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1. In 1999, cigarette consumption in the U.S. was 125 packs per capita. This rate of consumption was $\frac{5}{8}$ of what it was in 1980. Find the rate of consumption in 1980.
2. Freeport McMoRan projects that in 2010 world grain supply will be 1.8 trillion metric tons and the supply will be only $\frac{3}{4}$ of world grain demand. What will world grain demand be in 2010?
3. On Thursday, 13/25 of the stocks traded on the New York Stock Exchange advanced in price. If 1495 stocks advanced, then how many stocks were traded on that day?
4. In 1996, $\frac{23}{50}$ of all accidental deaths in the U.S. were the result of automobile accidents (National Center for Health Statistics, www.nchs.gov). If there were 43,194 deaths due to automobile accidents, then how many accidental deaths were there in 1996?
5. A lawyer charges \$300 plus \$65 per hour for a divorce. If the total charge for Bill's divorce was \$1405, then for what number of hours did the lawyer work on the case?
6. A plumber charges \$45 plus \$26 per hour to unclog drains. If the bill for unclogging Tamika's drain was \$123, then for how many hours did the plumber work?
7. If the air temperature in Quebec is 68° Fahrenheit, then the solution to the equation $\frac{9}{5}C + 32 = 68$ gives the Celsius temperature of the air. Find the Celsius temperature.
8. If a rectangular patio has a length that is 3 feet longer than its width and a perimeter of 42 feet, then the width can be found by solving the equation $2x + 2(x+3) = 42$. What is the width?
9. The perimeter of the triangle shown in the accompanying figure is 12 meters. Determine the values of x , $x + 1$, and $x + 2$ by solving the equation $x + (x + 1) + (x + 2) = 12$.
10. Jane paid 9% sales tax and a \$150 title and license fee when she bought her new Saturn for a total of \$16,009.50. If x represents the price of the car, then x satisfies $x + 0.09x + 150 = 16,009.50$. Find the price of the car by solving the equation.
11. An electrician charged Eunice \$29.96 for a service call plus \$39.96 per hour for a total of \$169.82 for installing her electric dryer. If n represents the number of hours for labor, then n satisfies $39.96n + 29.96 = 169.82$. Find n by solving this equation.
12. Danielle sold her house through an agent who charged 8% of the selling price. After the commission was paid, Danielle received \$117,760. If x is the selling price, then x satisfies $x - 0.08x = 117,760$. Solve this equation to find the selling price.
13. Before Roland sold two female rabbits, half of his rabbits were female. After the sale, only one-third of his rabbits were female. If x represents his original number of rabbits, then $\frac{1}{2}x - 2 = \frac{1}{3}(x - 2)$. Solve this equation to find the number of rabbits that he had before the sale.
14. Reginald overheard his boss complaining that his federal income tax for 2000 was \$34,276.
 - a) Use the accompanying graph to estimate his boss's taxable income for 2000.
 - b) Find his boss's exact taxable income for 2000 by solving the equation $23,965.5 + 0.31(x - 105,950) = 34,276$

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15. According to Bruce Harrell, CPA, the federal income tax for a class C corporation is found by solving a linear equation. The reason for the equation is that the amount x of federal tax is deducted before the state tax is figured, and the amount of state tax is deducted before the federal tax is figured. To find the amount of federal tax for a corporation with a taxable income of \$200,000, for which the federal tax rate is 25% and the state tax rate is 10%, Bruce must solve $x = 0.25[200,000 - 0.10(200,000 - x)]$.
16. If the simple interest on \$5000 for 3 years is \$600, then what is the rate?
17. Wayne paid \$420 in simple interest on a loan of \$1000 for 7 years. What was the rate?
18. Kathy paid \$500 in simple interest on a loan of \$2500. If the annual interest rate was 5%, then what was the time?
19. Robert paid \$240 in simple interest on a loan of \$1000. If the annual interest rate was 8%, then what was the time?
20. The area of a rectangle is 28 square yards. The width is 4 yards. Find the length.
21. The area of a rectangle is 60 square feet. The length is 4 feet. Find the width.
22. If it takes 600 feet of wire fencing to fence a rectangular feed lot that has a width of 75 feet, then what is the length of the lot?
23. If it takes 500 feet of fencing to enclose a rectangular lot that is 104 feet wide, then how deep is the lot?
24. Find the original price if there is a 15% discount and the sale price is \$255.
25. Find the list price if there is a 12% discount and the sale price is \$4400.
26. Find the rate of discount if the discount is \$40 and the original price is \$200.
27. Find the rate of discount if the discount is \$20 and the original price is \$250.
28. The perimeter of a football field in the NFL, excluding the end zones, is 920 feet. How wide is the field?
29. If a picture frame is 16 inches by 20 inches, then what is its perimeter?
30. A rectangular box measures 2 feet wide, 3 feet long, and 4 feet deep. What is its volume?
31. The volume of a rectangular refrigerator is 20 cubic feet. If the top measures 2 feet by 2.5 feet, then what is the height?
32. If the circumference of a pizza is 8π inches, then what is the radius?
33. If the circumference of a circle is 4π meters, then what is the diameter?
34. If a banner in the shape of a triangle has an area of 16 square feet with a base of 4 feet, then what is the height of the banner?

