the relation shown.



3. **TECHNOLOGY** Gordon wrote a computer program to control the lighting for a deejay. He sets the lighting so that only one color is on at a time. The lighting pattern is red, blue, violet, green, and rose. The pattern repeats and colors change every 10 seconds. After 1 minute, what color light is on?

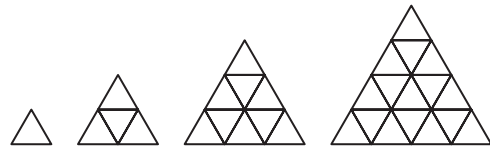
4. **MUSIC** A measure of music contains the same number of beats throughout the song. The table shows the relation for the number of beats counted after a certain number of measures have been played in the six-eight time. Write an equation to describe this relationship.

Measures Played (x)	1	2	3	4	5	6
Total Number of Beats (y)	6	12	18	24	30	36

Source: www.sheetmusicusa.com

GEOMETRY For Exercises 5–7, use the following information.

A fractal is a pattern containing parts which are identical to the overall pattern. The following geometric pattern is a fractal.



5. Complete the table.

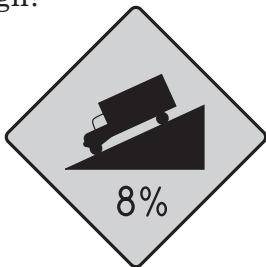
Term	x	1	2	3	4
Number of Smaller Triangles	y	1			

6. What are the next three numbers in the pattern?
7. Write an equation in function notation for the pattern.

4-1 Word Problem Practice

Rate of Change and Slope

- 1. HIGHWAYS** Roadway signs such as the one below are used to warn drivers of an upcoming steep down grade that could lead to a dangerous situation. What is the grade, or slope, of the hill described on the sign?



- 2. AMUSEMENT PARKS** The SheiKra roller coaster at Busch Gardens in Tampa, Florida, features a 138-foot vertical drop. What is the slope of the coaster track at this part of the ride? Explain.

- 3. CENSUS** The table shows the population density for the state of Texas in various years. Find the average annual rate of change in the population density from 1990 to 2000.

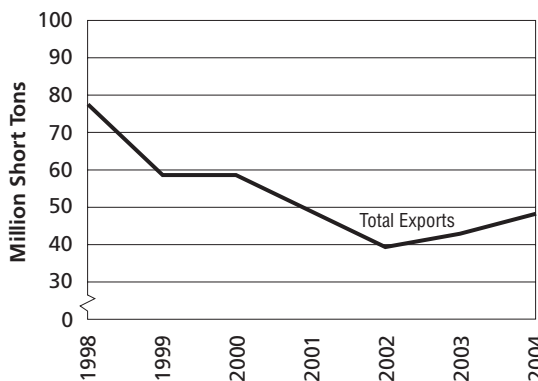
Population Density	
Year	People Per Square Mile
1930	22.1
1960	36.4
1980	54.3
1990	64.9
2000	79.6

Source: Bureau of the Census, U.S. Dept. of Commerce

- 4. REAL ESTATE** The median price of an existing home in the United States was \$139,000 in 2000. The median price had risen to \$191,300 by 2004. Find the average annual rate of change in median home price from 2000 to 2004.

COAL EXPORTS For Exercises 5–7, use the following graph.

The graph shows the annual coal exports from U.S. mines in millions of short tons.



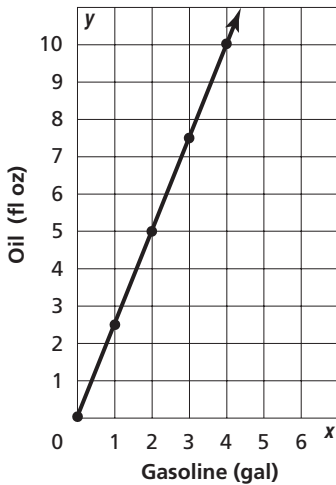
Source: www.eia.doe.gov/cneaf

- 5.** What was the rate of change in coal exports between 2001 and 2002?
- 6.** How does the rate of change in coal exports from 2003 to 2004 compare to that of 2001 to 2002?
- 7.** Explain the meaning of the part of the graph with a slope of zero.

4-2 Word Problem Practice

Slope and Direct Variation

1. **ENGINES** The engine of a chainsaw requires a mixture of engine oil and gasoline. According to the directions, oil and gasoline should be mixed as shown in the graph below. What is the constant of variation for the line graphed?



2. **RACING** In 2004, German driver Michael Schumacher won the United States Grand Prix at the Indianapolis Motor Speedway. His speed during the race averaged 113.523 miles per hour. Write a direct variation equation for the distance d that Schumacher drove in h hours at that speed.

3. **CURRENCY** The exchange rate from U.S. dollars to British pound sterling (£) was approximately \$1.79 to £1 in 2004. Write and solve a direct variation equation to determine how many pounds sterling you would receive in exchange for US\$90.

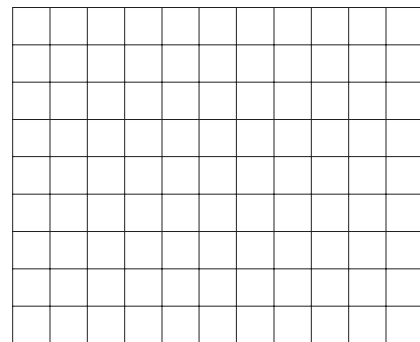
4. **SALARY** Henry started a new job in which he is paid \$9.50 an hour. Write and solve an equation to determine Henry's gross salary for a 40-hour work week.

SALES TAX For Exercises 5–7, use the following information.

Amelia received a gift card to a local music shop for her birthday. She plans to use the gift card to buy some new CDs.

5. Amelia chose 3 CDs that each cost \$16. The sales tax on the three CDs is \$3.96. Write a direct variation equation relating sales tax to the price.

6. Graph the equation you wrote in Exercise 5.



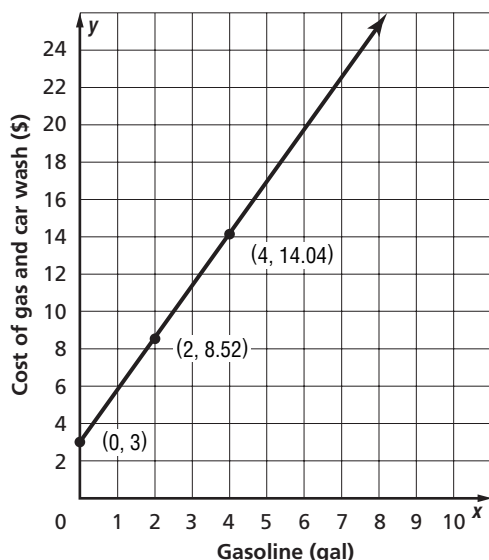
7. What is the sales tax that Amelia is paying on the CDs?

4-3 Word Problem Practice

Graphing Equations in Slope-Intercept Form

1. SAVINGS Wade's grandmother gave him \$100 for his birthday. Wade wants to save his money to buy a new MP3 player that costs \$275. Each month, he adds \$25 to his MP3 savings. Write an equation in slope-intercept form for m , the number of months that it will take Wade to save \$275.

2. CAR CARE Suppose regular gasoline costs \$2.76 per gallon. You can purchase a car wash at the gas station for \$3. The graph of the equation for the cost of gasoline and a car wash is shown below. Write the equation in slope-intercept form for the line shown on the graph.



3. ADULT EDUCATION Angie's mother wants to take some adult education classes at the local high school. She has to pay a one-time enrollment fee of \$25 to join the adult education community, and then \$45 for each class she wants to take. The equation $y = 45x + 25$ expresses the cost of taking classes. What are the slope and y -intercept of the equation?

4. BUSINESS A construction crew needs to rent a trench digger for up to a week. An equipment rental company charges \$40 per day plus a \$20 non-refundable insurance cost to rent a trench digger. Write and graph an equation to find the total cost to rent the trench digger for d days.

ENERGY For Exercises 5–7, use the following information.

From 1991 to 2000, U.S. production of hydroelectric power decreased an average of 0.02 quadrillion BTUs per year. About 3.02 quadrillion BTUs of hydroelectric power were produced in the year 1991.

- Write an equation in slope-intercept form to find the amount of hydroelectric power P produced in year y between 1991 and 2000.
- Approximately how much hydroelectric power was produced in 2000?
- If the same trend continues from 2001 to 2010, how much hydroelectric power will be produced in the year 2010?

4-4 Word Problem Practice**Writing Equations in Slope-Intercept Form**

1. FUND-RAISING Yvonne and her friends held a bake sale to benefit a shelter for homeless people. The friends sold 22 cakes on the first day and 15 cakes on the second day of the bake sale. They collected \$88 on the first day and \$60 on the second day. Let x represent the number of cakes sold and y represent the amount of money made. Find the slope of the line that would pass through the points given.

2. JOBS Mr. Kimball receives a \$3000 annual salary increase on the anniversary of his hiring if he receives a satisfactory performance review. His starting salary was \$41,250. Write an equation to show s , Mr. Kimball's salary after y years at this company if his performance reviews are always satisfactory.

3. CENSUS The population of Laredo, Texas, was about 197,500 in 2003. It was about 123,000 in 1990. If we assume that the population growth is constant, write a linear equation to find p , Laredo's population for any year y .

4. WATER Mr. Williams pays \$40 a month for city water, no matter how many gallons of water he uses in a given month. Let x represent the number of gallons of water used per month. Let y represent the monthly cost of the city water in dollars. What is the equation of the line that represents this information? What is the slope of the line?

SHOE SIZES For Exercises 5–7, use the following information.

The table shows how women's shoe sizes in the United Kingdom compare to women's shoe sizes in the United States.

Women's Shoe Sizes							
U.K.	3	3.5	4	4.5	5	5.5	6
U.S.	5.5	6	6.5	7	7.5	8	8.5

Source: www.dancesport.uk.com/shoes

5. Write a linear equation to determine any U.S. size if you are given the U.K. size.

6. What is the slope and y -intercept of the line?

7. Is the y -intercept a valid data point for the given information?

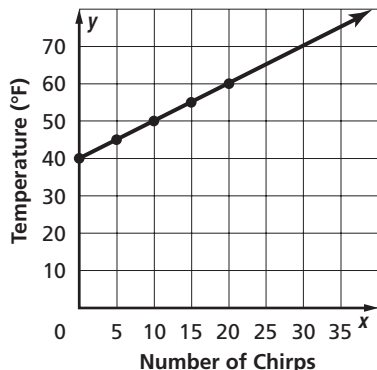
4-5 Word Problem Practice

Writing Equations in Point-Slope Form

1. BICYCLING Harvey rides his bike at an average speed of 12 miles per hour. In other words, he rides 12 miles in 1 hour, 24 miles in 2 hours, and so on. Let h be the number of hours he rides and d be distance traveled. Write the equation for the relationship between distance and time in point-slope form.

2. GEOMETRY The perimeter of a square varies directly with the side length. The point-slope form of the equation for this function is $y - 4 = 4(x - 1)$. Write the equation in standard form.

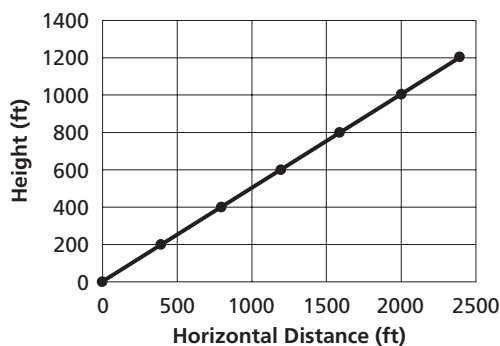
3. NATURE In a near perfect linear relationship, the frequency of a male cricket's chirp matches the outdoor temperature. The relationship is expressed by the equation $T = n + 40$, where T is the temperature in degrees Fahrenheit and n is the number of chirps the cricket makes in 14 seconds. Use the information on the graph below to write a point-slope form of the equation for the line.



4. CANOEING Geoff paddles his canoe at an average speed of 3.5 miles per hour. After 5 hours of canoeing, Geoff has traveled 18 miles. Write an equation in the point-slope form to find the total distance y for any number of hours x .

AVIATION For Exercises 5–7, use the following information.

A jet plane takes off and climbs consistently 20 feet for every 40 feet it moves horizontally. The graph shows the trajectory of the jet as it climbs.



5. Write an equation in point-slope form for the line representing the jet's climb.

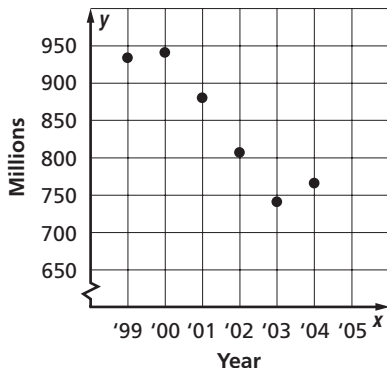
6. Write the equation in slope intercept form.

7. Write the equation in standard form.

4-6 Word Problem Practice

Statistics: Scatter Plots and Lines of Fit

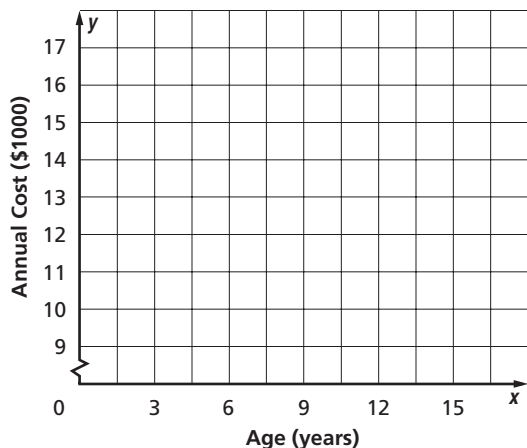
- 1. MUSIC** The scatter plot shows the number of CDs (in millions) that were sold from 1999 to 2004. If the trend continued, about how many CDs were sold in 2005?



Source: Recording Industry Association of America

- 2. FAMILY** The table shows the predicted annual cost for a middle income family to raise a child from birth until adulthood. Draw a scatter plot and describe what relationship exists within the data.

Cost of Raising a Child Born in 2003					
Child's Age	3	6	9	12	15
Annual Cost (\$)	10,700	11,700	12,600	15,000	16,700



Source: The 2005 World Almanac

- 3. HOUSING** The median price of existing homes was \$110,000 in 1990 and \$170,000 in 2004. If 1990 represents year 0, use these data to determine a possible line of best fit for the trends in the price of existing homes. Write the equation in slope-intercept form.

BASEBALL For Exercises 4–6, use the information in the table below. The table shows the average length (in minutes) of professional baseball games in selected years.

Average Length of Major League Baseball Games							
Year	'90	'92	'94	'96	'98	'00	'02
Time (min)	168	170	174	171	168	178	172

Source: Elias Sports Bureau

- 4.** Draw a scatter plot and determine what relationship, if any, exists in the data.

- 5.** Explain what the scatter plot shows.

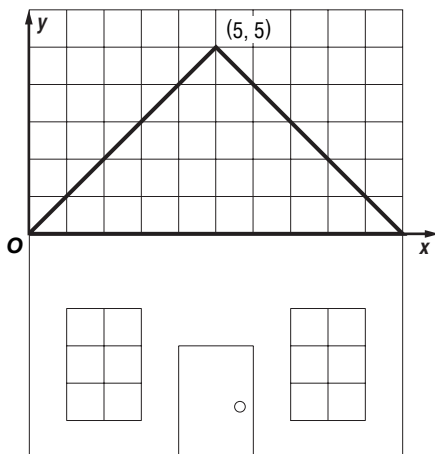
- 6.** Draw a line of fit for the scatter plot.

4-7 Word Problem Practice

Geometry: Parallel and Perpendicular Lines

1. BUSINESS Brady's Books is a retail store that also sells books online. The store's profits y are given by the equation $y = 2x + 3$ where x is the number of available hours for customer purchases. Brady's discontinues the online shopping option. Write a new equation in slope-intercept form to show a new profit line with the same profit rate containing the point $(0, 0)$.

2. ARCHITECTURE The front view of a house is drawn on graph paper. The left side of the roof of the house is represented by the equation $y = x$. The rooflines intersect at a right angle and the peak of the roof is represented by the point $(5, 5)$. Write the equation in slope-intercept form for the line that creates the right side of the roof.



3. ARCHAEOLOGY An archaeologist is comparing the location of a jeweled box she just found to the location of a brick wall. The wall can be represented by the equation $y = -\frac{5}{3}x + 13$. The box is located at the point $(10, 9)$. Write an equation representing a line that is perpendicular to the wall and that passes through the location of the box.

