Mixed Problem Solving

CHAPTER 1

1. BANKING The table below shows the balance in a checking account on the first day of each month for one year. List the dollar amounts in increasing order. **(Lesson 1.1)**

Jan	Feb	Mar	Apr	May	June
$55	−$20	$15	$62	$47	−$38
July	Aug	Sept	Oct	Nov	Dec
−$27	$11	$85	$36	$12	−$10

**2. INTELLIGENCE QUOTIENT** An *Intelligence Quotient,* or IQ, is sometimes used to evaluate a person's intelligence potential. You can find a person's IQ by multiplying the quotient of the person's mental age and the person's chronological age by 100. Write an algebraic expression for finding a person's IQ. What is the IQ of a person whose mental age is 18 and whose chronological age is 16? **(Lesson 1.2)**

3. COMMISSION At a clothing store, sales associates are paid an hourly rate of $7 and receive a 3% commission on sales. A sales associate works 30 hours one week and earns a total of $243. How much did the sales associate sell that week? **(Lesson 1.3)**

4. PRODUCE SALES A farmer makes a profit of $.06 per pound of potatoes and $.08 per pound of carrots, and always produces twice as many pounds of potatoes as carrots. Last year the farmer produced 192,000 pounds of potatoes and 96,000 pounds of carrots. This year the farmer wants to make a profit of $24,000. By what percent should the farmer increase his production of potatoes and carrots? **(Lesson 1.3)**

5. SIMPLE INTEREST The formula for simple interest is $I = Prt$ where I is the interest, P is the principal, r is the rate (written as a decimal) and t is the time (in years). You deposit $4000 into a savings account that pays a simple annual interest rate of 2%. Solve the simple interest formula for t. Then find how many years will it take to earn $500 in interest. **(Lesson 1.4)**

6. PHYSICS Newton's second law states that a force F acting on an object equals the mass of the object m times the acceleration a. Force is measured in Newtons. One Newton is equal to $1 \frac{kg \cdot m}{sec^2}$. A force of 60 Newtons acts on an object and produces an acceleration of 3 meters per second squared. What is the mass of the object? **(Lesson 1.5)**

7. SUMMER JOB You work 35 hours per week for a landscaping company during the summer. You earn $7 per hour for office work and $8 per hour for outside work. You earn $250 one week. How many hours did you work outside that week? **(Lesson 1.5)**

8. BOTANY A botanist received a sample of a certain species of a flower from her colleague in Africa. The botanist's colleague advised her to keep the flower in the temperature range of 35°C to 40°C. Write this temperature range as a compound inequality in degrees Fahrenheit. **(Lesson 1.6)**

9. GRADES A student's scores on the first four out of five tests are given in the table below. In order to achieve a final grade of A, the student needs a test average of 90 or greater. What scores could the student earn on the fifth test to achieve a final grade of A? **(Lesson 1.6)**

Test 1	88
Test 2	89
Test 3	93
Test 4	87
Test 5	?

10. DANCE COMPANY To be a member of a certain dance company, you must be between 66 inches and 69 inches tall when standing in stocking feet. Write an absolute value inequality that describes the acceptable heights for the members of the dance company. **(Lesson 1.7)**

CHAPTER 2

1. **WEIGHT ON THE MOON** A person's weight on the moon m (in pounds) can be modeled by $m = \frac{w}{6}$, where w is the person's weight (in pounds) on Earth. Graph the function. If a person weighs 150 pounds on Earth, about how much would the person weigh on the moon? **(Lesson 2.1)**

2. **STAIRCASE** A pull-down staircase for an attic is designed to have a slope of about 2. Find the horizontal distance x that a pull-down staircase would take up, given that the distance from the floor to the ceiling is 10 feet. **(Lesson 2.2)**
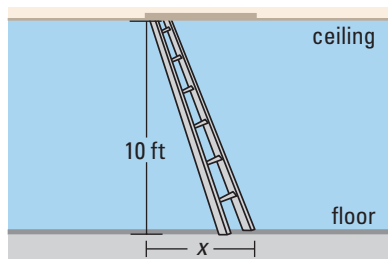
CALLING RATES In Exercises 3–5, use the following information. **(Lesson 2.3)**
A phone company charges $.30 for the first minute of a long-distance call and $.05 for each additional minute.

3. Write an equation that models the cost of a long-distance phone call.

4. Graph the equation.

5. How many minutes can you talk for $2?

PROFIT In Exercises 6 and 7, use the following information. **(Lesson 2.4)**
A company experienced a linear growth in profit from 1990 through 1999. The company's profit was $32,000 in 1990 and $87,000 in 1999.

6. Find the company's average annual rate of increase in profit.

7. Write a linear model for the company's profit at any given time between 1990 and 1999.

8. If the company continued to experience the same kind of profit in years beyond 1999, predict the company's profit in 2005.

COMMUTER TRAIN In Exercises 9 and 10, use the following information. **(Lesson 2.5)**
The table below gives the time t (in minutes) and the distance d (in miles) a commuter train must travel to get to a city from each of several train stations along its route.

t	45.5	41	34.5	31	27	9.5	4
d	26	24	20	19	17	5	3

9. Draw a scatter plot of the data. Then approximate the best-fitting line for the data.

10. Predict the time it would take the same train to travel 35 miles from a station.

VIDEO RENTAL STORE In Exercises 11 and 12, use the following information. **(Lesson 2.6)**
You have a $30 gift card for a video rental store. It costs $4.50 to rent a movie and $5.50 to rent a video game.