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35. If a right triangle has an area of 14 square meters and one leg is 4 meters in length, then what is the length of the other leg?
36. A trapezoid with height 20 inches and lower base 8 inches has an area of 200 square inches. What is the length of its upper base?
37. The end of a flower box forms the shape of a trapezoid. The area of the trapezoid is 300 square centimeters. The bases are 16 centimeters and 24 centimeters in length. Find the height.
38. Doctors often prescribe the same drugs for children as they do for adults. The formula $d=0.08aD$ (Fried's rule) is used to calculate the child's dosage d , where a is the child's age and D is the adult dosage. If a doctor prescribes 1000 milligrams of acetaminophen for an adult, then how many milligrams would the doctor prescribe for an eight-year-old child? Use the bar graph to determine the age at which a child would get the same dosage as an adult.

39. Cowling's rule is another method for determining the dosage of a drug to prescribe to a child. For this rule, the formula

$$d = \frac{D(a+1)}{24}$$

gives the child's dosage d , where D is the adult dosage and a is the age of the child in years. If the adult dosage of a drug is 600 milligrams and a doctor uses this formula to determine that a child's dosage is 200 milligrams, then how old is the child?

40. A patient is to receive 750 mg of the antibiotic Vancomycin. However, Vancomycin comes in a solution containing 1 gram (available dose) of Vancomycin per 5 milliliters (quantity) of solution. Use the formula

$$\text{Amount} = \frac{\text{desired dose}}{\text{available dose}} \times \text{quantity}$$

to find the amount to find the amount of this solution that should be administered to the patient.

41. The global investment in telecom infrastructure since 1990 can be modeled by the formula $I = 7.5t + 115$ where I is in billions of dollars and t is the number of years since 1990 (Fortune, September 8, 1997). See the accompanying figure.
- Use the formula to find the global investment in 1994.
 - Use the formula to predict the global investment in 2001.
 - Find the year in which the global investment will reach \$250 billion.

42. A 2.4-meter sailboat is a one-person boat that is about 13 feet in length, has a displacement of about 550 pounds, and a sail area of about 81 square feet. To compete in the 2.4-meter class, a boat must satisfy the formula

$$2.4 = \frac{L + 2D - F\sqrt{S}}{2.37}$$

where L = length, F = freeboard, D = girth, and S = sail area. Solve the formula for L .

43. The distance, given that the rate is x miles per hour and the time is 3 hours
44. The distance, given that the rate is $x + 10$ miles per hour and the time is 5 hours
45. The discount, given that the rate is 25% and the original price is q dollars

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46. The discount, given that the rate is 10% and the original price is t yen
47. The time, given that the distance is x miles and the rate is 20 miles per hour
48. The rate, given that the distance is $x - 100$ meters and the time is 12 seconds
49. Two numbers differ by 6 and have a product of -9
50. Herman's house sold for x dollars. The real estate agent received 7% of the selling price, and Herman received \$84,532.
51. Gwen sold her car on consignment for x dollars. The saleswoman's commission was 10% of the selling price, and Gwen received \$6570.
52. What percent of 500 is 100?
53. What percent of 40 is 120?
54. The value of x nickels and $x + 2$ dimes is \$3.80.
55. The value of d dimes and $d - 3$ quarters is \$6.75.
56. The sum of three consecutive integers is 42.
57. The sum of three consecutive odd integers is 27.
58. The product of two consecutive integers is 182.
59. The product of two consecutive even integers is 168.
60. Twelve percent of Harriet's income is \$3000.
61. If 9% of the members buy tickets, then we will sell 252 tickets to this group.
62. Thirteen is 5% of what number?
63. Three hundred is 8% of what number?
64. The length of a rectangle is 5 feet longer than the width, and the area is 126 square feet.
65. The length of a rectangle is 1 yard shorter than twice the width, and the perimeter is 298 yards.
66. The value of n nickels and $n - 1$ dimes is 95 cents.
67. The value of q quarters, $q + 1$ dimes, and $2q$ nickels is 90 cents.
68. The measure of an angle is 38° smaller than the measure of its supplementary angle.
69. The measure of an angle is 16° larger than the measure of its complementary angle.
70. For a cardiovascular work out, fitness experts recommend that you reach your target heart rate and stay at that rate for at least 20 minutes (Cycling, Burkett and Darst). To find your target heart rate,