4. GEOMETRY A parallelogram is created by the intersections of the lines $x = 2$, $x = 6$, $y = \frac{1}{2}x + 2$, and another line. Find the equation of the fourth line needed to complete the parallelogram. The line should pass through $(2, 0)$. (*Hint: Sketch a graph to help you see the lines.*)

INTERIOR DESIGN For Exercises 5–7, use the following information.

Pamela is planning to install an island in her kitchen. She draws the shape she likes by connecting vertices of the square tiles on her kitchen floor. She records the location of each corner in the table.

Corner	Distance from West Wall (tiles)	Distance from South Wall (tiles)
A	5	4
B	3	8
C	7	10
D	11	7

5. How many pairs of parallel sides are there in the shape she designed? Explain.

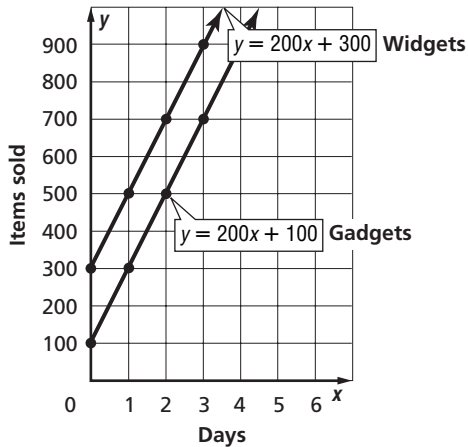
6. How many pairs of perpendicular sides are there in the shape she designed? Explain.

7. What is the shape of her new island?

5-1 Word Problem Practice

Graphing Systems of Equations

- 1. BUSINESS** The widget factory will sell a total of y widgets after x days according to the equation $y = 200x + 300$. The gadget factory will sell y gadgets after x days according to the equation $y = 200x + 100$. Look at the graph of the system of equations and determine whether it has *no* solution, *one* solution, or *infinitely many* solutions.

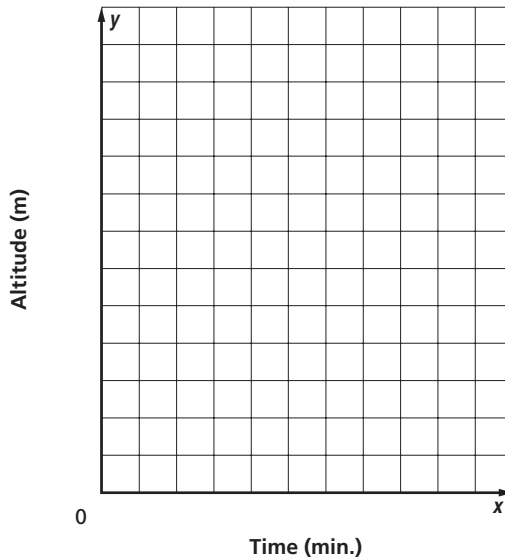


- 2. ARCHITECTURE** An office building has two elevators. One elevator starts out on the 4th floor, 35 feet above the ground, and is descending at a rate of 2.2 feet per second. The other elevator starts out at ground level and is rising at a rate of 1.7 feet per second. Write a system of equations to represent the situation.
- 3. FITNESS** Olivia and her brother William had a bicycle race. Olivia rode at a speed of 20 feet per second while William rode at a speed of 15 feet per second. To be fair, Olivia decided to give William a 150-foot head start. The race ended in a tie. How far away was the finish line from where Olivia started?

AVIATION For Exercises 4 and 5, use the following information.

Two planes are in flight near a local airport. One plane is at an altitude of 1000 meters and is ascending at a rate of 400 meters per minute. The second plane is at an altitude of 5900 meters and is descending at a rate of 300 meters per minute.

- 4.** Write a system of equations that represents the progress of each plane
- 5.** Make a graph that represents the progress of each plane.



5-2 Word Problem Practice**Substitution**

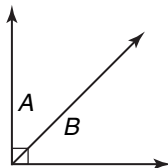
- 1. BUSINESS** Mr. Randolph finds that the supply and demand for gasoline at his station are generally given by the following equations.

$$x - y = -2$$

$$x + y = 10$$

Use substitution to find the equilibrium point where the supply and demand lines intersect.

- 2. GEOMETRY** The measures of complementary angles have a sum of 90 degrees. Angle A and angle B are complementary, and their measures have a difference of 20° . What are the measures of the angles?



- 3. MONEY** Harvey has some \$1 bills and some \$5 bills. In all, he has 6 bills worth \$22. Let x be the number of \$1 bills and let y be the number of \$5 bills. Write a system of equations to represent the information and use substitution to determine how many bills of each denomination Harvey has.

- 4. POPULATION** Sanjay is researching population trends in South America. He found that experts expect the population of Ecuador to increase by 1,000,000 and the population of Chile to increase by 600,000 from 2004 to 2009. The table displays the information he found.

Country	2004 Population	Predicted 5-Year Change
Ecuador	13,000,000	+1,000,000
Chile	16,000,000	+600,000

Source: *World Almanac 2005*

If the population growth for each country continues at the same rate, in what year are the populations of Ecuador and Chile predicted to be equal?

CHEMISTRY For Exercises 5 and 6, use the following information.

Shelby and Calvin are doing a chemistry experiment. They need 5 ounces of a solution that is 65% acid and 35% distilled water. There is no undiluted acid in the chemistry lab, but they do have two flasks of diluted acid: Flask A contains 70% acid and 30% distilled water. Flask B contains 20% acid and 80% distilled water.

- 5.** Write a system of equations that Shelby and Calvin could use to determine how many ounces they need to pour from each flask to make their solution.
- 6.** Solve your system of equations. How many ounces from each flask do Shelby and Calvin need?

5-3 Word Problem Practice**Elimination Using Addition and Subtraction**

- 1. NUMBER FUN** Ms. Simms, the sixth grade math teacher, gave her students this challenge problem.

Twice a number added to another number is 15. The sum of the two numbers is 11.

Lorenzo, an algebra student who was Ms. Simms aide, realized he could solve the problem by writing the following equations.

$$2x + y = 15$$

$$x + y = 11$$

Use the elimination method to solve the system and find the two numbers.

- 2. GOVERNMENT** The Texas State Legislature is comprised of state senators and state representatives. The sum of the number of senators and representatives is 181. There are 119 more representatives than senators. How many senators and how many representatives make up the Texas Legislature?

- 3. RESEARCH** Melissa wondered how much it cost to send a letter by mail in 1990, so she asked her father. Rather than answer directly, Melissa's father gave her the following information. It would have cost \$3.70 to send 13 postcards and 7 letters, and it would have cost \$2.65 to send 6 postcards and 7 letters. Use a system of equations and elimination to find how much it cost to send a letter in 1990.

- 4. SPORTS** As of 2004 the New York Yankees had won more Major League Baseball World Series than any other team. In fact The Yankees had won 1 fewer than 3 times the number of World Series won by the Oakland A's. The sum of the two teams' World Series championships is 35. How many times has each team won the World Series has each team?

BASKETBALL For Exercises 5 and 6, use the following information.

In 2005, the average ticket prices for Dallas Mavericks games and Boston Celtics games are shown in the table below. The change in price is from the 2004 season to the 2005 season.

Team	Average Ticket Price	Change in Price
Dallas	\$53.60	\$0.53
Boston	\$55.93	-\$1.08

Source: TeamMarketingReport.com

- 5.** Assume that tickets continue to change at the same rate each year after 2005. Let x be the number of years after 2005, and y be the price of an average ticket. Write a system of equations to represent the information in the table.
- 6.** In how many years will the average ticket price for Dallas approximately equal that of Boston?

5-4 Word Problem Practice***Elimination Using Multiplication***

- 1. SOCCER** Suppose a youth soccer field has a perimeter of 320 yards and its length measures 40 yards more than its width. Ms. Hughey asks her players to determine the length and width of their field. She gives them the following system of equations to represent the situation. Use elimination to solve the system to find the length and width of the field.

$$\begin{aligned} 2L + 2W &= 320 \\ L - W &= 40 \end{aligned}$$

- 2. SPORTS** The Fan Cost Index (FCI) tracks the average costs for attending sporting events, including tickets, drinks, food, parking, programs, and souvenirs. According to the FCI, a family of four would spend a total of \$592.30 to attend two Major League Baseball (MLB) games and one National Basketball Association (NBA) game. The family would spend \$691.31 to attend one MLB and two NBA games. Write and solve a system of equations to find the family's costs for each kind of game according to the FCI.

- 3. ART** Mr. Santos, the curator of the children's museum, recently made two purchases of clay and wood for a visiting artist to sculpt. Use the table to find the cost of each product per kilogram.

Clay (kg)	Wood (kg)	Total Cost
5	4	\$35.50
3.5	6	\$50.45

- 4. TRAVEL** Antonio flies from Houston to Philadelphia, a distance of about 1340 miles. His plane travels with the wind and takes 2 hours and 20 minutes. At the same time, Paul is on a plane from Philadelphia to Houston. Since his plane is heading against the wind, Paul's flight takes 2 hours and 50 minutes. What was the speed of the wind in miles per hour?

BUSINESS For Exercises 5–7, use the following information.

Suppose you start a business assembling and selling motorized scooters. It costs you \$1500 for tools and equipment to get started, and the materials cost \$200 for each scooter. Your scooters sell for \$300 each.

- 5.** Write and solve a system of equations representing the total costs and revenue of your business.
- 6.** Describe what the solution means in terms of the situation.
- 7.** Give an example of a reasonable number of scooters you could assemble and sell in order to make a profit, and find the profit you would make for that number of scooters.

5-5 Word Problem Practice

Applying Systems of Linear Equations

1. MONEY Veronica has been saving dimes and quarters. She has 94 coins in all, and the total value is \$19.30. How many dimes and how many quarters does she have?

2. CHEMISTRY How many liters of 15% acid and 33% acid should be mixed to make 40 liters of 21% acid solution?

Concentration of Solution	Amount of Solution (L)	Amount of Acid
15%	x	
33%	y	
21%	40	

3. BUILDINGS The Sears Tower in Chicago is the tallest building in North America. The total height of the tower t and the antenna that stands on top of it is 1729 feet. The difference in heights between the building and the antenna is 1171 feet. How tall is the Sears Tower?

4. PRODUCE Roger and Trevor went shopping for produce on the same day. They each bought some apples and some potatoes. The amount they bought and the total price they paid are listed in the table below.

	Apples (lb)	Potatoes (lb)	Total Cost (\$)
Roger	8	7	18.85
Trevor	2	10	12.88

What was the price of apples and potatoes per pound?

5. SHOPPING Two stores are having a sale on T-shirts that normally sell for \$20. Store S is advertising an s percent discount, and Store T is advertising a t dollar discount. Rose spends \$63 for three T-shirts from Store S and one from Store T. Manny spends \$140 on five T-shirts from Store S and four from Store T. Find the discount at each store.

TRANSPORTATION For Exercises 6–8 use the following information.

A Speedy River barge bound for New Orleans leaves Baton Rouge, Louisiana, at 9:00 A.M. and travels at a speed of 10 miles per hour. A Rail Transport freight train also bound for New Orleans leaves Baton Rouge at 1:30 P.M. the same day. The train travels at 25 miles per hour, and the river barge travels at 10 miles per hour. Both the barge and the train will travel 100 miles to reach New Orleans.

6. How far will the train travel before catching up to the barge?

7. Which shipment will reach New Orleans first? At what time?

8. If both shipments take an hour to unload before heading back to Baton Rouge, what is the earliest time that either one of the companies can begin to load grain to ship in Baton Rouge?

6-1 Word Problem Practice

Solving Inequalities by Addition and Subtraction

1. SOUND The loudest insect on Earth is the African cicada. It produces sounds as loud as 105 decibels at 20 inches away. The blue whale is the loudest mammal on Earth. The call of the blue whale can reach levels up to 83 decibels louder than the African cicada. How loud are the calls of the blue whale?

2. GARBAGE The amount of garbage that the average American adds to a landfill daily is 4.6 pounds. If at least 2.5 pounds of a person's daily garbage could be recycled, how much will still go into a landfill?

3. SHOPPING Tyler has \$75 to spend at the mall. He purchases a music video for \$14.99 and a pair of jeans for \$18.99. He also spent \$4.75 for lunch. Tyler still wants to purchase a video game. How much money can he spend on a video game?

4. SUPREME COURT The first Chief Justice of the U.S. Supreme Court, John Jay, served 2079 days as Chief Justice. He served 10,463 days fewer than John Marshall, who served as Supreme Court Chief Justice for the longest period of time. How many days must the current Supreme Court Chief Justice John Roberts serve to surpass John Marshall's record?

WEATHER For Exercises 5 and 6, use the following table.

Theodore Fujita of the University of Chicago developed a classification of tornadoes according to wind speed and damage. The table shows the classification system.

Level	Name	Wind Speed Range (mph)
F0	Gale	40–72
F1	Moderate	73–112
F2	Significant	113–157
F3	Severe	158–206
F4	Devastating	207–260
F5	Incredible	261–318
F6	Inconceivable	319–379

Source: www.charmeck.org

5. Suppose an F3 tornado has winds that are 162 miles per hour. Write and solve an inequality to determine how much the winds would have to increase before the F3 tornado becomes an F4 tornado.

6. A tornado has wind speeds that are at least 158 miles per hour. Write and solve an inequality that describes how much greater these wind speeds are than the slowest tornado.

6-2 Word Problem Practice***Solving Inequalities by Multiplication and Division***

1. PIZZA Tara and friends order a pizza. Tara eats 3 of the 10 slices and pays \$4.20 for her share. Assuming that Tara has paid at least her fair share, what is the most the pizza cost?

2. AIRLINES On average, at least 25,000 pieces of luggage are lost or misdirected each day by United States airlines. Of these, 98% are located by the airlines within 5 days. From a given day's lost luggage, at least how many pieces of luggage are still lost after 5 days?

3. SCHOOL Gil earned these scores on the first three tests in biology this term: 86, 88, and 78. What is the lowest score that Gil can earn on the fourth and final test of the term if he wants to have an average of at least 83?

4. EVENT PLANNING The Downtown Community Center does not charge a rental fee as long as a rentee orders a minimum of \$5000 worth of food from the center. Antonio is planning a banquet for the Quarterback Club. If he is expecting at least 225 people to attend, what is the minimum he will have to spend on food per person?

PHYSICS For Exercises 5 and 6, use the table.

The density of a substance determines whether it will float or sink in a liquid. The density of water is 1 gram per milliliter. Any object with a greater density will sink and any object with a lesser density will float. Density is given by the formula $d = \frac{m}{v}$, where m is mass and v is volume.

Here is a table of common chemical solutions and their densities.

Solution	Density (g/mL)
concentrated calcium chloride	1.40
70% isopropyl alcohol	0.92

Source: www.teachingplastics.org

5. Plastics vary in density when they are manufactured; therefore, their volumes are variable for a given mass. A tablet of polystyrene (a manufactured plastic) sinks in water and alcohol solution and floats in calcium chloride solution. The tablet has a mass of 0.4 grams. What is the most its volume can be?

6. What is the least its volume can be?

6-3 Word Problem Practice

Solving Multi-Step Inequalities

1. BEACHCOMBING Jay has lost his mother's favorite necklace, so he will rent a metal detector to try to find it. A rental company charges a one-time rental fee of \$15 plus \$2 per hour to rent a metal detector. Jay has only \$35 to spend. What is the maximum amount of time he can rent the metal detector?

2. AGES Bobby, Billy, and Barry Smith are each one year apart in age. The sum of their ages is greater than the age of their father, who is 60. What is the youngest age that the oldest brother can be?

3. TAXI FARE Jamal works in a city and sometimes takes a taxi to work. The taxicabs charge \$1.50 for the first $\frac{1}{5}$ mile and \$0.25 for each additional $\frac{1}{5}$ mile.

Jamal has only \$3.75 in his pocket. What is the maximum distance he can travel by cab if he does not intend to tip the cab driver?

4. PLAYGROUND The perimeter of a rectangular playground must be no greater than 120 meters, because that is the total length of the materials available for the border. The width of the playground cannot exceed 22 meters. What are the possible lengths of the playground?

MEDICINE For Exercises 5–7, use the following information.

Clark's Rule is a formula used to determine pediatric dosages of over-the-counter medicines.

$$\frac{\text{Weight of child (lb)}}{150} \times \text{adult dose} = \text{child dose}$$

5. If an adult dose of acetaminophen is 1000 milligrams and a child weighs no more than 90 pounds, what is the recommended child's dose?