11. Write and graph an inequality that represents the numbers of movies and video games you can rent.

12. Give three possible combinations of the numbers of movies and video games you can rent.

13. **WATER RATES** For a certain city, the cost C for water is given by the following function, where g is the number of gallons consumed (in thousands):

$$C(g) = \begin{cases} 1.48g + 3.2 & \text{if } 0 \le g \le 22 \\ 1.78g - 3.4 & \text{if } g > 22 \end{cases}$$

Graph the function. Then find the total cost for 31,000 gallons of water. **(Lesson 2.7)**

BOOK SALES In Exercises 14 and 15, use the following information. **(Lesson 2.8)**
The number of copies of a new book sold s (in hundreds) increases steadily for a while and then decreases as given by the function $s = -3|t - 29| + 112$ where t is the time (in weeks).

14. Graph the function.

15. What was the maximum number of copies sold in one week?

CHAPTER 3

1. **PHONE BILL** Your family pays different rates for long-distance phone calls made during the night and during the day. Daytime calls cost $.12 per minute. Nighttime calls cost $.07 per minute. Your family used 425 minutes this month, and the total bill (excluding base fees) was $36. How many daytime minutes did your family use? Use a verbal model to write a system of linear equations. Graph and solve the system. **(Lesson 3.1)**

MOVIE THEATER **In Exercises 2 and 3, use the following information.** **(Lesson 3.2)**
A movie theater charges $9 for an adult's ticket and $6 for a child's ticket. One Friday night the theater sold a total of 848 tickets for $6711.

2. How many tickets of each type were sold?

3. How much money did the theater make on each type of ticket?

4. **FUNDRAISING** Your student government is planning a sale of donated used books and CDs to raise money for a local charity. You have 200 books and 160 CDs. Each book will cost $4 and each CD will cost $6. Use the information below to write and graph a system of linear inequalities for the possible numbers of books and CDs sold. **(Lesson 3.3)**

> **Fundraiser on Saturday in the gym**
> - Buy used books and CDs.
> - All proceeds to benefit local charity.
> - Please help us raise at least $200.

5. **GARDEN DESIGN** You are designing a rectangular garden that is to be enclosed by a fence. The fence can be no longer than 500 feet. The length of the garden must be greater than 50 feet, and the width of the garden must be greater than 25 feet. Let l be the length of the garden and let w be the width of the garden. Write and graph a system of linear inequalities to describe the possible lengths and widths of the garden. **(Lesson 3.3)**

6. **RUNNING** You are training for a running race. You want to consume at least 300 grams of carbohydrates per day, but no more than 2000 calories. You are considering how you can meet these requirements by eating only pasta and lentils. Lentils cost $.79 per cup and pasta costs $.25 per cup. How many cups of lentils and how many cups of pasta should you buy to minimize cost while satisfying your nutritional requirements? **(Lesson 3.4)**

Contents	1 cup pasta	1 cup lentils
Calories	160	200
Carbohydrates (grams)	30	30

PAINTING **In Exercises 7–9, use the following information.** **(Lesson 3.5)**
You are hired to paint the exterior of a house. The cost of siding paint is $16 per gallon and the cost of trim paint is $14 per gallon. The painting equipment costs $26.

7. Write a model for the total cost of the project as a function of the number of gallons of siding paint and the number of gallons of trim paint you buy.

8. Evaluate the model for 10 gallons of siding paint and 3 gallons of trim paint.

9. Make a table that shows the total cost for several different numbers of gallons.

BASEBALL GAME **In Exercises 10 and 11, use the following information.** **(Lesson 3.6)**
You and two friends are at a baseball game together. You each buy concessions from a vendor. You buy one drink, one hot dog, and one bag of peanuts for $7.75. Tim buys one drink and two hot dogs for $6.25. Meg buys one hot dog and one bag of peanuts for $5.50.

10. Write a system of equations to represent the given information.

11. What is the price of each item purchased?

CHAPTER 4

PRODUCT SHIPPING **In Exercises 1–3, use the following information.** (Lesson 4.1, 4.2)
A company produces printers and fax machines. Both machines come in models A, B, and C. The matrices below show the company's shipping totals in 2002.

Units Shipped to Europe

	A	B	C
Printers	1200	1800	1500
Fax machines	2400	2800	2500

Units Shipped to Asia

	A	B	C
Printers	240	380	280
Fax machines	120	480	300

1. Write a matrix that shows the total numbers of units shipped to Europe and Asia.

2. The company shipped twice as many units to Asia in 2003 as in 2002. Write a matrix that shows the units shipped to Asia in 2003.

3. For both printers and fax machines, the shipping cost of model A is $2, the shipping cost of model B is $2.50, and the shipping cost of model C is $3. Use matrix multiplication to find the total cost of shipping to Europe for each model of printer and fax machine in 2002.

4. **TRAY WEIGHT** A server makes three trips from the kitchen carrying heavy trays. The matrix below shows the contents of each tray. Each entree weighs 3 pounds, each salad weighs 1.5 pounds, and each drink weighs 2 pounds. Use matrix multiplication to find the total weight carried on each tray. (Lesson 4.2)

Trays

	A	B	C
Entrees	2	4	3
Salads	4	2	1
Drinks	4	2	2

5. **THEATER** The total cost of theater tickets for 3 adults and 5 children is $120. The total cost of theater tickets for 5 adults and 3 children is $136. Use a linear system and Cramer's rule to find the price of one adult's ticket and the price of one child's ticket. (Lesson 4.3)