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find the sum of your age and your resting heart rate, then subtract that sum from 220. Find 60% of that result and add it to your resting heart rate.

- a) Write an equation with variable r expressing the fact that the target heart rate for 30-year-old Bob is 144.
 - b) Judging from the accompanying graph, does the target heart rate for a 30-year-old increase or decrease as the resting heart rate increases.
71. The saddle height on a bicycle should be 109% of the rider's inside leg measurement L (Cycling, Burkett and Darst). See the figure. Write an equation expressing the fact that the saddle height for Brenda is 36 in.
72. Find three consecutive integers whose sum is 141.
73. Find three consecutive even integers whose sum is 114.
74. Two consecutive odd integers have a sum of 152. What are the integers?
75. Four consecutive odd integers have a sum of 120. What are the integers?
76. Find four consecutive integers whose sum is 194.
77. If an Olympic swimming pool is twice as long as it is wide and the perimeter is 150 meters, then what are the length and width?
78. If the perimeter of a tennis court is 228 feet and the length is 6 feet longer than twice the width, then what are the length and width?
79. Julia framed an oil painting that her uncle gave her. The painting was 4 inches longer than it was wide, and it took 176 inches of frame molding. What were the dimensions of the picture?
80. Geraldo drove his truck from Indianapolis to Chicago, then to St. Louis, and then back to Indianapolis. He observed that the second side of his triangular route was 81 miles short of being twice as long as the first side and that the third side was 61 miles longer than the first side. If he traveled a total of 720 miles, then how long is each side of this triangular route?
81. A banner in the shape of an isosceles triangle has a base that is 5 inches shorter than either of the equal sides. If the perimeter of the banner is 34 inches, then what is the length of the equal sides?
82. Dr. Good's waiting room is 8 feet longer than it is wide. When Vincent wallpapered Dr. Good's waiting room, he used 88 feet of border paper. What are the dimensions of Dr. Good's waiting room?
83. A civil engineer is planning a highway overpass as shown in the figure. Find the degree measure of the angle marked w .
84. For the other side of the overpass, the engineer has drawn the plans shown in the figure. Find the degree measure of the angle marked z .
85. Bret drove for 4 hours on the freeway, then decreased his speed by 20 miles per hour and drove for 5 more hours on a country road. If his total trip was 485 miles, then what was his speed on the freeway?