6. This label appears on a child's cold medicine. What is the adult minimum dosage in milliliters?

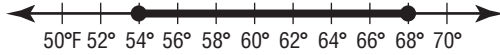
Weight (lb)	Age (yr)	Dose
under 48	under 6	call a doctor
48-95	6-11	2 tsp or 10 mL

7. What is the maximum adult dosage in milliliters?

6-4 Word Problem Practice

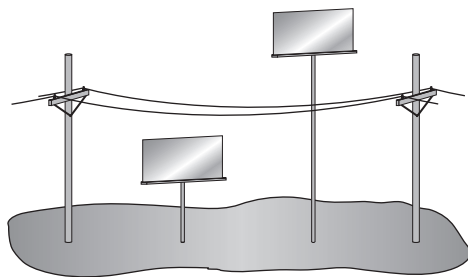
Solving Compound Inequalities

1. **WEATHER** Ken saw this graph in the newspaper weather forecast. It shows the predicted temperature range for the following day. Write an inequality to represent the number line graph.



2. **POOLS** The pH of a person's eyes is 7.2. Therefore, the ideal pH for the water in a swimming pool is between 7.0 and 7.6. Write an inequality to represent pH levels that could cause physical discomfort to a person's eyes.

3. **STORE SIGNS** In Randy's town, street-side signs themselves must be exactly 8 feet high. When mounted on poles, the signs must be shorter than 20 feet or taller than 35 feet so that they do not interfere with the power and phone lines. Write a compound inequality to represent the possible height of the poles.



4. **HEALTH** The human heart circulates from 770,000 to 1,600,000 gallons of blood through a person's body every year. How many gallons of blood does the heart circulate through the body in one day?

HEALTH For Exercises 5 and 6, use the following information.

Body mass index (BMI) is a measure of weight status. The BMI of a person over 20 years old is calculated using the following formula.

$$\text{BMI} = 703 \times \frac{\text{weight in pounds}}{(\text{height in inches})^2}$$

The table below shows the meaning of different BMI measures.

BMI	Weight Status
less than 18.5	underweight
18.5 – 24.9	normal
25 – 29.9	overweight
more than 30	obese

Source: www.cdc.gov

5. Write a compound inequality to represent the normal BMI range.
6. Write a compound inequality to represent an adult weight that is within the healthy BMI range for a person 6 feet tall.

6-5 Word Problem Practice***Solving Open Sentences Involving Absolute Value***

1. **WEATHER** A news station guarantees the weather forecast will be within 3°F of the actual temperature, or the station will make a donation to a particular charity. If the station forecasts the temperature to be 78°F , at what actual temperatures will the station begin to make a charity donation?

2. **TRACK** Mika runs the 800 meter race for her high school track team. Her average time is 2 minutes and 26 seconds, but her time varies by as much as 4 seconds. Write an absolute value equation to represent Mika's fastest and slowest times in the 800 meter race.

3. **WORK** Marcus works an average of 15 hours per week at his part-time job at a grocery store. Depending on how busy the store is, he may pick up or lose a 4 hour shift. What is the range of the number of hours per week Marcus is scheduled to work?

ELECTORAL COLLEGE For Exercises 4 and 5, use the following information.

In presidential elections, each state has a designated number of votes in the Electoral College, which are generally all cast for the candidate who won the popular vote in the state. The number of members of the Electoral College from each state is based on the number of Senators and House of Representatives.

4. If a presidential candidate is 42 votes ahead of his opponent before the votes for the state of California are added, what absolute value equation would represent the margin of votes between the candidate and his opponent after California's 55 votes are cast?

5. What absolute value equation can be used to determine the minimum number of votes needed to change the outcome of the election in question 4?

6-6 Word Problem Practice

Solving Inequalities Involving Absolute Value

Lesson 6-6

1. ENGINEERING Tolerance in engineering is an allowance made for imperfections in a manufactured object. The manufacturer of an oven specifies a temperature tolerance of $\pm 15^\circ\text{F}$. This means that the temperature inside the oven will be within 15°F of the temperature that it is set on. Write an absolute value expression to represent the possible temperatures inside the oven when the thermostat is set on 400°F .

3. COLLEGE A certain scholarship and student loan fund uses a formula to determine whether or not a student qualifies for college funding. The formula is $|3k + 6| > 15$, where k is a need score determined by an interview. What are the possible need scores?

2. AVIATION The circle graph shows the results of a survey that asked 4300 students ages 7 to 18 what they thought would be the most important benefit of air travel in the future. There are about 40 million students in the United States. If the margin of error is $\pm 3\%$, what is the range of the number of students ages 7 to 18 who would likely say that “finding new resources for Earth” is the most important benefit of future flight?

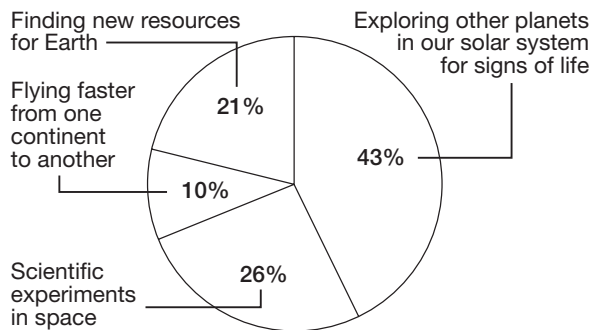
STATISTICS For Exercises 4 and 5, use the following information.

The most familiar statistical measure is the arithmetic mean, or average. A second important statistical measure is the standard deviation, which is a measure of how far the individual scores are from the mean. For example, the mean score on the Wechsler IQ test is 100 and the standard deviation is 15. This means that people within one deviation of the mean have IQ scores that are 15 points higher or lower than the mean.

4. Write an absolute value inequality to find the range of test scores within one standard deviation if the mean was 80 and the standard deviation was 12.

5. What is the range of Wechsler IQ test scores ± 3 standard deviations from the mean?

The Next Frontier for Flight



Source: The 2005 World Almanac

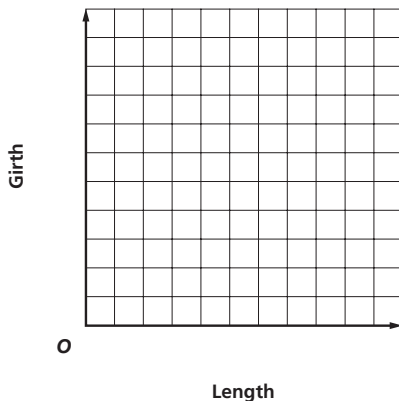
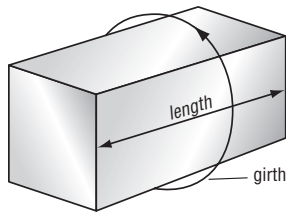
6-7 Word Problem Practice

Graphing Inequalities in Two Variables

- 1. FAMILY** Tyrone said that the ages of his siblings are all part of the solution set of $y > 2x$, where x is the age of a sibling and y is Tyrone's age. Which of the following ages is possible for Tyrone and a sibling?
 Tyrone is 23; Maxine is 14.
 Tyrone is 18; Camille is 8.
 Tyrone is 12; Francis is 4.
 Tyrone is 11; Martin is 6.
 Tyrone is 19; Paul is 9.

- 2. FARMING** The average value of U.S. farm cropland has steadily increased in recent years. In 2000, the average value was \$1490 per acre. Since then, the value has increased at least an average of \$77 per acre per year. Write an inequality to show land values above the average for farmland.

- 3. SHIPPING** An international shipping company has established size limits for packages with all their services. The total of the length of the longest side and the girth (distance completely around the package at its widest point perpendicular to the length) must be less than or equal to 419 centimeters. Write and graph an inequality that represents this situation.



- 4. FUNDRAISING** Troop 200 sold cider and donuts to raise money for victims of Hurricane Katrina. They sold small boxes of donut holes for \$1.25 and cider for \$2.50 a gallon. In order to cover their expenses, they needed to raise at least \$100. Write and graph an inequality that represents this situation.

INCOME For Exercises 5–7, use the following information.

In 2004 the median yearly family income was about \$44,000 per year. Suppose the average annual rate of change since then is \$1240 per year.

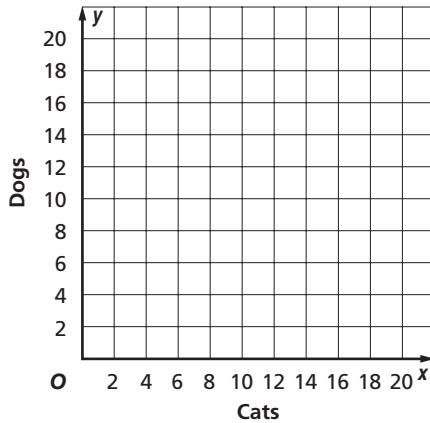
- 5.** Write and graph an inequality for the annual family incomes y that are less than the median for x years after 2004.

- 6.** Which of the following points is part of the solution set?
 (2, 49,000) (8, 65,000)
 (5, 46,000) (10, 55,000)

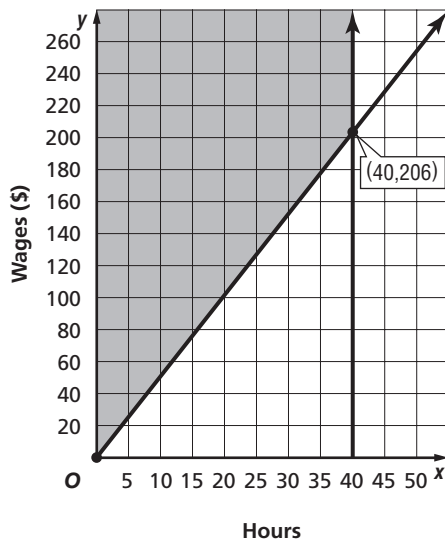
6-8 Word Problem Practice

Graphing Systems of Inequalities

1. **PETS** Renée’s Pet Store never has more than a combined total of 20 cats and dogs and never more than 8 cats. This is represented by the inequalities $x \leq 8$ and $x + y \leq 20$. Solve the system of inequalities by graphing.



2. **WAGES** The minimum wage for one group of workers in Texas is \$5.15 per hour. The graph below shows the possible weekly wages for a person who makes at least minimum wages and works at most 40 hours. Write the system of inequalities for the graph.



3. **FUND-RAISING** The Camp Courage Club plans to sell tins of popcorn and peanuts as a fundraiser. The Club members have \$900 to spend on products to sell and want to order up to 200 tins in all. They also want to order at least as many tins of popcorn as tins of peanuts. Each tin of popcorn costs \$3 and each tin of peanuts costs \$4. Write a system of equations to represent the conditions of this problem.

BUSINESS For Exercises 4–6, use the following information.

For maximum efficiency, a factory must have at least 100 workers, but no more than 200 workers on a shift. The factory also must manufacture at least 30 units per worker.

4. Let x be the number of workers and let y be the number of units. Write four inequalities expressing the conditions in the problem given above.
5. Graph the systems of inequalities.

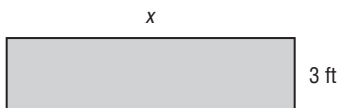
6. List at least three possible solutions.

7-1 Word Problem Practice

Multiplying Monomials

1. GRAVITY An egg that has been falling for x seconds has dropped at an average speed of $16x$ feet per second. If the egg is dropped from the top of a building, its total distance traveled is the product of the average rate times the time. Write a simplified expression to show the distance the egg has traveled after x seconds.

2. CIVIL ENGINEERING A developer is planning a sidewalk for a new development. The sidewalk can be installed in rectangular sections that have a fixed width of 3 feet and a length that can vary. Assuming that each section is the same length, express the area of a 4-section sidewalk as a monomial.



3. PROBABILITY If you flip a coin 3 times in a row, there are 2^3 outcomes that can occur.

Outcomes	
HHH	TTT
HTT	THH
HTH	TTH
HHT	THT

If you then flip the coin two more times, there are $2^3 \times 2^2$ outcomes that can occur. How many outcomes can occur if you flip the quarter as mentioned above plus four more times? Write your answer in the form 2^x .

4. SPORTS The volume of a sphere is given by the formula $V = \frac{4}{3}\pi r^3$, where r is the radius of the sphere. Find the volume of air in three different basketballs. Use $\pi = 3.14$. Round your answers to the nearest whole number.

Ball	Radius (in.)	Volume (in ³)
Child's	4	
Women's	4.5	
Men's	4.8	

Source: <http://www.faqfarm.com>

ELECTRICITY For Exercises 5 and 6, use the following information.

An electrician uses the formula $W = I^2R$, where W is the power in watts, I is the current in amperes, and R is the resistance in ohms.

5. Find the power in a household circuit that has 20 amperes of current and 5 ohms of resistance.

6. If the current is reduced by one half, what happens to the power?

7-2 Word Problem Practice***Dividing Monomials***

1. CHEMISTRY The nucleus of a certain atom is 10^{-13} centimeters across. If the nucleus of a different atom is 10^{-11} centimeters across, how many times as large is it as the first atom?

2. SPACE The Moon is approximately 25^4 kilometers away from Earth on average. The Olympus Mons volcano on Mars stands 25 kilometers high. How many Olympus Mons volcanoes, stacked on top of one another, would fit between the surface of the Earth and the Moon?

3. E-MAIL Spam (also known as junk e-mail) consists of identical messages sent to thousands of e-mail users. People often obtain anti-spam software to filter out the junk e-mail messages they receive. Suppose Yvonne's anti-spam software filtered out 10^2 e-mails, and she received 10^4 e-mails last year. What fraction of her e-mails were filtered out? Write your answer as a monomial.

4. METRIC MEASUREMENT Consider a dust mite that measures 10^{-3} millimeters in length and a caterpillar that measures 10 centimeters long. How many times as long as the mite is the caterpillar?

COMPUTERS For Exercises 5–7, use the following information.

In 1995, standard capacity for a personal computer hard drive was 40 megabytes (MB). In 2006, a standard hard drive capacity was 40 gigabytes (GB or Gig). Refer to the table below.

Memory Capacity Approximate Conversions
8 bits = 1 byte
10^3 bytes = 1 kilobyte
10^3 kilobytes = 1 megabyte (meg)
10^3 megabytes = 1 gigabyte (gig)
10^3 gigabytes = 1 terabyte

5. The newer hard drives have about how many times the capacity of the 1995 drives?

6. Predict the hard drive capacity in the year 2017 if this rate of growth continues.

7. One kilobyte of memory is what fraction of one terabyte?

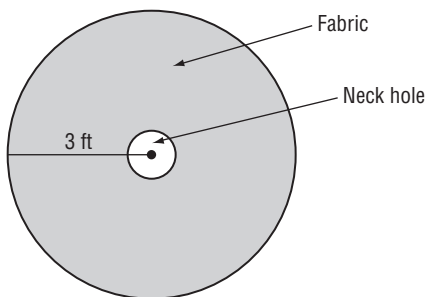
7-3 Word Problem Practice

Polynomials

1. PRIMES Mei is trying to list as many prime numbers as she can for a challenge problem for her math class. She finds that the polynomial expression $n^2 - n + 41$ can be used to generate some, but not all, prime numbers. What is the degree of Mei's polynomial?

2. PHONE CALLS A long-distance telephone company charges a \$19.95 standard monthly service fee plus \$0.05 per minute of long-distance use. Write a polynomial to express the monthly cost of the phone plan if x minutes of long-distance time are used per month. What is the degree of the polynomial?

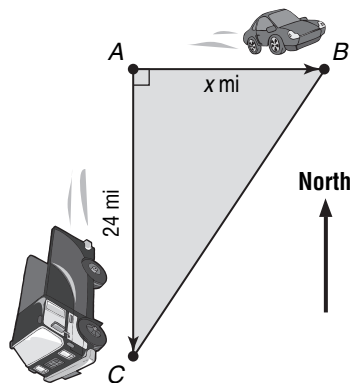
3. COSTUMES Jack's mother is sewing the cape of his costume for a charity masked ball. The pattern for the cape (lying flat) is shown below. The radius of the neck hole is 6 inches. What is the area, in square feet, of the finished cape?



4. ARCHITECTURE Graphing the polynomial function $y = -x^2 + 3$ produces an accurate drawing of the shape of an archway inside a historical library, where x is the horizontal distance in meters from the base of the arch and y is the height of the arch. At $x = 0$, what is the height of the arch?

DRIVING For Exercises 5 and 6, use the following information.

A truck and a car leave an intersection. The truck travels south, and the car travels east. When the truck had gone 24 miles, the distance between the car and truck was four miles more than three times the distance traveled by the car heading east.