6. **SCULPTURE** You are constructing a wooden sculpture for an art class. You cut a triangle from a larger piece of wood as shown below. The coordinates given are measured in inches. Find the area of the triangle. (Lesson 4.3)
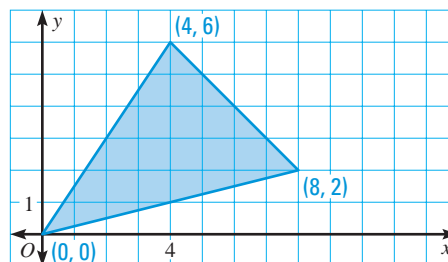
CRYPTOGRAPHY **In Exercises 7–9, use the code below. A blank space is represented by the number 0.** (Lesson 4.4)

|				
E = 7	H = 3	M = 10	N = 8	O = 2
P = 9	R = 5	U = 1	V = 4	Y = 6

7. Convert the message HURRY UP to row matrices.

8. Use matrix A below to encode the message HURRY UP.

$$A = \begin{bmatrix} -2 & -1 \\ 1 & 1 \end{bmatrix}$$

9. Use the inverse of the matrix A to decode the following message.

$$-18, -8, -1, 3, 2, 2, -16, -8$$

10. **COINS** In a collection of nickels and dimes, there are 115 coins. The total value of the coins is $8.25. Use an inverse matrix to determine how many nickels and how many dimes are in the collection. (Lesson 4.5)

11. **BANQUET HALL** A banquet hall contains square, hexagonal, and octagonal tables. There are a total of 12 tables, and no table has an empty seat. Square tables seat 4 people, hexagonal tables seat 6 people, and octagonal tables seat 8 people. The number of square tables is two less than the total number of octagonal and hexagonal tables. There are 68 people at the banquet. Use an inverse matrix and a graphing calculator to find the number of tables of each size. (Lesson 4.5)

CHAPTER 5

1. **CABLES** A cable is suspended between the tops of two poles that are both 12 feet tall. The cable forms a parabola modeled by the equation $y = \frac{4}{625}(x - 25)^2 + 8$ where x and y are measured in feet. Use a graph to find the distance between the two poles. **(Lesson 5.1)**

2. **PICTURE FRAME** You are making a frame for a picture that is 3 inches by 4 inches. You have 18 square inches of material for the frame. You want all sides of the frame to have the same width. What should the width of the frame be? **(Lesson 5.2)**
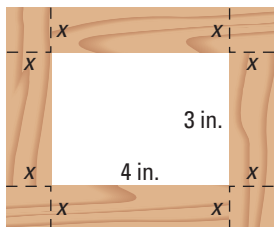
3. **FALLING OBJECT** A button accidentally falls off of a shirtsleeve and drops from the top of a building that is 784 feet tall. How many seconds will it take for the button to hit the ground? **(Lesson 5.3)**

ELECTRICAL CIRCUITS In Exercises 4 and 5, use the following information. (Lesson 5.4) The resistance to the flow of electrical current in a circuit is called *impedance*. The equation $V = IZ$ relates the voltage of a circuit V (in volts) to the impedance Z (in ohms) and the current I (in amperes).

4. The current of a circuit is $6 + 3i$ amperes, and the impedance is $5 - 2i$ ohms. What is the voltage of the circuit?

5. What is the impedance for a current of $8 + 4i$ amperes in a 120 volt circuit? Write your answer in standard form.

6. **COMPANY PROFITS** The profits of a company from 1992 to 2001 can be modeled by $P = 100t^2 - 20t + 55,000$ where t is the number of years since 1992. Predict the year in which the profits of the company will be $69,160. **(Lesson 5.5)**

7. **TENNIS** You throw a tennis ball into the air in order to serve the ball. The tennis ball leaves your hand 6 feet above the ground and has an initial velocity of 50 feet per second. You hit the ball when it falls back to a height of 7 feet. For how long was the ball in the air? **(Lesson 5.6)**

8. **WEB TRAFFIC** The number of visitors to a certain Web site increases weekly. A Web site monitor develops the formula $\frac{T}{1000} = d^2 - 8d + 32$ for the average number of visitors T in week d of the Web site's first year. During what week will the average number of visitors reach 50,000? **(Lesson 5.6)**

9. **POTTERY** You are making a cylindrical clay pencil holder. So that you have enough space to paint the outside of the pencil holder, you want the outer surface area to be at least 35 square inches. You want the height of the pencil holder to be 4 inches. What values can you use for the radius of the pencil holder? (*Hint:* Because the pencil holder has no lid, include the area of only one base in your calculation of the surface area.) **(Lesson 5.7)**

SCHOOL ENROLLMENT In Exercises 10 and 11, use the following information. (Lesson 5.8) The table below gives the annual enrollment E at a school t years after 1990.

t	1	2	3	4	5	6
E	525	492	498	521	534	582

10. Make a scatter plot of the data and draw the parabola you think best fits the data.

11. Write and solve a system of linear equations to find a quadratic model for the data.

CHAPTER 6

1. **ASTRONOMY** The radius of Mars is about one half the radius of Earth. What fraction of Earth's volume is Mars's volume? **(Lesson 6.1)**

2. **ASTRONOMY** The distance from Neptune to Earth is about 4.3×10^9 kilometers. The distance from Mars to Earth is about 5.5×10^7 kilometers. About how many times farther is Neptune from Earth than Mars is from Earth? **(Lesson 6.1)**

3. **MOVIES** The monthly revenue R (in millions of dollars) earned by a certain movie from January 2002 to September 2002 can be modeled by

$$R = 0.025t^3 - t^2 + 7t + 14$$

where t is the number of months since January 2002. What was the monthly revenue in April 2002? **(Lesson 6.2)**

4. **SCHOOL POPULATION** The number of students in each class in a high school from 1995 to 2000 can be modeled by

Freshman: $y = x^2 + 2x + 97$

Sophomore: $y = x^2 + 3x + 77$

Junior: $y = x^2 + x + 81$

Senior: $y = x^2 + x + 43$

where x is the number of students and y is the number of years since 1995. Find a model for the total number of students in the high school. **(Lesson 6.3)**