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86. On Saturday morning, Lynn walked for 2 hours and then ran for 30 minutes. If she ran twice as fast as she walked and she covered 12 miles altogether, then how fast did she walk?
87. Kathryn drove her rig 5 hours before dawn and 6 hours after dawn. If her average speed was 5 miles per hour more in the dark and she covered 630 miles altogether, then what was her speed after dawn?
88. On Monday, Roger drove to work in 45 minutes. On Tuesday he averaged 12 miles per hour more, and it took him 9 minutes less to get to work. How far does he travel to work?
89. A jet flew at an average speed of 640 mph from Los Angeles to Chicago. Because of head winds the jet averaged only 512 mph on the return trip, and the return trip took 48 minutes longer. How many hours was the flight from Chicago to Los Angeles? How far is it from Chicago to Los Angeles?
90. Penny's bicycle trip from Colorado Springs to Pikes Peak took 1.5 hours longer than the return trip to Colorado Springs. If she averaged 6 mph on the way to Pikes Peak and 15 mph for the return trip, then how long was the ride from Colorado Springs to Pikes Peak?
91. The 1977 Super Bowl was played in the Rose Bowl in Pasadena. In that football game the Oakland Raiders scored 18 more points than the Minnesota Vikings. If the total number of points scored was 46, then what was the final score for the game?
92. Revenues for the top three companies in 1997, General Motors, Ford, and Exxon, totaled \$453 billion (Fortune 500 List, www.fortune.com). If Ford's revenue was \$31 billion greater than Exxon's, and General Motor's revenue was \$25 billion greater than Ford's, then what was the 1997 revenue for each company?
93. Before lunch, Sally drove from Idabel to Ardmore, averaging 50 mph. After lunch she continued on to Lawton, averaging 53 mph. If her driving time after lunch was 1 hour less than her driving time before lunch and the total trip was 256 miles, then how many hours did she drive before lunch? How far is it from Ardmore to Lawton?
94. On Monday, Chuck drove from Norfolk to Valentine, averaging 47 mph. On Tuesday, he continued on to Chadron, averaging 69 mph. His driving time on Monday was 2 hours longer than his driving time on Tuesday. If the total distance from Norfolk to Chadron is 326 miles, then how many hours did he drive on Monday? How far is it from Valentine to Chadron?
95. Joan Crawford, John Wayne, and James Stewart were born in consecutive years (Doubleday Almanac). Joan Crawford was the oldest of the three, and James Stewart was the youngest. In 1950, after all three had their birthdays, the sum of their ages was 129. In what years were they born?
96. Bob Hope was born 2 years after Clark Gable and 2 years before Henry Fonda (Doubleday Almanac). In 1951, after all three of them had their birthdays, the sum of their ages was 144. In what years were they born?
97. A carpenter used 30 ft of molding in three pieces to trim a garage door. If the long piece was 2 ft longer than twice the length of each shorter piece, then how long was each piece?
98. Clint is constructing two adjacent rectangular dog pens. Each pen will be three times as long as it is wide, and the pens will share a common long side. If Clint has 65 ft of fencing, what are the dimensions of each pen?

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99. At a 25% off sale, Jose saved \$80 on a 19-inch Panasonic TV. What was the original price of the television.
100. A 12% discount on a Giant Perigee saved Melanie \$46.68. What was the original price of the bike?
101. After getting a 20% discount, Robert paid \$320 for a Pioneer CD player for his car. What was the original price of the CD player?
102. After getting a 15% discount on the price of a new Chrysler Sebring convertible, Helen paid \$27,000. What was the original price of the convertible?
103. Kirk wants to get \$72,000 for his house. The real estate agent gets a commission equal to 10% of the selling price for selling the house. What should the selling price be?
104. Gene is selling his palomino at an auction. The auctioneer's commission is 10% of the selling price. If Gene still owes \$810 on the horse, then what must the horse sell for so that Gene can pay off his loan?
105. Merilee sells tomatoes at a roadside stand. Her total receipts including the 7% sales tax were \$462.24. What amount of sales tax did she collect?
106. Gwen bought a new Toyota Corolla. The selling price plus the 8% state sales tax was \$15,714. What was the selling price?
107. Wiley invested some money in the Berger 100 Fund and \$3000 more than that amount in the Berger 101 Fund. For the year he was in the fund, the 100 Fund paid 18% simple interest and the 101 Fund paid 15% simple interest. If the income from the two investments totaled \$3750 for one year, then how much did he invest in each fund?
108. Becky lent her brother some money at 8% simple interest, and she lent her sister twice as much at twice the interest rate. If she received a total of 20 cents interest, then how much did she lend to each of them?
109. David split his \$25,000 inheritance between Fidelity Short-Term Bond Fund with an annual yield of 5% and T. Rowe Price Tax-Free Short-Intermediate Fund with an annual yield of 4%. If his total income for one year on the two investments was \$1140, then how much did he invest in each fund?
110. Of the \$50,000 that Natasha pocketed on her last real estate deal, \$20,000 went to charity. She invested part of the remainder in Dreyfus New Leaders Fund with an annual yield of 16% and the rest in Templeton Growth Fund with an annual yield of 25%. If she made \$6060 on these investments in one year, then how much did she invest in each fund?
111. How many gallons of milk containing 1% butterfat must be mixed with 30 gallons of milk containing 3% butterfat to obtain a mixture containing 2% butterfat?
112. How many gallons of a 5% acid solution should be mixed with 30 gallons of a 10% acid solution to obtain a mixture that is 8% acid?
113. Gus has on hand a 5% alcohol solution and a 20% alcohol solution. He needs 30 liters of a 10% alcohol solution. How many liters of each solution should he mix together to obtain the 30 liters?