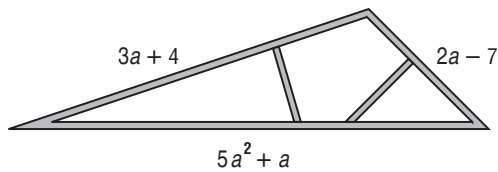
5. Suppose the truck stops at point C and the car stops at point B . Write a polynomial to express the sum of the distances traveled by the car and the truck.

6. Write a simplified polynomial to express the perimeter of triangle ABC .

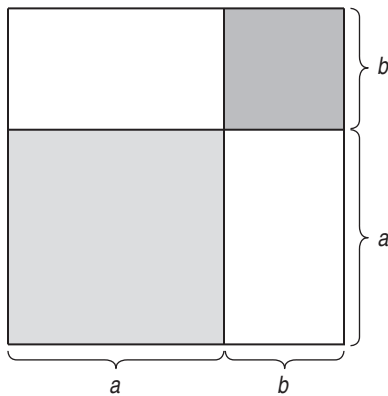
7-4 Word Problem Practice

Adding and Subtracting Polynomials

- 1. BUILDING** Find the simplest expression for the perimeter of the triangular roof truss.



- 2. GEOMETRY** Write a polynomial to show the area of the large square below.



- 3. FIREWORKS** Two bottle rockets are launched straight up into the air. The height, in feet, of each rocket at t seconds after launch is given by the polynomial equations below. Write an equation to show how much higher Rocket A traveled.

Rocket A: $H_1 = -16t^2 + 122t$

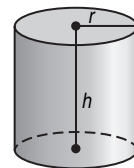
Rocket B: $H_1 = -16t^2 + 84t$

- 4. ENVELOPES** An office supply company produces yellow document envelopes. The envelopes come in a variety of sizes, but the length is always 4 centimeters more than double the width. Write a polynomial expression to give the perimeter of any of the envelopes.

- INDUSTRY** For Exercises 5–7, use the following information.

Two identical right cylindrical steel drums containing oil need to be covered with a fire-resistant sealant. In order to determine how much sealant to purchase, George must find the surface area of the two drums. The surface area (including the top and bottom bases) is given by the following formula.

$$S = 2\pi rh + 2\pi r^2$$



- 5.** Write a polynomial to represent the total surface area of the two drums.

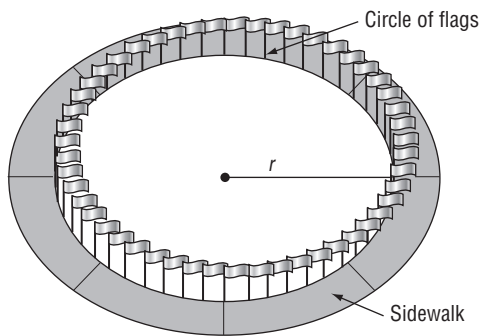
- 6.** Find the total surface area if the height of each drum is 2 meters and the radius of each is 0.5 meters. Let $\pi = 3.14$.

- 7.** The fire resistant sealant must be applied while they are stacked vertically in groups of three. If h is the height of each drum and r is the radius, write a polynomial to represent the exposed surface area.



7-5 Word Problem Practice***Multiplying a Polynomial by a Monomial***

- 1. NUMBER THEORY** The sum of the first n whole numbers is given by the expression $\frac{1}{2}(n^2 + n)$. Expand the equation by multiplying, then find the sum of the first 12 whole numbers.
- 2. COLLEGE** Troy's boss gave him \$700 to start his college savings account. Troy's boss also gives him \$40 each month to add to the account. Troy's mother gives him \$50 each month, but has been doing so for 4 fewer months than Troy's boss. Write a simplified expression for the amount of money Troy has received from his boss and mother after m months.
- 3. LANDMARKS** A circle of 50 flags surrounds the Washington Monument. Suppose a new sidewalk 12 feet wide is installed just around the outside of the circle of flags. The outside circumference of the sidewalk is 1.10 times the circumference of the circle of flags.

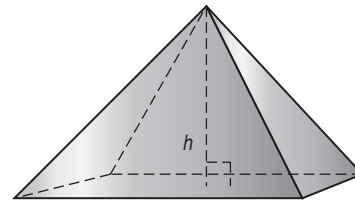


Write an equation that equates the outside circumference of the sidewalk to 1.10 times the circumference of the circle of flags. Solve the equation for the radius of the circle of flags. Recall that circumference of a circle is $2\pi r$.

- 4. MARKET** Sophia went to the farmers' market to purchase some vegetables. She bought peppers and potatoes. The peppers were \$0.39 each and the potatoes were \$0.29 each. She spent \$3.88 on vegetables, and bought 4 more potatoes than peppers. If x = the number of peppers, write and solve an equation to find out how many of each vegetable Sophia bought.

GEOMETRY For Exercises 5 and 6, use the following information.

Some monuments are constructed as rectangular pyramids. The volume of a pyramid can be found by multiplying the area of its base B by one third of its height. The area of the rectangular base of a monument in a local park is given by the polynomial equation $B = x^2 - 4x - 12$.



- 5.** Write a polynomial equation to represent V , the volume of a rectangular pyramid if its height is 10 centimeters.
- 6.** Find the volume of the pyramid if $x = 12$.

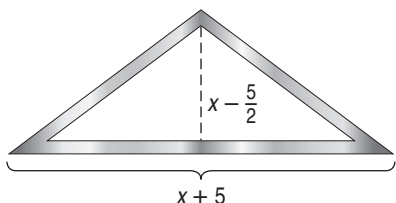
7-6 Word Problem Practice

Multiplying Polynomials

1. THEATER The Loft Theater has a center seating section with $3c + 8$ rows and $4c - 1$ seats in each row. Write an expression for the total number of seats in the center section.

2. CRAFTS Suppose a quilt made up of squares has a length-to-width ratio of 5 to 4. The length of the quilt is $5s$ inches. The quilt can be made slightly larger by adding a border of 1-inch squares all the way around the perimeter of the quilt. Write a polynomial expression for the area of the larger quilt.

3. SERVICE A folded United States flag is sometimes presented to individuals in recognition of outstanding service to the country. The flag is presented folded in a triangle. Often the recipient purchases a case designed to display the folded flag to protect it from wear. One such display case has dimensions (in inches) shown below. Write a polynomial expression that represents the area of wall space covered by the display case.

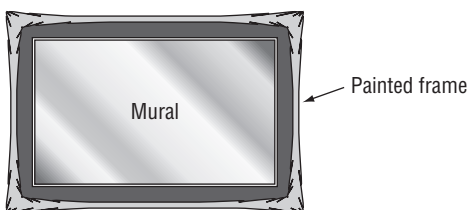


Source: <http://www.americanflagstore.com/flagcase/flagcase.htm>

4. MATH FUN Think of a whole number. Subtract 2. Write down this number. Take the original number and add 2. Write down this number. Find the product of the numbers you wrote down. Subtract the square of the original number. The result is always -4 . Use polynomials to show how this number trick works.

ART For Exercises 5 and 6, use the following information.

The museum where Julia works plans to have a large wall mural replica of Vincent van Gogh's *The Starry Night* painted in its lobby. First, Julia wants to paint a large frame around where the mural will be. The mural's length will be 5 feet longer than its width, and the frame will be 2 feet wide on all sides. Julia has only enough paint to cover 100 square feet of wall surface. How large can the mural be?

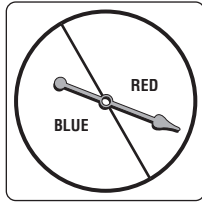


- Write an expression for the area of the mural.
- Write an expression for the area of the frame.
- Write and solve an equation to find how large the mural can be.

7-7 Word Problem Practice

Special Products

- 1. PROBABILITY** The spinner below is divided into 2 equal sections. If you spin the spinner 2 times in a row, the possible outcomes are shown in the table below.

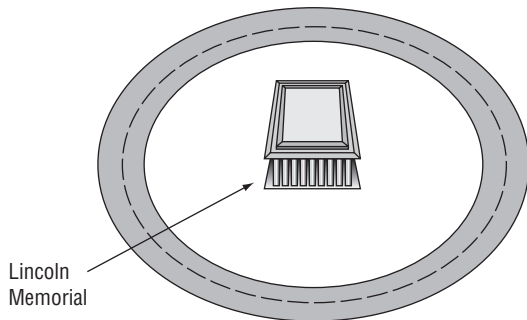


red	blue
red	red
red	blue
blue	blue

What is the probability of spinning a blue and a red in two spins?

- 2. WISHING** The height of a penny t seconds after being dropped down a well is given by the product of $(10 - 4t)$ and $(10 + 4t)$. Find the product and simplify. What type of special product does this represent?

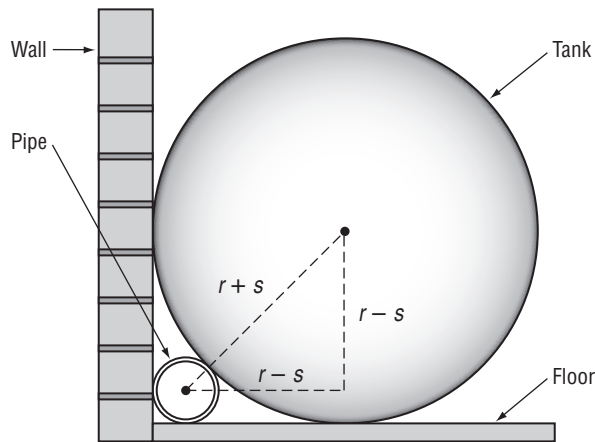
- 3. TRAFFIC PLANNING** The Lincoln Memorial in Washington, D.C., is surrounded by a circular drive called Lincoln Circle. Suppose the National Park Service wants to change the layout of Lincoln Circle so that there are two concentric circular roads. Write a polynomial equation for the area A of the space between the roads if the radius of the smaller road is 10 meters less than the radius of the larger road.



- 4. BUSINESS** The Combo Lock Company finds that its profit data from 1997 to the present can be modeled by the function $y = 4n^2 + 44n + 121$, where y is the profit n years since 1997. Which special product does this polynomial demonstrate? Explain.

STORAGE For Exercises 5 and 6, use the following information.

A cylindrical tank is placed along a wall. A cylindrical PVC pipe will be hidden in the corner behind the tank. See the side view diagram below. The radius of the tank is r inches and the radius of the PVC pipe is s inches.



- 5.** Use the Pythagorean Theorem to write an equation for the relationship between the two radii. Simplify your equation so that there is a zero on one side of the equals sign.
- 6.** Write a polynomial equation you could solve to find the radius s of the PVC pipe if the radius of the tank is 20 inches.

8-1 Word Problem Practice**Monomials and Factoring**

- 1. MATH GAMES** Mrs. Jenson's class is playing "Guess the Monomial." One student displays factors of the secret monomial, and the team tries to guess the monomial. When it is James' turn, he sees that the secret monomial is $210x^2y^2$. Which of the following cards should he display so his team guesses the correct monomial?

x	x	y	y	z	z	z
---	---	---	---	---	---	---

3	5	7	11	13	17	19
---	---	---	----	----	----	----

- 2. PARTY FAVORS** Balloons come in packages of 18 and party hats come in packages of 8. Jeff wants to have the same number of balloons and hats. What is the fewest packages of balloons and hats that he needs to buy so he has no hats or balloons left over?

- 3. PACKAGING** Color Wheel printer ink company wants to design a new carton in which to pack printer ink cartridges for shipment to stores. Cartridge boxes are 7 inches long and 3 inches wide. What are the dimensions of the smallest square-bottom carton that will hold the cartridge boxes without extra space?

- 4. MATHEMATICIANS** A Greek mathematician and astronomer named Eratosthenes created a way to separate prime numbers from composite numbers. His method is known as the Sieve of Eratosthenes. It proceeds as follows.

Write numbers 1 to 50.

Since 1 is neither prime nor composite, ignore 1.

Circle the number 2, and then cross off every number that is divisible by 2.
--

Circle the next number that is not crossed off, 3, and cross off all multiples of 3. Circle the next number that is not crossed off, 5, and cross off the multiples of 5, etc...
--

Source: www.mathforum.org

Recreate the Sieve of Eratosthenes to find the first 11 prime numbers.

REPAIRS For Exercises 5 and 6 use the following information.

Heidi wants to replace the floor in her 16-foot by 18-foot rectangular dance studio. She wants to use square wood tiles, and she does not want to have to cut any of the tiles nor leave any gaps.

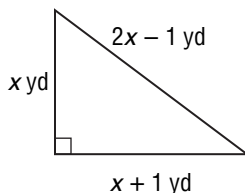
- 5.** Suppose the flooring company can use any size tile. What is the largest square tile that Heidi can use for the new floor?
- 6.** If Heidi first knocks out a wall and increases the studio to 24 feet by 18 feet, what is the largest square tile she can use for the new floor?

8-2 Word Problem Practice**Factoring Using the Distributive Property**

1. PHYSICS According to legend, Galileo dropped objects of different weights from the so-called “leaning tower” of Pisa while developing his formula for free falling objects. The relationship that he discovered was that the distance d an object falls after t seconds is given by $d = 16t^2$ (ignoring air resistance). This relationship can be found in the equation $h = 4t - 16t^2$, where h is the height of an object thrown upward from ground level at a rate of 32 feet per second. Solve the equation for $h = 0$.

2. SWIMMING POOL The area A of a rectangular swimming pool is given by the equation $A = 12w - w^2$, where w is the width of one side. Write an expression for the other side of the pool.

3. CONSTRUCTION Unique Building Company is constructing a triangular roof truss for a building. The workers assemble the truss with the dimensions shown on the diagram below. Using the Pythagorean Theorem, find the length of the sides of the truss.



4. VERTICAL JUMP Your vertical jump height is measured by subtracting your standing reach height from the height of the highest point you can reach by jumping without taking a running start. Typically, NBA players have vertical jump heights of up to 34 inches. If an NBA player jumps this high, his height h in inches above his standing reach height after t seconds can be modeled by the equation $h = 162t - 192t^2$. Solve the equation for $h = 0$ and interpret the solution. Round your answer to the nearest hundredth.

Source: sportsmedicine.about.com

PETS For Exercises 5–7, use the following information.

Conner tosses a dog treat upward with an initial velocity of 13.7 meters per second. The height of the treat above the dog’s mouth h in meters after t seconds is given by the equation.

$$h = 13.7t - 4.9t^2$$

5. After how many seconds does the dog catch the treat?

6. The dog treat reaches its maximum height halfway between when it was thrown and when it was caught. What is its maximum height?

7. How fast would Connor have to throw the dog treat in order to make it fly through the air for 6 seconds?

8-3 Word Problem Practice

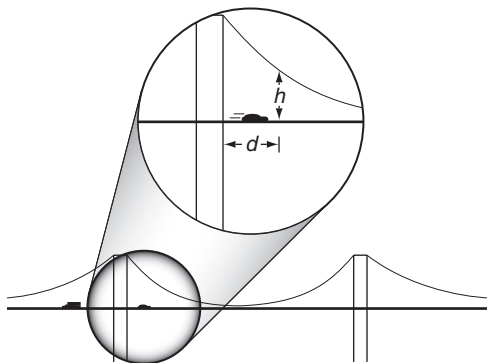
Factoring Trinomials: $x^2 + bx + c$

- 1. COMPACT DISCS** A standard jewel case for a compact disc has a width 2 cm greater than its length. The area for the front cover is 168 square centimeters. The first two steps to finding the value of x are shown below. Solve the equation and find the length of the case.

$$\begin{aligned} \text{Length} \times \text{width} &= \text{area} \\ x(x + 2) &= 168 \\ x^2 + 2x - 168 &= 0 \end{aligned}$$

- 2. NUMBER FUN** Fiona and Greg play a number guessing game. Greg gives Fiona this hint about his two secret numbers, "The product of the two consecutive positive integers that I am thinking of is 11 more than their sum." What are Greg's numbers?

- 3. BRIDGE ENGINEERING** A car driving over a suspension bridge is supported by a cable hanging between the ends of the bridge. Since its shape is parabolic, it can be modeled by a quadratic equation. The height above the road bed of a bridge's cable h (in inches) measured at distance d (in yards) from the first tower is given by the equation $h = d^2 - 36d + 324$.



If the driver of a car looks out at a height of 49 inches above the roadbed, at what distance(s) from the tower will the driver's eyes be at the same height as the cable?