5. **GIFT BOXES** A department store purchases gift boxes that each have a volume of 256 cubic inches. The width of each box is 4 inches less than the length. The height is twice the width. Find the dimensions of a gift box. **(Lesson 6.4)**

6. **ORANGE GROVE** The area A (in square feet) and the length L (in feet) of a rectangular orange grove can be modeled by

$$A = 1.5x^2 + 36x \quad \text{and} \quad L = x + 24$$

where x is the number of orange trees in the grove. Find a model for the width of the orange grove. **(Lesson 6.5)**

7. **ICE SCULPTURE** As part of an ice sculpture, an artist wants to build an ice cone that has a volume of 24π cubic feet. The artist wants the height of the cone to be 2 feet longer than the diameter of the base. What should the diameter and the height of the cone be? **(Lesson 6.6)**
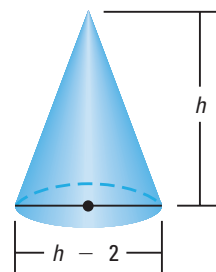
8. **BODY TEMPERATURE** Suppose a patient's body temperature T (in degrees Fahrenheit) during a viral infection can be modeled by

$$T = -0.001x^3 - 0.1x + 103$$

where x is the number of days since the infection began. After about how many days does the patient's temperature drop to $100°F$? **(Lesson 6.7)**

9. **COAT SALES** The number of coats sold at a department store during one year can be modeled by

$$f(x) = 0.627x^3 - 6.32x^2 - 4.06x + 125$$

where x is the number of months and $x = 1$ represents January. In what month were sales at a minimum? **(Lesson 6.8)**

10. **SALARIES** The table shows the salary y (in thousands of dollars) of a bank employee between 1993 and 2002. Find a polynomial model for the data. Then predict the employee's salary in 2005. **(Lesson 6.9)**

t	1993	1994	1995	1996	1997
y	33	38	43	46	48
t	1998	1999	2000	2001	2002
y	49	49	50	55	56

CHAPTER 7

1. **ASTRONOMY** Phoebe is a satellite that orbits Saturn. Phoebe is roughly spherical in shape and has a volume of approximately 5,580,000 cubic kilometers. The formula for the volume of a sphere is $V = \frac{4}{3}\pi r^3$ where r is the radius of the sphere. Find the approximate radius of Phoebe. **(Lesson 7.1)**

**BIOLOGY In Exercises 2 and 3, use the following information. (Lesson 7.2)**
The surface area S (in square centimeters) of a large dog's body can be approximated by the model $S = 11.2m^{2/3}$ where m is the mass (in grams) of the dog.

2. Approximate the surface area of a dog that has a mass of 9 kilograms (9×10^3 grams).

3. Dog A has a mass that is 5 times the mass of dog B. What is the ratio of the surface area of dog A to the surface area of dog B?

GEOMETRY In Exercises 4 and 5, use the following information. (Lesson 7.3)
The functions below show how the circumference c (in centimeters) of a circle is related to the radius of the circle r (in centimeters), and how the area a (in square centimeters) of the rectangle is related to c.

$$c(r) = 2\pi r \qquad a(c) = \frac{c^2}{2}$$
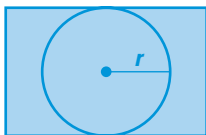
4. Use composition of functions to find the relationship between the radius of the circle and the area of the rectangle.

5. Find the area of the rectangle when the radius of the circle is 5 centimeters.

6. **WIND POWER** The power of wind W (in watts per square meter) can be modeled by the function $W = 0.6125s^3$ where s is the wind's speed (in meters per second). Find the inverse of the function. Then find the speed of wind with a power of 132.3 watts per square meter. **(Lesson 7.4)**

7. **FREE FALL** The time t (in seconds) it takes a dropped object to reach the ground can be modeled by $t = \frac{1}{4}\sqrt{h}$ where h is the height (in feet) from which the object is dropped. Graph the model. Then determine from what height you must drop an object so that it falls for 1.5 seconds. **(Lesson 7.5)**

8. **PENDULUMS** The period of a pendulum is the time it takes the pendulum to complete one swing. The period p (in seconds) can be modeled by $p = 2\pi\sqrt{\dfrac{l}{32}}$ where l is the pendulum's length (in feet). What is the length of a pendulum with a period of 3 seconds? **(Lesson 7.6)**

9. **SHIP POWER** The power p (in horsepower) that a ship needs can be modeled by $p = \dfrac{d^{2/3} \cdot s^3}{c}$ where d is the ship's displacement (in tons), s is the normal speed (in knots), and c is the Admiralty coefficient. A ship's power is 81,000 horsepower, its normal speed is 30 knots, and its Admiralty coefficient is 300. What is the ship's displacement? **(Lesson 7.6)**

BASEBALL In Exercises 10 and 11, use the table below which gives the home run totals of fourteen Major League Baseball teams for the 2002 season. (Lesson 7.7)

Team Home Run Totals (2002 Season)
165, 152, 164, 177, 200, 223, 146, 205, 139, 198, 152, 175, 165, 152

10. Find the mean, median, and mode of the data.

11. Find the standard deviation of the data.

12. **REPTILES** The table below shows the numbers of threatened reptile species in countries of Central America, South America, and the Caribbean. Draw a box-and-whisker plot of the data set. **(Lesson 7.7)**

Threatened Reptile Species
5, 7, 7, 10, 6, 9, 6, 7, 8, 18, 7, 7, 5, 5, 3, 15, 1, 15, 12, 8, 3, 9, 6, 0, 14

CHAPTER 8

1. **ACCOUNT BALANCE** You deposit $2000 in an account that pays 5% annual interest. Find the balance after 3 years if the interest is compounded quarterly. **(Lesson 8.1)**

2. **POPULATION** The population of a certain town increases by about 2% each year. If the population of the town is 3560 in 2002, predict the population in 2006. **(Lesson 8.1)**

SAILBOATS In Exercises 3–5, use the following information. **(Lesson 8.2)**
You buy a new sailboat for $15,000. The value of the boat decreases by 11% each year.