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114. Angela needs 20 quarts of 50% antifreeze solution in her radiator. She plans to obtain this by mixing some pure antifreeze with an appropriate amount of a 40% antifreeze solution. How many quarts of each should she use?
115. If 60% of the registered voters of Lancaster County voted in the November election and 33,420 votes were cast, then how many registered voters are there in Lancaster County?
116. **Tough on crime.** In a random sample of voters, 594 respondents said that they favored passage of a \$33 billion crime bill. If the number in favor of the crime bill was 45% of the number of voters in the sample, then how many voters were in the sample?
117. **Ford Taurus.** At an 8% sales tax rate, the sales tax on Peter's new Ford Taurus was \$1200. What was the price of the car?
118. **Taxpayer blues.** Last year, Faye paid 24% of her income to taxes. If she paid \$9600 in taxes, then what was her income?
119. **Making a profit.** A retail store buys shirts for \$8 and sells them for \$14. What percent increase is this?
120. **Monitoring AIDS.** If 28 new AIDS cases were reported in Landon County this year and 35 new cases were reported last year, then what percent decrease in new cases is this?
121. **High school integration.** Wilson High School has 400 students, of whom 20% are African American. The school board plans to merge Wilson High with Jefferson High. This one school will then have a student population that is 44% African American. If Jefferson currently has a student population that is 60% African American, then how many students are at Jefferson?
122. **Junior high integration.** The school board plans to merge two junior high schools into one school of 800 students in which 40% of the students will be Caucasian. One of the schools currently has 58% Caucasian students; the other has only 10% Caucasian students. How many students are in each of the two schools?
123. **Hospital capacity.** When Memorial Hospital is filled to capacity, it has 18 more people in semiprivate rooms (two patients to a room) than in private rooms. The room rates are \$200 per day for a private room and \$150 per day for a semiprivate room. If the total receipts for rooms is \$17,400 per day when all are full, then how many rooms of each type does the hospital have?
124. **Public relations.** Memorial Hospital is planning an advertising campaign. It costs the hospital \$3000 each time a television ad is aired and \$2000 each time a radio ad is aired. The administrator wants to air 60 more television ads than radio ads. If the total cost of airing the ads is \$580,000, then how many ads of each type will be aired?
125. **Mixed nuts.** Cashews sell for \$4.80 per pound, and pistachios sell for \$6.40 per pound. How many pounds of pistachios should be mixed with 20 pounds of cashews to get a mixture that sells for \$5.40 per pound?
126. **Premium blend.** Premium coffee sells for \$6.00 per pound, and regular coffee sells for \$4.00 per pound. How many pounds of each type of coffee should be blended to obtain 100 pounds of a blend that sells for \$4.64 per pound?