- 4. PHYSICAL SCIENCE** The boiling point of water depends on altitude. The following equation approximates the number of degrees D below 212°F at which water will boil at altitude h .

$$D^2 + 520D = H$$

In Denver, Colorado, the altitude is approximately 5300 feet above sea level. At approximately what temperature does water boil in Denver?

MONUMENTS For Exercises 5 and 6, use the following information.

Susan is designing a pyramidal stone monument for a local park. The design specifications tell her that the height needs to be 9 feet, the width of the base must be 5 feet less than the length, and the volume should be 150 cubic feet. Recall that the volume of a pyramid is given by $V = \frac{1}{3}bh$, where b is the area of the base and h is the height.

- 5.** Write and solve an equation to find the width of the base of the monument.
- 6.** Interpret each answer in terms of the situation.

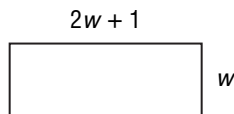
8-4 Word Problem Practice

Factoring Trinomials: $ax^2 + bx + c$

1. BREAK EVEN Breaking even occurs when the revenues for a business equal the cost. A local children's museum studied their costs (wages, electricity, etc.) and revenues from paid admission. They found that their break-even time is given by the equation $2h^2 - 2h - 24 = 0$, where h is the number of hours the museum is open per day. How many hours must the museum be open per day to reach the point when they break even?

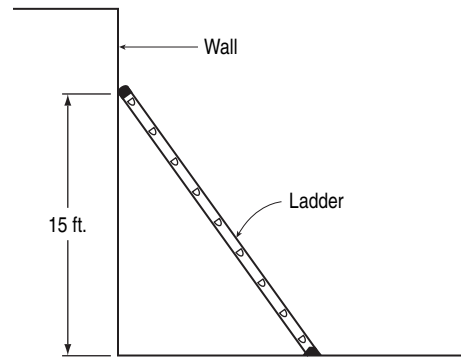
2. CARPENTRY Miko wants to build a toy box for her sister. It is to be 2 feet high, and the width is to be 3 feet less than its length. If it needs to hold a volume of 80 cubic feet, find the length and width of the box.

3. FURNITURE The student council wants to purchase a table for the school lobby. The table comes in a variety of dimensions, but for every table, the length is 1 meter greater than twice the width. The student council has budgeted for a table top with an area of 3 square meters.



Find the width and length of the table they can purchase.

4. LADDERS A ladder is resting against a wall. The top of the ladder touches the wall at a height of 15 feet, and the length of the ladder is one foot more than twice its distance from the wall. Find the distance from the wall to the bottom of the ladder. (*Hint: Use the Pythagorean Theorem.*)



FARMING For Exercises 5–7, use the following information.

Mr. Hensley has a total of 480 square feet of sheet metal with which he would like to construct a cylindrical tank for storing grain. The local zoning law limits the height of the tank to 13.5 feet. Recall that a formula for the surface area of a bottomless cylinder with radius r and height h is

$$A = \pi r^2 + 2\pi rh.$$

5. Write a quadratic equation (set equal to zero) to represent the information.
6. Using 3 as an approximation for π , solve the equation for r .
7. What radius should Mr. Hensley use for his tank?

8-5 Word Problem Practice

Factoring Differences of Squares

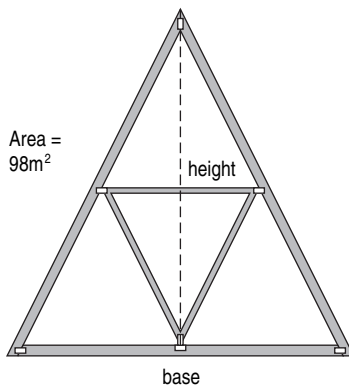
- 1. LOTTERY** A state lottery commission analyzes the ticket purchasing patterns of its citizens. The following expression is developed to help officials calculate the likely number of people who will buy tickets for a certain size jackpot.

$$81a^2 - 36b^2$$

Factor the expression completely.

- 2. OPTICS** A reflector on the inside of a certain flashlight is a parabola given by the equation $y = x^2 - 25$. Find the points where the reflector meets the lens by finding the values of x when $y = 0$.

- 3. ARCHITECTURE** The drawing shows a triangular roof truss with a base measuring the same as its height. The area of the truss is 98 square meters.

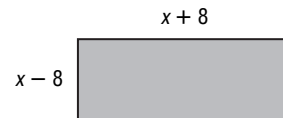


Find the height of the truss.

- 4. BALLOONING** The function $f(t) = -16t^2 + 576$ represents the height of a freely falling ballast bag that starts from rest on a balloon 576 feet above the ground. After how many seconds t does the ballast bag hit the ground?

DECORATING For Exercises 5 and 6, use the following information.

Marvin wants to purchase a rectangular rug. It has an area of 80 square feet. He cannot remember the length and width, but he remembers that the length was 8 more than some number and the width was 8 less than that same number.



- 5.** Write a quadratic equation using the information given.
- 6.** What are the length and width of the rug?

8-6 Word Problem Practice

Perfect Squares and Factoring

1. CONSTRUCTION The area of Liberty Township's square playground is represented by the trinomial $x^2 - 10x + 25$. Write an expression using the variable x that represents the perimeter.

2. AMUSEMENT PARKS Funtown Downtown wants to build a vertical motion ride where the passengers are launched straight upward from ground level with an initial velocity of 96 feet per second. The ride car's height h in feet after t seconds is $h = 96t - 16t^2$. How many seconds after launch would the car reach 144 feet?

3. BUSINESS Saini Sprinkler Company installs irrigation systems. To track monthly costs C and revenues R , they use the following functions, where x is the number of systems they install.

$$R(x) = 8x^2 = 12x + 4$$

$$C(x) = 7x^2 + 20x - 12$$

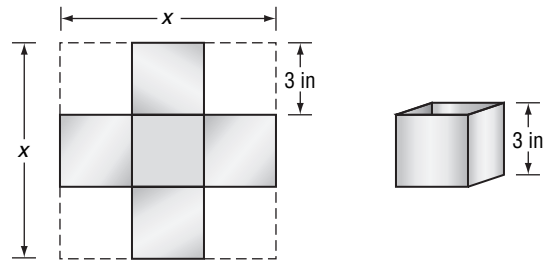
The monthly profit can be found by subtracting cost from revenue.

$$P(x) = R(x) - C(x)$$

Find a function to project monthly profit and use it to find the break-even point where the profit is zero.

GEOMETRY For Exercises 4–6, use the following information.

Holly can make an open-topped box out of a square piece of cardboard by cutting 3-inch squares from the corners and folding up the sides to meet. The volume of the resulting box is $V = 3x^2 - 36x + 108$, where x is the original length and width of the cardboard.



- Factor the polynomial expression from the volume equation.
- What is the volume of the box if the original length of each side of the cardboard was 14 inches?
- What is the original side length of the cardboard when the volume of the box is 27 in^3 ?

9-1

Word Problem Practice

Graphing Quadratic Functions

1. OLYMPICS Olympics were held in 1896 and have been held every four years (except 1916, 1940, and 1944). The winning height y in men's pole vault at any number Olympiad x can be approximated by the equation $y = 0.37x^2 + 4.3x + 126$. Complete the table to estimate the pole vault heights in each of the Olympic Games. Round your answers to the nearest tenth.

Year	Olympiad (x)	Height (y inches)
1896	1	
1900	2	
1924	7	
1936	10	
1964	15	
2008	26	

Source: www.nsa.gov/teachers/hs/alg01.pdf

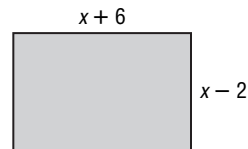
2. PHYSICS Mrs. Capwell's physics class investigates what happens when a ball is given an initial push, rolls up, and then back down an inclined plane. The class finds that $y = -x^2 + 6x$ accurately predicts the ball's position y after rolling x seconds. On the graph of the equation, what would be the y value when $x = 4$?

3. ARCHITECTURE A hotel's main entrance is in the shape of a parabolic arch. The equation $y = -x^2 + 10x$ models the arch height y for any distance x from one side of the arch. Use a graph to determine its maximum height.

4. SOFTBALL Olympic softball gold medalist Michele Smith pitches a curveball with a speed of 64 feet per second. If she throws the ball straight upward at this speed, the ball's height h (in feet) after t seconds is given by $h = -16t^2 + 64t$. Find the coordinates of the vertex of the graph of the ball's height and interpret its meaning.

GEOMETRY For Exercises 5–7, use the following information.

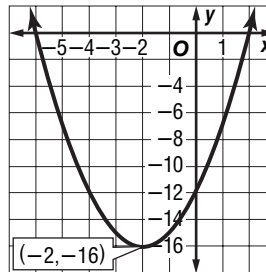
Teddy is building the rectangular deck shown below.



5. Write the equation representing the area of the deck.

6. What is the equation of the axis of symmetry?

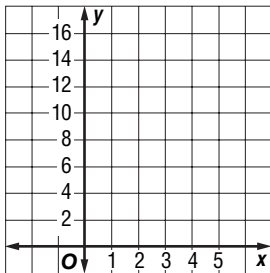
7. Graph the equation and label its vertex.



9-2 Word Problem Practice

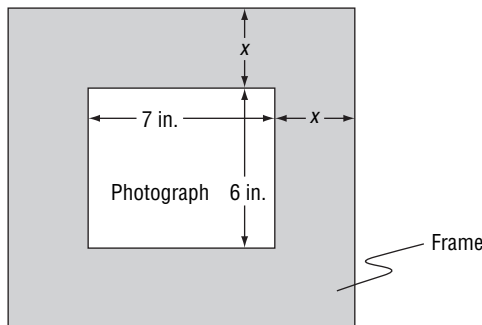
Solving Quadratic Equations by Graphing

1. **FARMING** In order for Ray to decide how much fertilizer to apply to his corn crop this year, he reviews records from previous years. He finds that his crop yield y depends on the amount of fertilizer he applies to his fields x according to the equation $y = -x^2 + 4x + 12$. Graph the function, and find the point at which Ray gets the highest yield possible.



2. **LIGHT** Ayzha and Jeremy hold a flashlight so that the light falls on a piece of graph paper in the shape of a parabola. Ayzha and Jeremy sketch the shape of the parabola and find that the equation $y = x^2 - 3x - 10$ matches the shape of the light beam. Determine the roots of the function.

3. **FRAMING** A rectangular photograph is 7 inches long and 6 inches wide. The photograph is framed using material x inches wide. If the area of the frame and photograph combined is 156 square inches, what is the width of the framing material?



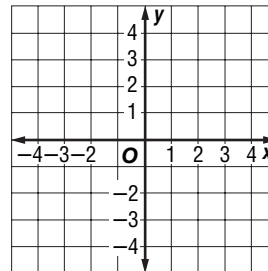
4. **WRAPPING PAPER** Can a rectangular piece of wrapping paper with an area of 81 square inches have a perimeter of 60 inches? (*Hint: Let length = $30 - w$.*) Explain.

ENGINEERING For Exercises 5–7, use the following information.

The shape of a satellite dish is often parabolic because of the reflective qualities of parabolas. Suppose a particular satellite dish is modeled by the following equation.

$$0.5x^2 = 2 + y$$

5. Approximate the solution by graphing.

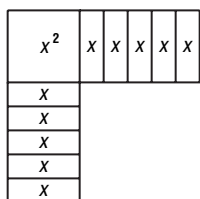


6. On the coordinate plane above, translate the parabola so that there is a double root. Label this curve A.
7. Translate the parabola so that there are no roots. Label this curve B.

9-3 Word Problem Practice

Solving Quadratic Equations by Completing the Square

1. INTERIOR DESIGN Modular carpeting is installed in small pieces rather than as a large roll so that only a few pieces need to be replaced if a small area is damaged. Suppose the room shown in the diagram below is being fitted with modular carpeting. Complete the square to determine the number of 1 ft by 1 ft squares of carpeting needed to finish the room. Fill in the missing terms in the corresponding equation below.



$x^2 + 10x + \underline{\hspace{2cm}} = (x + \underline{\hspace{2cm}})^2$

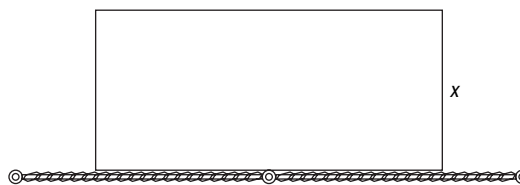
2. FALLING OBJECTS Keisha throws a rock down an old well. The distance d (in feet) the rock falls after t seconds can be represented by the equation $d = 16t^2 + 64t$. If the water in the well is 80 feet below ground, how many seconds will it take for the rock to hit the water?

3. MARS On Mars, the gravity acting on an object is less than that on Earth. On Earth, a golf ball hit with an initial upward velocity of 26 meters per second will reach a maximum height of about 34.5 meters. The height h of an object on Mars that leaves the ground with an initial velocity of 26 meters per second is given by the equation $h = -1.9t^2 + 26t$. Find the maximum height if the same golf ball is hit on Mars. Round your answer to the nearest tenth.

4. FROGS A frog sitting on a stump 3 feet high hops off and lands on the ground. During its leap, its height h (in feet) is given by $h = -0.5d^2 + 2d + 3$, where d is the distance from the base of the stump. How far is the frog from the base of the stump when it landed on the ground?

GARDENING For exercises 5–7, use the following information.

Peg is planning a rectangular vegetable garden using 250 feet of fencing material. She only needs to fence three sides of the garden since one side borders an existing fence.



- 5. Let x = the width of the rectangle. Write an expression to represent the area of the garden if she uses all the fencing material.
- 6. Find the vertex of the equation and identify it as a maximum or a minimum.
- 7. Interpret the vertex of the equation in terms of the situation.

9-4 Word Problem Practice

Solving Quadratic Equations by Using the Quadratic Formula

1. BUSINESS Tanya runs a catering business. Based on her records, her weekly profit can be approximated by the function $f(x) = x^2 + 2x - 37$, where x is the number of meals she caters. If $f(x)$ is negative, it means that the business has lost money. What is the least number of meals that Tanya needs to cater in order to have a profit?

2. AERONAUTICS At liftoff, the space shuttle *Discovery* has a constant acceleration of 16.4 feet per second squared and an initial velocity of 1341 feet per second due to the rotation of Earth. The distance *Discovery* has traveled t seconds after liftoff is given by the equation $d(t) = 1341t + 8.2t^2$. How long after liftoff has *Discovery* traveled 40,000 feet? Round your answer to the nearest tenth.

3. ARCHITECTURE

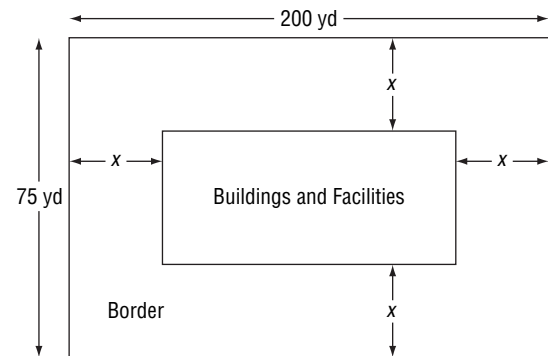
The Golden Ratio appears in the design of the Greek Parthenon because the width and height of the façade are related by the equation $\frac{W + H}{W} = \frac{W}{H}$. If the height of a model of the Parthenon is 16 inches, what is its width? Round your answer to the nearest tenth.



4. CRAFTS Madelyn cut a 60-inch pipe cleaner into two unequal pieces, and then she used each piece to make a square. The sum of the areas of the squares was 117 square inches. Let x = the length of one piece. Write and solve an equation to represent the situation and find the lengths of the two original pieces.

SITE DESIGN For Exercises 5–7, refer to the following information. Round your answers to the nearest tenth.

The town of Smallport plans to build a new water treatment plant on a rectangular piece of land 75 yards wide and 200 yards long. The buildings and facilities need to cover an area of 10,000 square feet. The town’s zoning board wants the site designer to allow as much room as possible between each edge of the site and the buildings and facilities. Let x = the width of the border.



5. Use an equation similar to area = length \times width to represent the situation.

6. Write the equation in standard quadratic form and solve for x .

7. What should be the width of the border?

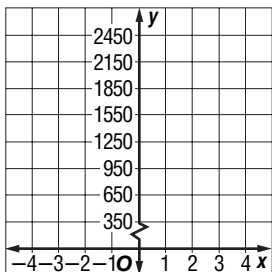
9-5 Word Problem Practice

Exponential Functions

- 1. WASTE** Suppose the waste generated by nonrecycled paper and cardboard products is approximated by the following function.

$$y = 1000(2)^{0.3x}$$

Sketch the exponential function on the coordinate grid below.