3. Write an exponential decay model for the value of the sailboat. Use the model to determine the value after 5 years.

4. Graph the model.

5. Use the graph to estimate when the sailboat will have a value of about $10,000.

6. **CONTINUOUS COMPOUNDING** You deposit $1800 in bank A that pays 6% annual interest compounded continuously and deposit $1200 in bank B that pays 8% annual interest compounded continuously. What is the balance of each account after 10 years? **(Lesson 8.3)**

7. **HURRICANES** Once a hurricane reaches land, the wind speed s (in knots) within the hurricane is related to the time t (in hours) the hurricane remains over land. For one particular hurricane, this relationship is given by:

$$s = -57.1 \log t + 121$$

Graph the model. About how long after the hurricane reached land was the wind speed about 60 knots? **(Lesson 8.4)**

8. **PH MEASUREMENT** The pH of a solution is given by

$$pH = -\log[H^+]$$

where $[H^+]$ is the solution's hydrogen ion concentration (in moles per liter). Find the pH of a solution whose hydrogen ion concentration is 1×10^{-7} mole per liter. **(Lesson 8.4)**

9. **SOUND INTENSITY** The loudness L (in decibels) produced by a sound is related to the intensity I of the sound (in watts per square meter) by the equation

$$L = 10 \log \frac{I}{I_0}$$

where I_0 is an intensity of 10^{-12} watt per square meter, the faintest sound that can be heard by humans. Use the equation to find the difference in the loudness of a hair dryer with an intensity of 10^{-4} watt per square meter and an air conditioning unit with an intensity of 10^{-6} watt per square meter. **(Lesson 8.5)**

10. **RADIOACTIVE DECAY** You have 30 grams of cobalt-60 that decays 12% per year. How many years will it take for half the original amount to decay? **(Lesson 8.6)**

BASEBALL In Exercises 11 and 12, use the following information. **(Lesson 8.7)**
The table gives the average salary S (in millions of dollars) of a professional baseball player from 1998 to 2002 where t is the number of years since 1998.

t	0	1	2	3	4
S	1.441	1.720	1.988	2.264	2.383

11. Draw a scatter plot of ln S versus t. Is an exponential model a good fit for the original data?

12. Find an exponential model for the original data.

13. **CHILD DEVELOPMENT** For the first 36 months of life, the body weight W (in pounds) of male babies in the 50th percentile (the median weight for all male babies) can be modeled by

$$W = \frac{30.4}{1 + 1.99e^{-0.144t}}$$

where t is the number of months since birth. Graph the model. At about what age will a male baby in the 50th percentile weigh 20 pounds? **(Lesson 8.8)**

CHAPTER 9

GAS LAWS In Exercises 1 and 2, use the following information. **(Lesson 9.1)**
According to Boyle's Law, the volume V of a gas varies inversely with the pressure P of a gas, as long as the temperature of the gas remains constant. According to Charles's Law, the volume V of a gas varies directly with the absolute temperature T of the gas (in kelvins), as long as the pressure of the gas remains constant.

1. Write an equation relating V, P, and a constant k when temperature is constant. Find the value of k for 3.1 cubic meters of a gas at a pressure of 1.3 atmospheres.

2. Write an equation that that relates V, T, and a constant k when pressure is constant. Find the value of k for 4.8 liters of a gas at a temperature of 320 kelvins.

INTERNET SERVICE In Exercises 3 and 4, use the advertisement shown below. **(Lesson 9.2)**

> **Low Cost Internet Access**
> Low monthly fee of $8.
> Just $.40 per hour of high-speed access.
> Order NOW!

3. Write a model that represents the average cost per hour of Internet access as a function of the number of hours of use. Graph the model.

4. A second Internet provider offers service for $1 per hour of access with no monthly fee. If you subscribe to the plan in the advertisement above, how many hours of Internet access would you have to use to make your average cost per hour less than $1?

5. PACKAGING A packaging company has been asked to design a box that has a volume of 100 cubic inches. The length of the box must be twice the width of the box. Find the dimensions of the box that minimize the material needed to make the box. **(Lesson 9.3)**
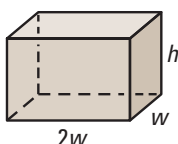

EDUCATION COSTS In Exercises 6 and 7, use the following information. **(Lesson 9.4)**
In one city from the 1990–91 school year through the 2001–02 school year, the number of students S and the cost of education per student C (in dollars) can be modeled by

$$S = \frac{50t + 9000}{0.005t + 1} \quad \text{and} \quad C = \frac{12t + 6300}{0.003t^2 + 1}$$

where t is the number of years since the 1990–91 school year.

6. Write a model for the total cost of education for students in the city.

7. What was the total cost of education for students in the 1996–97 school year?

8. GEOMETRY Use the diagram below. Find the ratio of the volume of the square pyramid to the volume of the inscribed cone. Write your answer in simplified form. **(Lesson 9.4)**
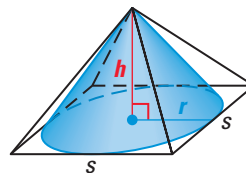
**RESISTANCE** In Exercises 9 and 10, use the following information. **(Lesson 9.5)**
Four resistors in a parallel circuit have resistances R_1, R_2, R_3, and R_4 (all in ohms). The total resistance R_t (in ohms) is given by this formula:

$$R_t = \frac{1}{\dfrac{1}{R_t} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + \dfrac{1}{R_4}}$$

9. Simplify the complex fraction.

10. You have four resistors in a parallel circuit with resistances 5 ohms, 8 ohms, 15 ohms, and 12 ohms. What is the total resistance?

11. BASEBALL An Earned Run Average (ERA) is the average number of earned runs a pitcher gives up in 9 innings of baseball. ERA is nine times the number of earned runs divided by the number of innings pitched. If a pitcher has given up 20 runs in 80 innings, how many more innings must he pitch without giving up a run in order to have an ERA of 2.00? **(Lesson 9.6)**

CHAPTER 10

1. **WALKING** You plan to walk along a path at a local park. Quadrilateral *ABCD* represents the path that you plan to follow. Find the length of the path. Two units in the coordinate plane represent 1 mile. **(Lesson 10.1)**
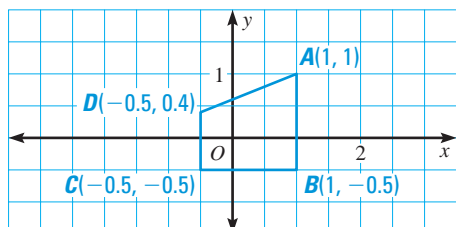
2. **RADIO TELESCOPES** A radio telescope is a large dish that astronomers use to collect data from space. The cross section of a radio telescope dish is a parabola. The receiver is located at the focus, 6.125 meters above the vertex. Find an equation for the cross section of the telescope dish. (Assume the vertex is at the origin.) If the dish is 14 meters wide, how deep is it? **(Lesson 10.2)**

SCHOOL BUS ROUTES In Exercises 3 and 4, use the following information. **(Lesson 10.3)**
Students living within 1 mile of the high school in your town are not eligible to ride a school bus to school.

3. Write an inequality to describe the region for which students are not eligible to ride a school bus. Let (0, 0) represent the location of the high school.

4. Your house is located 1.5 miles east and 1 mile south of the school. Tell whether you are eligible to ride a school bus to school.

5. **SPRINKLERS** A lawn sprinkler waters a circular region of grass with an area of 2000 square feet. Write an equation that represents the boundary of the watered region of grass. Let (0, 0) represent the location of the sprinkler. **(Lesson 10.3)**

6. **PLANETARY ORBITS** In its elliptical orbit, Mars ranges from 206.6 million kilometers to 249.2 million kilometers from the center of the sun. The center of the sun is a focus of the orbit. Write an equation of the orbit. **(Lesson 10.4)**

COFFEE TABLES In Exercises 7–9, use the following information. **(Lesson 10.4)**
The surface of a coffee table is shaped like an ellipse. It is 20 inches wide and 40 inches long.

7. Write an equation that models the shape of the surface of the coffee table.

8. How far apart are the two foci?

9. The area of an ellipse is given by the formula $A = \pi ab$. What is the area of the surface of the table?

HOURGLASSES In Exercises 10 and 11, use the following information. **(Lesson 10.5)**
The diagram below shows the hyperbolic cross section of an hourglass. Each unit in the coordinate plane represents 1 inch.
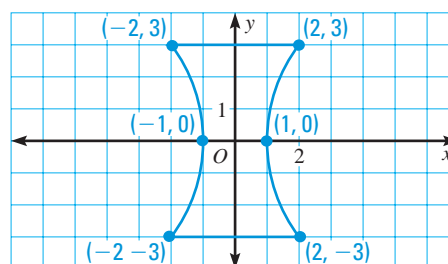
10. Write an equation that models the curved sides of the hourglass.

11. At a height of 1.5 inches, how wide is the hourglass?

12. **AIRCRAFT ALTITUDES** The KC-135 is an aircraft that flies in arcs to produce a weightless environment. At the top of each arc, passengers experience about 25 seconds of weightlessness. The altitude y, in feet, of the aircraft during part of an arc after x seconds can be modeled by the equation $15x^2 - 923x + y - 18,659 = 0$. What type of conic is it? **(Lesson 10.6)**

13. **COMMUNICATIONS** The range (in miles) of a cellular telephone tower is bounded by a circle given by the equation $x^2 + y^2 = 178$. A straight highway can be modeled by the equation $y = x + 10$. Find the length of the highway that lies within the range of the cellular telephone tower. **(Lesson 10.7)**

CHAPTER 11

1. **ANGLE MEASURES** The degree measure d_n of an interior angle of a regular polygon with n sides is given by:

$$d_n = \frac{180(n - 2)}{n}, n \geq 3$$

Copy and complete the table below using the terms of the sequence. **(Lesson 11.1)**

Regular polygon	Number of sides (n)	Interior angle measure
triangle	?	?
quadrilateral	?	?
pentagon	?	?
hexagon	?	?
heptagon	?	?
octagon	?	?

AUDITORIUM In Exercises 2–5, use the following information. **(Lesson 11.2)**
An auditorium has 25 rows of seats. There are 16 seats in the first row, and each row after the first has 4 more seats than the row before it.

2. Write a rule for the number of seats in the nth row.

3. A group of 40 people want to sit in the same row. How close to the front can they sit?

4. What is the total number of seats in the auditorium?

5. During a renovation, 8 rows of seats are added to the back of the auditorium. (Each row has 4 more seats than the row before it.) How many additional seats are added?