- 2. MONEY** Tatyana’s grandfather gave her one penny on the day she was born. He plans to double the amount he gives her every day. Estimate how much she will receive from him on the 12th day of her life.

- 3. PICTURE FRAMES**
 Since a picture frame includes a border, the picture must be smaller in area than the entire frame. The table shows the relationship between picture area and frame length for a particular line of frames. Is this an exponential relationship? Explain.

Side Length (in)	Picture Area (in ²)
5	6
6	12
7	20
8	30
9	42

- 4. DEPRECIATION** The value of Royce Company’s computer equipment is decreasing in value according to the following function.

$$y = 4000(0.87)^x$$

In the equation, x is the number of years that have elapsed since the equipment was purchased and y is in dollars. What was the value 5 years after it was purchased? Round your answer to the nearest dollar.

- METEOROLOGY** The atmospheric pressure (in millibars) at a given altitude x , in meters, can be approximated by the following function. The function is valid for values of x between 0 and 10,000.

$$f(x) = 1038(1.000134)^{-x}$$

5. What is the pressure at sea level?
6. The McDonald Observatory in Texas is at an altitude of 2000 meters. What is the approximate atmospheric pressure there?
7. As altitude increases, what happens to atmospheric pressure?

9-6 Word Problem Practice

Growth and Decay

- DEPRECIATION** The value of a new plasma television depreciates by about 7% each year. Aeryn purchases a 50-inch plasma television for \$5000. What is its value after 4 years? Round your answer to the nearest hundred.
- MONEY** Hans opens a savings account by depositing \$1200 in an account that earns 3 percent interest compounded weekly. How much will his investment be worth in 10 years? Assume that there are exactly 52 weeks in a year and round your answer to the nearest cent.
- HIGHER EDUCATION** The table lists the average costs of attending a four-year college in the United States during the 2005–2006 school years.

College Sector	Tuition and Fees	Room and Board
Four-year Public	\$5,491	\$6,636
Four-year Private	\$21,235	\$7,791

Source: www.collegeboard.com

Russ’s parents invested money in a savings account earning an average of 4.5 percent interest, compounded monthly. After 15 years, they have exactly the right amount to cover the tuition, fees, room and board for Russ’s first year at a public college. What was their initial investment? Round your answer to the nearest dollar.

- POPULATION** In the 2000 U.S. Census, the population of the United States was estimated at 281 million. The annual rate of growth is about 1.1%. At this rate, what is the expected population at the time of the 2020 census? Round your answer to the nearest ten million.

MEDICINE For Exercises 5–7, use the following information. If necessary, round your answers to the nearest tenth.

When doctors prescribe medication, they have to consider the rate at which the body filters a drug from the bloodstream. Suppose it takes the human body 6 days to filter out half of the Flu-B-Gone vaccine. The amount of Flu-B-Gone vaccine remaining in the bloodstream x hours after an injection is given by the equation $y = y_0(0.5)^{\frac{x}{6}}$, where y_0 is the initial amount. Suppose a doctor injects a patient with 20 μg (micrograms) of Flu-B-Gone.

- How much of the vaccine will remain after 1 day?
- How much of the vaccine will remain after 12 days?
- After how many days will the amount of vaccine be less than 1 μg ?

10-1 Word Problem Practice***Simplifying Radical Expressions***

- 1. SPORTS** Jasmine calculated the height of her team's soccer goal to be $\frac{15}{\sqrt{3}}$ feet. Simplify the expression.

- 2. NATURE** In 2004, an earthquake below the ocean floor initiated a devastating tsunami in the Indian Ocean. Scientists can approximate the velocity (in feet per second) of a tsunami in water of depth d (in feet) with the formula $V = \sqrt{16d}$. Determine the velocity of a tsunami in 300 feet of water. Write your answer in simplified radical form.

- 3. AUTOMOBILES** The following formula can be used to find the “zero to sixty” time for a car, or the time it takes for a car to accelerate from a stop to sixty miles per hour.

$$V = \sqrt{\frac{2PT}{M}}$$

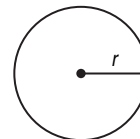
V is the velocity (in meters per second).
 P is the car's average power (in watts).
 M is the mass of the car (in kilograms).
 T is the time (in seconds).

Find the time it takes for a 900-kilogram car with an average 60,000 watts of power to accelerate from stop to 26.82 meters per second (60 miles per hour). Round your answer to the nearest tenth.

- 4. PHYSICAL SCIENCE** When a substance such as water vapor is in its gaseous state, the volume and the velocity of its molecules increase as temperature increases. The average velocity V of a molecule with mass m at temperature T is given by the formula $V = \sqrt{\frac{3kT}{m}}$. Solve the equation for k .

GEOMETRY For Exercises 5–7, use the following information.

Suppose Emeryville Hospital wants to build a new helipad on which medic rescue helicopters can land. The helipad will be circular and made of fire resistant rubber.

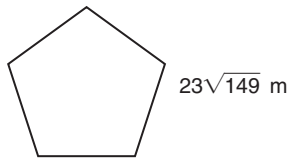


- 5.** If the area of the helipad is A , write an equation for the radius r .
- 6.** Write an expression in simplified radical form for the radius of a helipad with an area of 288 square meters.
- 7.** Using your calculator, find a decimal approximation for the radius. Round your answer to the nearest hundredth.

10-2 Word Problem Practice

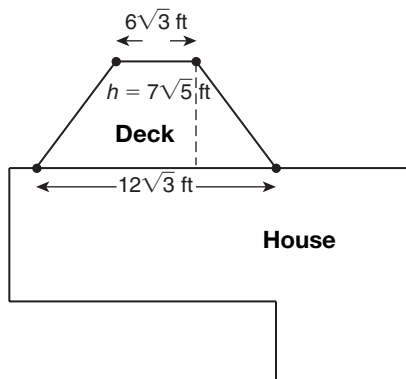
Operations with Radical Expressions

- 1. ARCHITECTURE** The Pentagon is the building that houses the U.S. Department of Defense. Find the approximate perimeter of the building, which is a regular pentagon. Leave your answer as a radical expression.

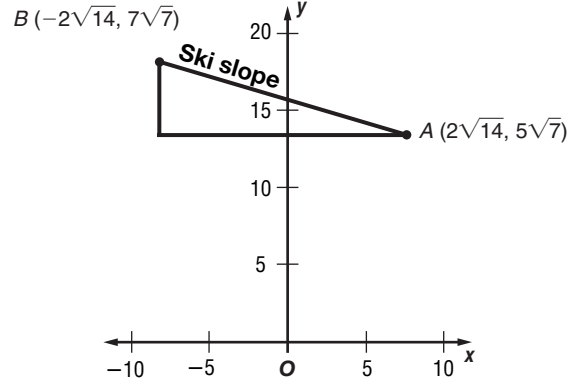


- 2. EARTH** The surface area of a sphere with radius r is given by the formula $4\pi r^2$. Assuming that the Earth is close to spherical in shape and has a surface area of about 5.1×10^8 square kilometers, what is the radius of the Earth to the nearest ten?

- 3. GEOMETRY** The area of a trapezoid is found by multiplying its height by the average length of its bases. Find the area of deck attached to Mr. Wilson's house. Give your answer as a simplified radical expression.



- 4. RECREATION** Carmen surveyed a ski slope using a digital device connected to a computer. The computer model assigned coordinates to the top and bottom points of the hill as shown in the diagram. Write a simplified radical expression that represents the slope of the hill.



FREE FALL For Exercises 5-7, use the following information.

Suppose a ball is dropped from a building window 800 feet in the air. Another ball is dropped from a lower window 288 feet high. Both balls are released at the same time. Assume air resistance is not a factor and use the following formula to find how many seconds t it will take a ball to fall h feet.

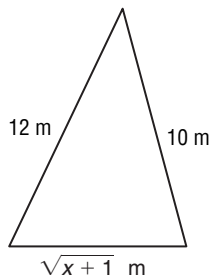
$$t = \frac{1}{4} \sqrt{h}$$

- How much time will pass between when the first ball hits the ground and when the second ball hits the ground? Give your answer as a simplified radical expression.
- Which ball lands first?
- Find a decimal approximation of the answer for Exercise 5. Round your answer to the nearest tenth.

10-3 Word Problem Practice**Radical Equations**

- 1. SUBMARINES** The distance in miles that the lookout of a submarine can see is approximately $d = 1.22\sqrt{h}$, where h is the height in feet above the surface of the water. How far would a submarine periscope have to be above the water to locate a ship 6 miles away? Round your answer to the nearest tenth.

- 2. PETS** Find the value of x if the perimeter of a triangular dog pen is 25 meters.



- 3. LOGGING** Doyle's log rule estimates the amount of usable lumber (in board feet) that can be milled from a shipment of logs. It is represented by the equation $B = L\left(\frac{d-4}{4}\right)^2$, where d is the log diameter (in inches) and L is the log length (in feet). Suppose the truck carries 20 logs, each 25 feet long, and that the shipment yields a total of 6000 board feet of lumber. Estimate the diameter of the logs to the nearest inch. Assume that all the logs have uniform length and diameter.

- 4. FIREFIGHTING** Fire fighters calculate the flow rate of water out of a particular hydrant by using the following formula.

$$F = 26.9d^2\sqrt{p}$$

F is the flow rate (in gallons per minute), p is the nozzle pressure (in pounds per square inch), and d is the diameter of the hose (in inches). In order to effectively fight a fire, the combined flow rate of two hoses needs to be about 2430 gallons per minute. The diameter of each of the hoses is 3 inches, but the nozzle pressure of one hose is 4 times that of the second hose. What are the nozzle pressures for each hose? Round your answers to the nearest tenth.

GEOMETRY For Exercises 5 and 6, use the following information.

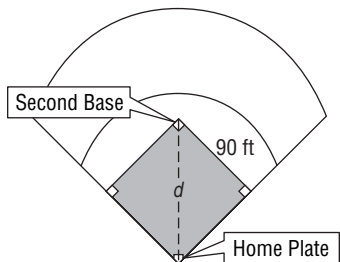
The lateral surface area s of a right circular cone, not including the base, is represented by the equation $s = \pi r\sqrt{r^2 + h^2}$, where r is the radius of the circular base and h is the height of the cone.

- 5.** If the lateral surface area of a funnel is 127.54 square centimeters and its radius is 3.5 centimeters, find its height to the nearest tenth of a centimeter.
- 6.** What is the area of the opening (i.e., the base) of the funnel?

10-4 Word Problem Practice

Pythagorean Theorem

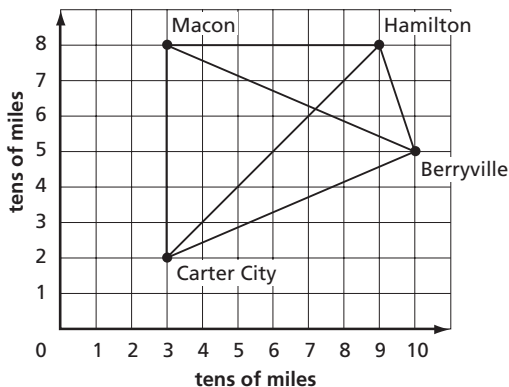
- 1. BASEBALL** A baseball diamond is a square. Each base path is 90 feet long. After a pitch, the catcher quickly throws the ball from home plate to a teammate standing by second base. Find the distance the ball travels. Round your answer to the nearest tenth.



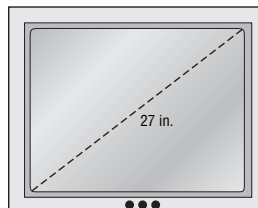
- 2. TRIANGLES** Each student in Mrs. Kelly's geometry class constructed a unique right triangle from drinking straws. Mrs. Kelly made a chart with the dimensions of each triangle. However, Mrs. Kelly made a mistake when recording their results. Which result was recorded incorrectly?

Side Lengths							
Student	a	b	c	Student	a	b	c
Amy	3	4	5	Fran	8	14	16
Belinda	7	24	25	Gus	5	12	13
Emory	9	12	15				

- 3. MAPS** Find the distance between Macon and Berryville. Round your answer to the nearest tenth.



- 4. TELEVISION** Televisions are identified by the diagonal measurement of the viewing screen. For example, a 27-inch television has a diagonal screen measurement of 27 inches.



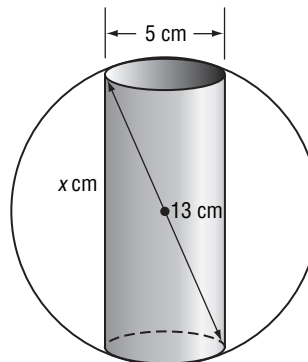
Complete the chart to find the screen height of each television given its size and screen width. Round your answers to the nearest whole number.

TV size	width (in.)	height (in.)
19-inch	15	
25-inch	21	
32-inch	25	
50-inch	40	

Source: measurements at Best Buy

- MANUFACTURING** For Exercises 5 and 6, use the following information.

Karl works for a company that manufactures car parts. His job is to drill a hole in spherical steel balls. The balls and the holes have the dimensions shown on the diagram.

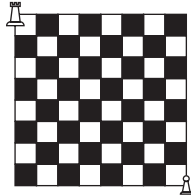


- 5.** How deep is the hole?
6. What would be the radius of a ball with a similar hole 7 centimeters wide and 24 centimeters deep?

10-5 Word Problem Practice

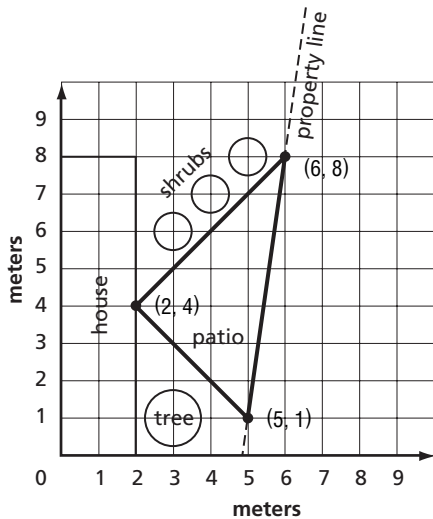
The Distance Formula

1. **CHES** Margaret's last two remaining chess pieces are located at the centers of the squares at opposite corners of the board. If the chessboard is a square with 8-inch sides, about how far apart are the pieces? Round your answer to the nearest tenth.

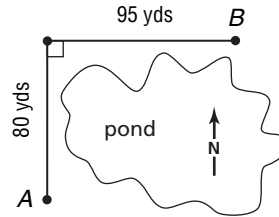


2. **ENGINEERING** Todd has drawn a cul-de-sac for a residential development plan. He used a compass to draw the cul-de-sac so that it would be circular. On his blueprint, the center of the cul-de-sac has coordinates $(-1, -1)$ and a point on the circle is $(2, 3)$. What is the radius of the cul-de-sac?

3. **LANDSCAPING** Randy plotted a triangular patio on a landscape plan for a client. What is the length of fencing he will need along the patio edge that borders the property line? Round your answer to the nearest tenth.

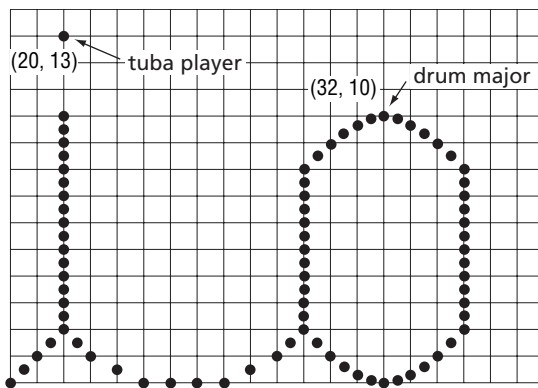


4. **ELECTRIC** An electrical wire starts at point A and runs 80 yards due north, then turns and runs 95 yards due east to point B. How much farther is it to string the wire this way rather than the shortest distance across the lake? Round your answer to the nearest tenth.



MARCHING BAND For Exercises 5 and 6, use the following information.

The Ohio State University marching band performs a famous on-field spelling of O-H-I-O called "Script Ohio". Sometimes they must adjust the usual dimensions of the word to fit it into the limited guest band performance area. The diagram below shows part of the adjusted drill chart. Each point represents one band member, and the coordinates are in yards.