AUDITIONS In Exercises 6 and 7, use the following information. **(Lesson 11.3)**
Several rounds of auditions are being held to cast the three main parts in a musical production. There were 3072 actors at the first round of auditions. In each successive round of auditions, one fourth of the actors from the previous round remain.

6. Find a rule for the number of actors in the nth round of auditions.

7. For what values of n does your rule make sense?

BACTERIA In Exercises 8 and 9, use the following information. **(Lesson 11.3)**
The number of bacteria in a petri dish doubles each hour. Initially there are 2.4×10^{18} bacteria in the petri dish.

8. Find a rule for the total number of bacteria after n hours.

9. Find the total number of bacteria in the dish after 8 hours. Write your answer in scientific notation.

BOUNCING BALL In Exercises 10 and 11, use the following information. **(Lesson 11.4)**
A ball drops from a height of 12 feet. Each time it hits the ground, it bounces to 70% of its previous height.

12 ft

8.4 ft
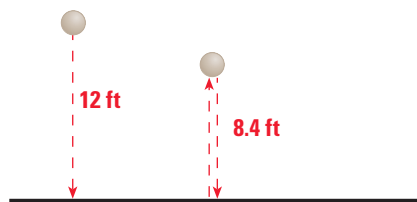
10. Find the total distance traveled by the ball.

11. On which bounce will the ball have traveled 90% of its total distance?

12. **DOG POPULATION** A town's dog population increases at a rate of about 4% per year. In 2000, there were a total of 1050 dogs in the town. Let $n = 1$ represent the dog population in 2000. Write an explicit and a recursive rule for the town's dog population in terms of the year. **(Lesson 11.5)**

SAVING MONEY In Exercises 13 and 14, use the following information. **(Lesson 11.5)**
You keep $120 in a jar in your room. Each week, you allow yourself to spend 5% of the money in the jar. You also add $5 to the jar every week.

13. Write a recursive rule for the amount of money in the jar after n weeks. How much money is in the jar after 10 weeks?

14. Use a graphing calculator to determine what happens to the amount of money in the jar over time.

CHAPTER 12

BANKING In Exercises 1 and 2, use the following information. **(Lesson 12.1)**
You are given a random four-digit personal identification number (PIN) to use with your bank card. Each of the digits is a whole number from 0 to 9.

1. How many different four-digit PINs are possible if the digits can be repeated?

2. How many different four-digit PINs are possible if the digits cannot be repeated?

MUSIC In Exercises 3 and 4, decide whether the problem requires permutations or combinations to find the answer. Then solve the problem. **(Lessons 12.1, 12.2)**

3. There are 15 school bands participating in a competition. In how many ways can first, second, and third places be awarded?

4. You want to buy 9 CDs at a music store. However, you have enough money for only 3 CDs. In how many ways can you select 3 of the CDs to buy?

5. GEOMETRY The target below is a circle enclosed by a rectangle. Find the probability that a dart thrown at the target will hit the shaded region. Assume that the dart is equally likely to hit any point inside the target. **(Lesson 12.3)**
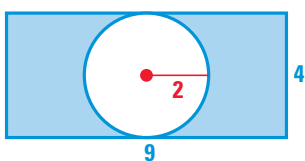
CHOOSING CARDS In Exercises 6–9, a card is randomly drawn from a standard 52-card deck. Find the probability of the event. **(Lesson 12.4)**

6. a four or a nine

7. a five or a diamond

8. a seven and a heart

9. a club or a heart

STUDENTS In Exercises 10 and 11, use the table below, which shows the male and female students at a school. **(Lesson 12.5)**

	Male	Female
Freshman	97	103
Sophomore	92	84
Junior	95	93
Senior	93	97

10. Find the probability that a randomly selected student is a freshman.

11. Find the probability that a randomly selected junior is a male student.

12. SOCKS A drawer contains 11 pairs of white socks and 9 pairs of gray socks. You randomly select 3 pairs of socks from the drawer. Find the probability that the 3 pairs that you selected are white. **(Lesson 12.5)**

TESTS In Exercises 13 and 14, use the following information. **(Lesson 12.6)**
Your chemistry test has 6 multiple choice questions, and each question has 4 choices. Suppose you randomly select the answer to each multiple choice question. Assume that the probability of answering a multiple choice question correctly is 0.25.

13. Draw a histogram of the binomial distribution for the number of multiple choice questions answered correctly.

**14.** What is the probability of answering at least 4 of the multiple choice questions correctly?

GARDENS In Exercises 15 and 16, use the following information. **(Lesson 12.7)**
The heights of the day lilies in a garden are normally distributed with a mean of 33 inches and a standard deviation of 3 inches.

15. What percent of the day lilies have heights between 27 inches and 36 inches?

16. You randomly select two day lilies in the garden. What is the probability that the day lilies have a height of 30 inches or less?

CHAPTER 13

1. **ESCALATORS** An escalator connects two levels of a shopping mall. The escalator rises 66 feet at a 30° angle, as shown below. Find the distance d that a person travels on the escalator. **(Lesson 13.1)**
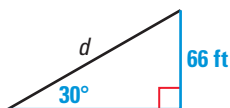

2. **FERRIS WHEELS** A Ferris wheel with a radius of 83 feet takes 40 seconds to complete one rotation. After you ride the Ferris wheel for 54 seconds, it stops to let more passengers on. Through what angle did you rotate? Give the answer in both degrees and radians. **(Lesson 13.2)**

FOOTBALL **In Exercises 3–5, use the following information.** **(Lesson 13.3)**
The horizontal distance d (in feet) traveled by a projectile with an initial speed v (in feet per second) is given by $d = \frac{v^2}{32} \sin 2\theta$, where θ is the angle at which the projectile is launched.

3. Estimate the horizontal distance traveled by a football that is kicked at an angle of 60° with an initial speed of 62 feet per second.