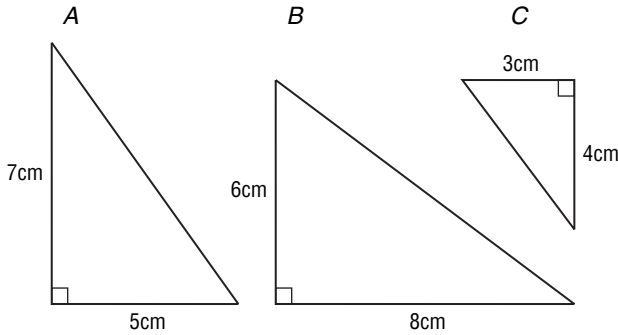


5. How far is the drum major from the tuba player who dots the "i"?
6. Carol is the band member at the top left of the first O in Ohio. She is located at $(0, 26)$. How far away is Carol from the tuba player? Round your answer to the nearest tenth.

10-6 Word Problem Practice

Similar Triangles

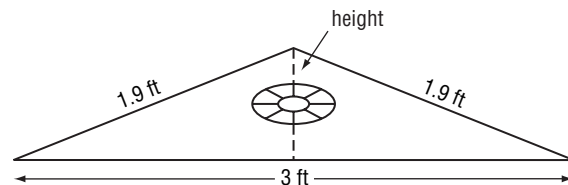
1. CRAFTS Layla is wants to buy a set of similar magnets for her refrigerator door. Layla finds the magnets below for sale at a local shop. Which two are similar?



2. EXHIBITIONS The world's largest candle was displayed at the 1897 Stockholm Exhibition. Suppose Lars measured the length of the shadow it cast at 11:00 A.M. and found that it was 12 feet. Suppose that immediately after this, he measured to find that a nearby 25-foot tent pole cast a shadow 5 feet long. How tall was the world's largest candle?

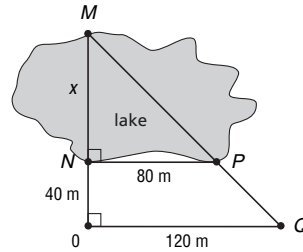
Source: <http://www.wackyuses.com/experiments/seesawingcandle.htm>

3. LANDMARKS The Toy and Miniature Museum of Kansas City displays a miniature replica of George Washington's Mount Vernon mansion. The miniature house is 10 feet long, 6 feet wide, 8 feet tall, and has 22 rooms. The scale of the model to the original is one inch to one foot. If the roof gable of the miniature has dimensions as shown on the diagram below, what is the height of the roof gable on the original Mount Vernon mansion?



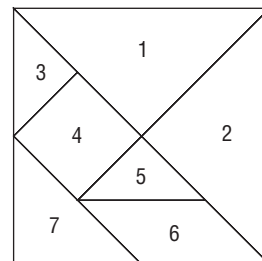
Source: <http://www.mountvernon.org/visit/plan/index.cfm/pid/114/>

4. SURVEYING Surveyors use properties of triangles including similarity and the Pythagorean Theorem to find unknown distances. Use the dimensions on the diagram to find the unknown distance x across the lake.



PUZZLES For Exercises 5–7, use the following information.

The figure below shows an ancient Chinese movable puzzle called a tangram. It has 7 pieces that can be reconfigured to produce an endless number of designs and pictures.



Assume that the side length of this tangram square is $\sqrt{2}$ cm. Leave your answers as simplified radical expressions.

5. What are the side lengths of triangles 1 and 2?
6. What are the side lengths of triangle 7?
7. What are the side lengths of triangles 3 and 5?

11-1 Word Problem Practice

Inverse Variation

- 1. PHYSICAL SCIENCE** The illumination produced by a light source varies inversely as the square of the distance from the source. The illumination produced 5 feet from the light source is 80 foot-candles.

$$id^2 = k$$

$$80(5)^2 = k$$

$$2000 = k$$

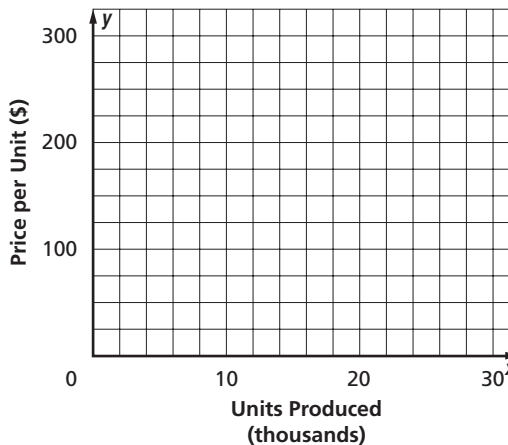
Find the illumination produced 8 feet from the same source.

- 2. MONEY** A formula called the Rule of 72 approximates how fast money will double in a savings account. It is based on the relation that the number of years it takes for money to double varies inversely as the annual interest rate. Use the information in the table to write the Rule of 72 formula.

Years to Double Money	Annual Interest Rate (percent)
18	4
14.4	5
12	6
10.29	7

- 3. ELECTRICITY** The resistance, in ohms, of a certain length of electric wire varies inversely as the square of the diameter of the wire. If a wire 0.04 centimeter in diameter has a resistance of 0.60 ohm, what is the resistance of a wire of the same length and material that is 0.08 centimeters in diameter?

- 4. BUSINESS** In the manufacturing of a certain digital camera, the cost of producing the camera varies inversely as the number produced. If 15,000 cameras are produced, the cost is \$80 per unit. Graph the relationship and label the point that represents the cost per unit to produce 25,000 cameras.



- SOUND** For Exercises 5–7, use the following information.

The sound produced by a string inside a piano depends on its length. The frequency of a vibrating string varies inversely as its length.

- 5.** Write an equation that represents the relationship between frequency f and length ℓ . Use k for the constant of variation.
- 6.** If you have two different length strings, which one vibrates more quickly (that is, has a greater frequency)?
- 7.** Suppose a piano string 2 feet long vibrates 300 cycles per second. What would be the frequency of a string 4 feet long?

11-2 Word Problem Practice**Rational Expressions**

- 1. PHYSICAL SCIENCE** Pressure is equal to the magnitude of a force divided by the area over which the force acts.

$$P = \frac{F}{A}$$

Gabe and Shelby each push open a door with one hand. In order to open, the door requires 20 pounds of force. The surface area of Gabe's hand is 10 square inches, and the surface area of Shelby's hand is 8 square inches. Whose hand feels the greater pressure?

- 2. GRAPHING** Recall that the slope of a line is a ratio of the vertical change to the horizontal change in coordinates for two given points. Write a rational expression that represents the slope of the line containing the points at (p, q) and $(7, -3)$.

- 3. AUTOMOBILES** The force needed to keep a car from skidding out of a turn on a particular road is given by the formula below. What force is required to keep a 2000-pound car traveling at 50 miles per hour on a curve with radius of 750 feet on the road? What value of r is excluded?

$$f = \frac{0.0672ws^2}{r}$$

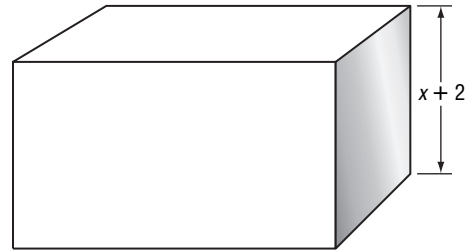
f = force in pounds

w = weight in pounds

s = speed in mph

r = radius in feet

- 4. PACKAGING** In order to safely ship a new electronic device, the distribution manager at Data Products Company determines that the package must contain a certain amount of cushioning on each side of the device. The device is shaped like a cube with side length x , and some sides need more cushioning than others because of the device's design. The volume of a shipping container is represented by the expression $(x^2 + 6x + 8)(x + 6)$. Find the polynomial that represents the area of the top of the box if the height of the box is $x + 2$.



SCHOOL CHOICE For Exercises 5 and 6, use the following information.

During the 2005-2006 school year, the ratio of public school students to private school students in the United States was approximately 7.6 to 1. The students attending public school outnumbered those attending private schools by 42,240,000.

- 5.** Write a rational expression to express the ratio of public school students to x private school students.
- 6.** How many students attended private school?

11-3 Word Problem Practice

Multiplying Rational Expressions

1. ROLLER COASTERS The fastest roller coaster in operation is the Kingda Ka in New Jersey. Its maximum speed is 188 feet per second. In 2004, Jeff Gordon won the Brickyard 400 Stock Car race with an average speed of 115 miles per hour. Is this faster or slower than the roller coaster? Give the coaster's top speed rounded to the nearest mile per hour.

2. JOBS Rosa earned \$19.25 for babysitting for $3\frac{1}{2}$ hours. At this rate, how much will she earn babysitting for 5 hours?

3. SOLAR SYSTEM The diameter of the largest moon of Jupiter is 5268 kilometers. The diameter of our moon is 2160 miles. Compare the sizes of the moons in the same unit of measure to determine which is larger in diameter. (*Hint*: 1 inch equals 2.54 cm.)

4. HOMEWORK Ander and Alejandro were working on the following homework problem.

Find $\frac{n-10}{n+3} \cdot \frac{2n+6}{n+3}$.

Alejandro's Solution

$$\begin{aligned} & \frac{n-10}{n+3} \cdot \frac{2n+6}{n+3} \\ &= \frac{2(n-10)\cancel{(n+3)}^1}{(n+3)\cancel{(n+3)}^1} \\ &= \frac{2n-20}{n+3} \end{aligned}$$

Ander's Solution

$$\begin{aligned} & \frac{n-10}{n+3} \cdot \frac{2n+6}{n+3} \\ &= \frac{2(n-10)\cancel{(n+3)}^1}{n+3^1} \\ &= 2n-20 \end{aligned}$$

Which student is correct? Explain.

ELECTRICITY For Exercises 5 and 6, use the following information.

Electricity travels at approximately the speed of light, 3×10^8 meters per second.

5. About how many kilometers can electricity travel in 1 minute?

6. At 70 degrees Fahrenheit, sound travels at about 0.344 kilometers per second. About how many times faster does light travel than does sound?

11-4 Word Problem Practice

Dividing Rational Expressions

1. ANIMALS An elephant's heart beats approximately one billion times in its life. If the typical elephant lives to be 40 years old, about how many times has its heart beat per minute, on average? Round to the nearest whole number.

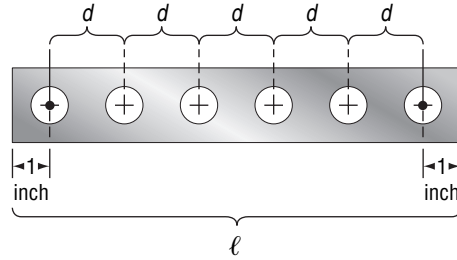
2. WAGES In several states, the average annual personal income is about \$29,400. If this amount is based on a 40-hour work week, what is the hourly wage?

3. GEOMETRY Suppose the rational expression $\frac{5n^2m^3}{2ab}$ represents the area of a section in a tiled floor and $\frac{2nm}{a}$ represents the section's length. Write a rational expression to represent the width.

4. TRAVEL Helene travels 800 miles from Amarillo to Brownsville at an average speed of 40 miles per hour. She makes the return trip driving an average of 60 miles per hour. What is the average rate for the entire trip? (*Hint:* Recall that $t = d \div r$.)

MANUFACTURING For Exercises 5–8, use the following information.

India works in a metal shop and needs to drill equally spaced holes along a strip of metal. The centers of the holes on the ends of the strip must be exactly 1 inch from each end. The remaining holes will be equally spaced.



5. If there are x equally spaced holes, write an expression for the number of equal spaces there between holes.

6. Write an expression for the distance between the end screws if the length is ℓ .

7. Write a rational equation that represents the distance between the holes on a piece of metal that is ℓ inches long and must have x equally spaced holes.

8. How many holes will be drilled in a metal strip that is 6 feet long with a distance of 7 inches between each screw?

11-5 Word Problem Practice**Dividing Polynomials**

1. TECHNOLOGY The surface area (in square millimeters) of a rectangular computer microchip is represented by the expression $x^2 - 12x + 35$, where x is the number of circuits. If the width of the chip is $x - 5$ millimeters, write a polynomial that represents the length.

2. HOMEWORK Your classmate Ava writes her answer to a homework problem on the chalkboard. She has simplified $\frac{6x^2 - 12x}{6}$ as $x^2 - 12x$. Is this correct? If not, what is the correct simplification?

3. CIVIL ENGINEERING Suppose 5400 tons of concrete costs $(500 + d)$ dollars. Write a formula that gives the cost C of t tons of concrete.

4. SHIPPING The Overseas Shipping Company loads cargo into a container to be shipped around the world. The volume of their shipping containers is determined by the following equation.

$$x^3 + 21x^2 + 99x + 135$$

The container's height is $x + 3$. Write an expression that represents the area of the base of the shipping container.

5. CIVIL ENGINEERING Greenshield's Formula can be used to determine the amount of time a traffic light at an intersection should remain green.

$$G = 2.1n + 3.7$$

G = green time in seconds

n = average number of vehicles traveling in each lane per light cycle

Write a simplified expression to represent the average green light time per vehicle.

SOLID GEOMETRY For Exercises 6 and 7, use the following information.

The surface area of a right cylinder is given by the formula $S = 2\pi r^2 + 2\pi rh$.

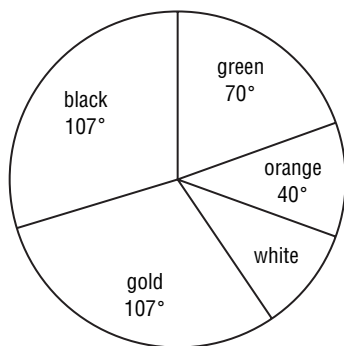


6. Write a simplified rational expression that represents the ratio of the surface area to the circumference of the cylinder.

7. Write a simplified rational expression that represents the ratio of the surface area to the area of the base.

11-6 Word Problem Practice**Rational Expressions with Like Denominators**

- 1. TEXAS** Of the 254 counties in Texas, 4 are larger than 6000 square miles. Another 21 counties are smaller than 300 square miles. What fraction of the counties are 300 to 6000 square miles in size?
- 2. TRAVEL** Trevor is driving across the country with his friend Max after their college graduation. Between Newport and Springfield, progress is slow because of a bumpy road; they drive for three hours and cover 130 miles. Once they pass Springfield, they speed up on the smooth highway and arrive in Middleton three hours later, 200 miles from Springfield. Recall the relationship $\text{rate} = \frac{\text{distance}}{\text{time}}$. What was Trevor and Max's average speed from Newport to Middleton?
- 3. CHOOSING A COSTUME** The color guard at Wayne High School performs in competitions. The guard captain wants to design a 14-inch diameter prop disc to help them choose from their costume colors: black, orange, green, and gold. She designs the disc so that the circular sections have the central angle measurements as shown on the diagram below.



What fraction of the circle is white?

- 4. INSURANCE** For a hospital stay, Paul's health insurance plan requires him to pay $\frac{2}{5}$ the cost of the first day in the hospital and $\frac{1}{5}$ the cost of the second and third days. If Paul's hospital stay is 3 days and cost him \$420, what was the full daily cost?

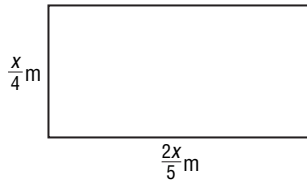
MAGAZINE DRIVE For Exercises 5 and 6, refer to the following information.

Ninth graders Victor, Barbara, and Robyn are participating in a magazine drive to raise money for special programs at their school. One of the incentives for selling magazine subscriptions is that for each subscription sold, the student gets one raffle ticket for a drawing to win a prize. Victor, Barbara, and Robyn sell 43, 18, and x magazine subscriptions, respectively.

- 5.** In the grand prize drawing, all ninth graders put their tickets together for one drawing to see who will win a new stereo. The ninth grade sold a total of 4372 subscriptions. Write an expression representing the probability that one of these three students will win a new stereo.
- 6.** Robyn won the grand prize! The second prize drawing is for a gift card at a local music store. The winner of the grand prize is not eligible for the second prize. Write an expression representing the probability that Victor or Barbara will win the second prize.

11-7 Word Problem Practice**Rational Expressions with Unlike Denominators**

- 1. SWIMMING** Power Pools installs swimming pools. To determine the appropriate size of pool for a yard, they measure the length of the yard in meters and call that value x . The length and width of the pool are calculated with the diagram below. Write an expression in simplest form for the perimeter of a rectangular pool for the given variable dimensions.