4. Estimate the horizontal distance traveled by a football that is kicked at an angle of 45° with an initial speed of 70 feet per second.

5. Estimate the horizontal distance traveled by a football that is kicked at an angle of 55° with an initial speed of 50 feet per second.

6. **WHEAT** Different types of granular substances naturally settle at different angles when stored in cone-shaped piles. The angle θ is called the angle of repose. The diagram below shows granular wheat stored in a cone-shaped pile. Find the angle of repose. **(Lesson 13.4)**
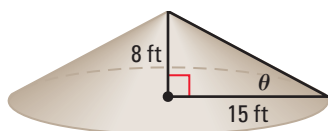
7. **LOCATING A FIRE** Two fire towers A and B are located 12 miles apart, as shown below. Use the information in the diagram to find the distance of the fire from each tower. **(Lesson 13.5)**
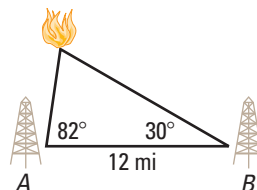
8. **LONG JUMP** The diagram below shows the position of a jumper's leg at the take off phase of a long jump. The angle θ of the jumper's knee at the take off phase should be between 165° and 170°. Is the angle of the jumper's knee in this range? Explain. **(Lesson 13.6)**
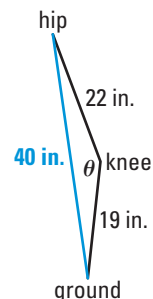
9. **GARDENS** A triangular garden has side lengths that are 12 feet, 9 feet, and 5 feet long. Find the area of the garden. **(Lesson 13.6)**

MARBLE ROLLER COASTER **In Exercises 10 and 11, use the following information.** **(Lesson 13.7)**
Your physics class is constructing a marble roller coaster. At the end of the track, the marble should project off a jump and land in a cup. Suppose the marble is projected with an initial speed of 14 feet per second, at an angle of 55°, and from an initial height of 0.8 feet.

10. Write a set of parametric equations for the motion of the marble.

11. Use the equations from Exercise 10 to find how far from the jump to place the cup.

CHAPTER 14

1. **MERRY-GO-ROUND** A wooden horse on a merry-go-round moves 6 inches above and 6 inches below its center position. It takes the horse 3 seconds to make 1 complete up-and-down movement. The motion of the horse can be modeled by the function

$$d = 6 \sin \frac{2}{3}\pi t$$

   where d is the vertical displacement (in inches) of the horse relative to its center position and t is the time (in seconds). Graph the function over a 12 second time interval. **(Lesson 14.1)**

2. **BICYCLE** You put a reflector on the spoke of your bicycle wheel. As you ride the bicycle, the reflector's height h (in inches) above the ground is $h = 13.5 + 13.5 \sin 2\pi t$, where t is the time (in seconds). Graph the height of the reflector as a function of time. **(Lesson 14.2)**

reflector
h
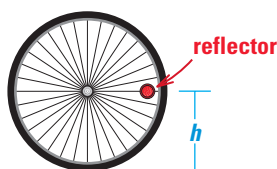
3. **ELEVATOR** You stand 25 meters away from a glass elevator that descends from 50 meters above the ground. Write and graph a model for the distance d (in meters) that the elevator has descended as a function of its angle of elevation θ. **(Lesson 14.2)**

elevator
d
$50 - d$
you
θ
25 m
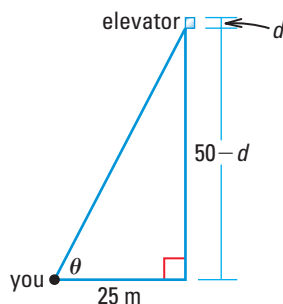
4. **RUNNING** The path a runner takes around a lake can be described by the equations $y = \frac{1}{2} \sin 2\pi t$ and $x = \cos 2\pi t$, where x and y are measured in feet and t is measured in hours. Describe the path followed by the runner. **(Lesson 14.3)**

5. **POSITION OF THE SUN** Houston, Texas, has a latitude of 30°N. At this latitude, the position of the sun at sunrise can be modeled by

$$D = 27 \sin \left(\frac{2\pi}{365}t - 1.3 \right)$$

   where t is the time in days and $t = 1$ represents January 1. In this model, D represents the number of degrees north of due east that the sun rises. Use a graphing calculator to determine the days that the sun is more than 23° north of due east at sunrise in Houston, Texas. **(Lesson 14.4)**

6. **SNOWFALL** The table below gives the average snowfall S (in inches) for each month m at Mount Washington in New Hampshire, with $m = 1$ representing January. Find a model for the data. **(Lesson 14.5)**

m	1	2	3	4	5	6
S	40.1	40.7	42.5	30.9	10.3	1.2
m	7	8	9	10	11	12
S	0	0.1	1.9	11.8	40.4	42.6

7. **REFRACTION** A beam of light passes through water at an angle of $\frac{\pi}{2}$ radians. The light then passes through oil at an angle α radians more than $\frac{\pi}{2}$. The refraction index of water N_1 is 1.33. The refraction index of oil N_2 is 1.51. The refraction index of the oil and water are related to the angle of the light beam by the equation $N_1 \sin \frac{\pi}{2} = N_2 \sin \left(\frac{\pi}{2} + \alpha \right)$. Simplify the equation and find the value of α. **(Lesson 14.6)**

8. **WINDOW** Express the area of the triangular window as a function of $\sin \frac{\theta}{2}$ and $\cos \frac{\theta}{2}$. Simplify the function. Then solve for θ assuming that the area is 200 square inches. **(Lesson 14.7)**

θ
24 in.   24 in.