- 2. EGYPTIAN FRACTIONS** Ancient Egyptians used only unit fractions, which are fractions in the form $\frac{1}{n}$. Their mathematical notation only allowed for a numerator of 1. When they needed to express a fraction with a numerator other than 1, they wrote it as a sum of unit fractions. An example is shown below.

$$\frac{5}{6} = \frac{1}{3} + \frac{1}{2}$$

Simplify the following expression so it is a sum of unit fractions.

$$\frac{5x + 6}{10x^2 + 12x} + \frac{2x}{8x^2}$$

- 3. WINDOW CLEANING** Working alone, Mateo can clean an office building's windows in 8 hours. It takes his assistant Tea 14 hours to do the same job. How long would it take to clean the building's windows if Mateo and Tea worked at the same time?

- 4. SCIENCE TEST** Tamika got 80% of the questions on her science test correct. She answered 14 of the first 15 questions correctly, and two thirds of the remaining questions correctly. How many questions were on the test?

PACKAGE DELIVERY For Exercises 5 and 6, use the following information.

The Fredricksburg Parcel Express delivered a total of 498 packages on Monday, Tuesday, and Wednesday. On Tuesday, they delivered 7 less than 2 times the number of packages delivered on Monday. On Wednesday, they delivered the average number delivered on Monday and Tuesday.

- 5.** Write a rational equation that represents the sum of the numbers of packages delivered on Monday, Tuesday, and Wednesday.
- 6.** How many packages were delivered on Monday?

11-8 Word Problem Practice**Mixed Expressions and Complex Fractions**

1. CYCLING Natalie rode in a bicycle event for charity on Saturday. It took her $\frac{2}{3}$ of an hour to complete the 18-mile race. What was her average speed in miles per hour?

2. QUILTING Mrs. Tantora sews and sells Amish baby quilts. She bought $42\frac{3}{4}$ yards of backing fabric, and $2\frac{1}{4}$ yards are needed for each quilt she sews. How many quilts can she make with the backing fabric she bought?

3. TRAVEL The Franz family traveled from Galveston to Waco for a family reunion. Driving their van, they averaged 30 miles per hour on the way to Waco and 45 miles per hour on the return trip home to Galveston. What is their average rate for the entire trip? (*Hint:* Remember that average rate equals total distance divided by total time and that time can be represented as a ratio of distance x to rate.)

4. PHYSICAL SCIENCE The volume of a gas varies directly as the Kelvin temperature T and inversely as the pressure P , where k is the constant of variation.

$$V = k\left(\frac{T}{P}\right)$$

If $k = \frac{13}{157}$, find the volume in liters of helium gas at 273 degrees Kelvin and $\frac{13}{3}$ atmospheres of pressure. Round your answer to the nearest hundredth.

WORKPLACE SAFETY For Exercises 5 and 6, use the following information. The Occupational Safety and Health Administration provides safety standards in the workplace to keep workers free from dangerous working conditions. OSHA recommends that for general construction there be 5 foot-candles of illumination in which to work. A foreman using a light meter finds that the illumination of a construction light on a surface 8 feet from the source is 11 foot-candles. The illumination produced by a light source varies inversely as the square of the distance from the source.

$$I = \frac{k}{d^2}$$

I is illumination (in foot-candles).
 d is the distance from the source (in feet).
 k is a constant.

5. Find the illumination of the same light at a distance of $15\frac{3}{4}$ feet. Round your answer to the nearest hundredth.

6. Is there enough illumination at this distance to meet OSHA requirements for lighting?

7. In order to comply with OSHA, what is the maximum allowable working distance from this light source? Round your decimal answer to nearest tenth.

11-9 Word Problem Practice**Solving Rational Equations**

1. ELECTRICITY The current in a simple electric circuit varies inversely as the resistance. If the current is 20 amps when the resistance is 5 ohms, find the current when the resistance is 8 ohms.

2. MASONRY Sam and Belai are masons who are working to build a stone wall that will be 120 feet long. Sam works from one end and is able to build one ten-foot section in 5 hours. Belai works from the other end and is able to finish a ten-foot section in 4 hours. How long will it take Sam and Belai to finish building the wall?

3. NUMBERS The formula to find the sum of the first n whole numbers is $\text{sum} = \frac{n^2 + n}{2}$. In order to encourage students to show up early to a school dance, the dance committee decides to charge less for those who come to the dance early. Their plan is to charge the first student to arrive 1 penny. The second student through the door is charged 2 pennies; the third student through the door is charged 3 pennies, and so on. How much money, in total, would be paid by the first 150 students?

4. NAUTICAL A ferry captain keeps track of the progress of his ship in the ship's log. One day, he records the following entry.

With the recent spring snow melt, the current is running strong today. The six-mile trip downstream to Whyte's landing was very quick. However, we only covered two miles in the same amount of time when we headed back upstream.

What was the speed of the boat through still water?

HEALTH CARE For Exercises 5 and 6, use the following information.

The total number of Americans waiting for kidney and heart transplants is approximately 66,500. The ratio of those awaiting a kidney transplant to those awaiting a heart transplant is about 20 to 1.

- 5.** How many people are on each of the waiting lists? Round your answers to the nearest hundred.
- 6.** These two groups make up about $\frac{3}{4}$ of the transplant candidates for all organs. About how many organ transplant candidates are there altogether? Round your answer to the nearest thousand.

12-1 Word Problem Practice

Sampling and Bias

For Exercises 1–4, identify the sample and the population from which it was selected, and state whether it is *biased* or *unbiased*. If unbiased, classify the sample as *simple*, *stratified*, or *systematic*. If biased, classify as *convenience* or *voluntary response*.

1. SCHOOL Ms. Yeong chooses four students to pass out snacks each day. To choose the students, she writes the names of each of her 18 students on small pieces of paper, and places them in a cup. She mixes up the names and pulls out four to be the snack helpers.

2. ELECTIONS In Summerville, residents vote for mayor at one of the eight precinct voting places near where they live. To acquire early election results for the evening news, a reporter stands outside one of the city’s eight voting stations and asks as many people as possible for whom they voted.

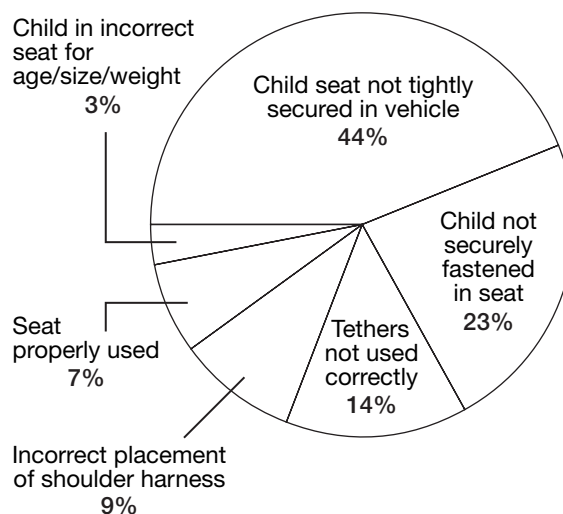
3. DISEASE A European country’s health department uses nets to trap birds near a local wildlife refuge. The bird is tested for the presence of the avian flu virus.

4. SOIL To check for the presence of harmful chemicals in the ground at a new construction site, geotechnical engineers divide the site into 12 rectangular areas and remove a pint of soil from each area for testing.

CHILD SAFETY For Exercises 5 and 6, use the following information.

The British Columbia Automobile Association performed a free child safety seat inspection for people that came in for the safety check. Only 7% of the 1000 seats inspected were properly used. The graph below shows the approximate percentages of results for the safety seat inspections.

Child Safety Seat Survey Results



Source: autonet.ca

5. Write a statement to describe the sampling technique.

6. Is it appropriate to say that 25% of children in child safety seats in British Columbia are not securely fastened in their seat? Explain.

12-2 Word Problem Practice

Counting Outcomes

1. SUPREME COURT There are nine justices on the United States Supreme Court. If the justices stand outside the court building for a group photograph, in how many ways can they line up standing side by side?

2. UNIFORMS Sanjay’s school requires students to wear uniforms. His uniform wardrobe includes an equal number of each of the following items.

Pants	Shirts	Sweaters	Ties
blue	white	cardigan	striped
gray	yellow	vest	blue
	light blue		checked
			red

One morning, Sanjay can’t decide what to wear, so without looking he reaches into his dresser drawers and closet to pick one pair of pants, one shirt, one sweater, and one tie. How many different outfit outcomes are possible in this situation?

3. MAIL DELIVERY In 1963, The United States Postal Service established the Zoning Improvement Plan, including the five-digit ZIP code, to expedite mail delivery. The first digit corresponds to one of ten national regions, the second and third digits form a number from 01 to 99 that corresponds to a metropolitan area, and the last two digits form a number from 01 to 99 that corresponds to an individual post office or zone. How many different five digit zip codes are possible?

4. MONEY Parker’s father puts all of his spare change in his piggy bank. One day he counted the coins and found he had 18 quarters, 26 dimes, 22 nickels, and 34 pennies. Parker put the coins back into the bank, then closed his eyes and pulled out two coins. How many outcomes are possible?

SPORTS For Exercises 5–8, use the following information.

The NCAA women’s basketball championship is a 64-team tournament. Teams are paired up to play one another, resulting in 32 first-round games. Losing teams are eliminated from the tournament while winning teams move on to play a game in the next round.

- 5. How many rounds of tournament games are played to obtain a single tournament champion?
- 6. How many total games are played in the tournament?
- 7. Texas’ Baylor University won the women’s NCAA basketball tournament in 2005. How many teams did they beat in the tournament?
- 8. If the NCAA wants to add an additional round of games next year, how many teams will be needed to start the tournament?

12-3 Word Problem Practice

Permutations and Combinations

1. CHORES In Ashley’s family there are 4 children and their mother and father. If two of the six must help clear the table after dinner, how many ways can two people be paired?

2. PUBLIC SERVICE A county computer randomly selects jurors from the lawyer-approved potential juror list. How many ways are there for 12 jurors to be chosen from a pool of 20?

Potential Jurors	
Fred	Jennifer
Sally	Carla
Mike	Sam
Tom	Sylvia
Maria	Jamal
Ted	Greg
Carlos	Todd
Dorothy	Lauren
Irene	Maya
Trish	Luke

3. SPORTS Hans’ basketball team decides to choose two captains each week so that many players get the chance to be captain. Each week, each of the 11 players writes his name on a slip of paper. The papers are then placed in a container and mixed. The last week’s captains draw two slips of paper from the container; these two people are captains for the following week. How many different pairs of captains can be formed?

4. PUZZLES A popular newspaper puzzle involves a series of letters that can be rearranged to form a word. Will is writing his own version of the game for a school project. He wants to scramble the following word for his puzzle.

numbers

How many ways are there to arrange the letters with the letter *b* as the first letter?

HORSE RACING For Exercises 5–7, use the following information.

In the 131st running of the Kentucky Derby in 2005, there were 20 contenders.

5. How many different ways can the horses finish the race?

6. How many different ways can horses place first, second, and third?

7. If all 20 horses have an equal chance of winning and 3 of the horses are female, what is the probability that a female horse places first, second, and third?

12-4 Word Problem Practice

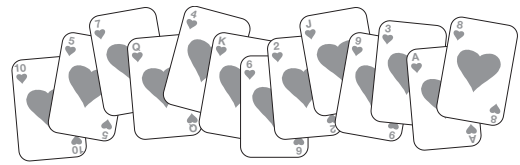
Probability of Compound Events

1. BIRTHDAYS On Juanita's birthday, her grandmother sends her a card. What is the probability that the man who delivered the mail has a birthday either the same day or one day before or after? Disregard February 29 as a possible birthday, and assume that all days are equally likely.

2. SPORTS The World Series is a "best of seven" game championship in which up to seven games are played, and one team has to win four games to win the Series. In the 2005 World Series, the Chicago White Sox swept the Houston Astros, meaning that they won the series by winning the first four games. If you assume that each team has an equal chance of winning each game, what is the probability of a World Series sweep?

3. BUSINESS At Corrugated Packaging, Inc., a team of six employees is in charge of marketing and selling the company's products; three are women and three are men. The president of the company decides to send four team members to a national cardboard box conference. He wants to make sure he chooses names fairly, so he decides to put the names of his six sales employees in a hat and draw four names to see who will go to the conference. What is the probability that the team will consist of three women and one man?

4. MAGIC Iris performs a magic trick in which she holds a standard deck of cards and has each of three people randomly choose a card from the deck. Each person keeps his or her card as the next person draws. What is the probability that all three people will draw a heart?



STOCKS For Exercises 5–7, use the following information.

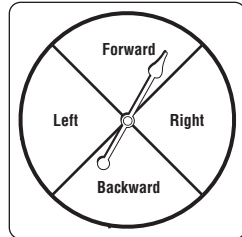
Bruce has just purchased 100 shares of Out Clone, Inc. stock. The company is seeking FDA approval for a treatment that relieves the common cold. According to pharmaceutical experts, there is a 50% chance that FDA approval will be granted, and according to market insiders there is an 85% chance the value of the stock will double if FDA approval is granted.

- What is the probability that the FDA will approve the treatment and the value of Bruce's investment will double?
- What is the probability that the FDA will approve the treatment and the value of your stock will not double?
- Are these events dependent or independent?

12-5 Word Problem Practice

Probability Distributions

1. **GAMES** A spinner for an adventure game decides how a player will move. Write the sample space with all possible outcomes if the spinner is spun twice.



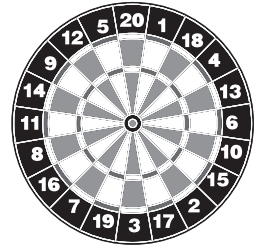
2. **JOBS** The probability distribution table shows the results of a newspaper survey that asked babysitters how much they make per hour.

Hourly Pay	\$3	\$4	\$5	\$6	\$7+
Probability	0.1	0.2	0.5	0.15	0.05

What is the probability that a babysitter chosen at random from the survey makes more than \$5 per hour?

3. **TIME** James looks at his 12-hour digital clock when he wakes up in the middle of the night. Make a probability histogram for all of the possible outcomes if you let X equal the first digit of the time. For instance, if it is 3:41, the first digit is a 3.

4. **DARTS** Suppose two darts are thrown at a traditional dart board and land near the center, but not on a bullseye. What is the probability that the sum of their scores is less than or equal to 5?



TENNIS For Exercises 5 and 6, use the following information.

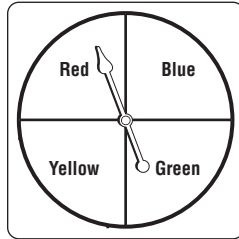
All season Oliver's tennis coach has kept track of where each of his serves has landed during practice. The results are shown in the probability distribution table. A serve in region 2 is "in", while a serve in any other region is a fault. A serve in region 1 represents hitting the net.

Region	1	2	3	4	5
Probability	0.19	0.52	0.15	0.09	0.05

5. What is the probability that any one of Oliver's serves does not hit the net and is a fault?
6. Make a probability histogram that represents the data in the table.

12-6 Word Problem Practice**Probability Simulations**

1. **GAMES** Suppose you spin the spinner below 20 times. You get 6 red, 4 blue, 5 yellow, and 5 green. What is the theoretical probability of spinning red? What is the experimental probability of spinning red?



2. **EARTHQUAKES** Geologists conclude that there is a 62% probability of a magnitude 6.7 or greater quake striking the San Francisco Bay region before 2032. Does this represent *empirical probability*, *theoretical probability*, or *experimental probability*?
3. **TOYS** There is a toy on the market that is sold as a mother dog with her puppies. Each mother dog comes with 2, 3, or 4 puppies. The number of puppies in the package remains a surprise until the toy is purchased and opened. Suppose the toy company has stated that one half of the toy packages contain 2 puppies, one third of the packages contain 3 puppies, and one sixth of the packages contain 4 puppies. Describe what could be used to perform a simulation for determining the probability of randomly receiving a certain number of puppies.

4. **AUTOMOBILES** A consumer group surveyed its members and found that many of them had flats or blowouts with a certain brand of tire. Out of a total of 20,224 tires purchased, 984 developed problems within the first 1000 miles. Lea has just had one of these tires installed on her car. What is the probability that her tire will have a flat or blowout in the first 1000 miles?

POLYGRAPH TESTING For Exercises 5 and 6, use the following information.

A former FBI detective has developed a voice stress analysis device to determine whether or not a person is telling the truth. He claims that the device is accurate 95% of the time. Additionally, a traditional polygraph machine has a reported accuracy rate of 80%.

5. Suppose four criminal suspects are given the voice stress analysis. According to the reported empirical probability, what is the probability that the device can correctly analyze the accuracy of all four suspects' statements? Round your answer to the nearest tenth of a percent.
6. If a randomly chosen person is given both the voice stress analysis and the traditional polygraph to validate his or her statements, what is the probability that both devices are able to correctly determine the accuracy of the person's statements?