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127. **Nickels and dimes.** Candice paid her library fine with 10 coins consisting of nickels and dimes. If the fine was \$0.80, then how many of each type of coin did she use?
128. **Dimes and quarters.** Jeremy paid for his breakfast with 36 coins consisting of dimes and quarters. If the bill was \$4.50, then how many of each type of coin did he use?
129. **Cooking oil.** Crisco Canola Oil is 7% saturated fat. Crisco blends corn oil that is 14% saturated fat with Crisco Canola Oil to get Crisco Canola and Corn Oil, which is 11% saturated fat. How many gallons of corn oil must Crisco mix with 600 gallons of Crisco Canola Oil to get Crisco Canola and Corn Oil?
130. **Chocolate ripple.** The Delicious Chocolate Shop makes a dark chocolate that is 35% fat and a white chocolate that is 48% fat. How many kilograms of dark chocolate should be mixed with 50 kilograms of white chocolate to make a ripple blend that is 40% fat?
131. **Hawaiian Punch.** Hawaiian Punch is 10% fruit juice. How much water would you have to add to one gallon of Hawaiian Punch to get a drink that is 6% fruit juice?
132. **VCRs and CDs.** The manager of a stereo shop placed an order for \$10,710 worth of VCRs at \$120 each and CD players at \$150 each. If the number of VCRs she ordered was three times the number of CD players, then how many of each did she order?
133. **Car shopping.** Jennifer is shopping for a new car. In addition to the price of the car, there is an 8% sales tax and a \$172 title and license fee. If Jennifer decides that she will spend less than \$10,000 total, then what is the price range for the car?
134. **Sewing machines.** Charles wants to buy a sewing machine in a city with a 10% sales tax. He has at most \$700 to spend. In what price range should he look?
135. **Truck shopping.** Linda and Bob are shopping for a new truck in a city with a 9% sales tax. There is also an \$80 title and license fee to pay. They want to get a good truck and plan to spend at least \$10,000. What is the price range for the truck?
136. **Curly's contribution.** Larry, Curly, and Moe are going to buy their mother a color television set. Larry has a better job than Curly and agrees to contribute twice as much as Curly. Moe is unemployed and can spare only \$50. If the kind of television Mama wants costs at least \$600, then what is the price range for Curly's contribution?
137. **Renting a Mustang.** Hillary can rent a Ford Mustang from Alpha Car Rental for \$45 per day with no charge for miles. From Beta Car Rental she can get the same car for \$35 per day plus 25 cents per mile. For what number of daily miles is Beta cheaper?
138. **Renting a Cadillac.** George can rent a Cadillac from Gamma Car Rental for \$50 per day plus 35 cents per mile. He can get the same car from Delta Car Rental for \$35 per day plus 45 cents per mile. For what number of daily miles is Delta cheaper?
139. **Bachelor's degrees.** The graph shows the number of bachelor's degrees awarded in the United States each year since 1985 (National Center for Education Statistics, www.nces.ed.gov).
- Has the number of bachelor's degrees been increasing or decreasing since 1985?
 - The formula $B = 16.45n + 980.20$ can be used to approximate the number of degrees awarded in thousands in the year $1985 + n$. What is the first year in which the number of bachelor's degrees will

exceed 1.3 million?

140. **Master's degrees.** In 1985, 15.9% of all degrees awarded in U.S. higher education were master's degrees (National Center for Education Statistics). If the formulas $M = 7.79n + 287.87$ and $T = 30.95n + 1808.22$ give the number of master's degrees and the total number of higher education degrees awarded in thousands, respectively, in the year $1985 + n$, then what is the first year in which more than 20% of all degrees awarded will be master's degrees?
141. **Weighted average.** Professor Jorgenson gives only a midterm exam and a final exam. The semester average is computed by taking $\frac{1}{3}$ of the midterm exam score plus $\frac{2}{3}$ of the final exam score. The grade is determined from the semester average by using the grading scale given in the table. If Stanley scored only 56 on the midterm, then for what range of scores on the final exam would he get a C or better in the course?
142. **C or better.** Professor Brown counts her midterm as $\frac{2}{3}$ of the grade and her final as $\frac{1}{3}$ of the grade. Wilbert scored only 56 on the midterm. If Professor Brown also uses the grading scale given in the table, then what range of scores on the final exam would give Wilbert a C or better in the course?
143. **Designer jeans.** A pair of ordinary jeans at A-Mart costs \$50 less than a pair of designer jeans at Enrico's. In fact, you can buy four pairs of A-Mart jeans for less than one pair of Enrico's jeans. What is the price range for a pair of A-Mart jeans?
144. **United Express.** Al and Rita both drive parcel delivery trucks for United Express. Al averages 20 mph less than Rita. In fact, Al is so slow that in 5 hours he covered fewer miles than Rita did in 3 hours. What are the possible values for Al's rate of speed?
145. **Aiming for a C.** Professor Johnson gives only a midterm exam and a final exam. The semester average is computed by taking $\frac{1}{3}$ of the midterm exam score plus $\frac{2}{3}$ of the final exam score. To get a C, Beth must have a semester average between 70 and 79 inclusive. If Beth scored only 64 on the midterm, then for what range of scores on the final exam would Beth get a C?
146. **Two tests only.** Professor Davis counts his midterm as $\frac{2}{3}$ of the grade, and his final as $\frac{1}{3}$ of the grade. Jason scored only 64 on the midterm. What range of scores on the final exam would put Jason's average between 70 and 79 inclusive?
147. **Keep on truckin'.** Abdul is shopping for a new truck in a city with an 8% sales tax. There is also an \$84 title and license fee to pay. He wants to get a good truck and plans to spend at least \$12,000 but no more than \$15,000. What is the price range for the truck?
148. **Selling-price range.** Renee wants to sell her car through a broker who charges a commission of 10% of the selling price. The book value of the car is \$14,900, but Renee still owes \$13,104 on it. Although the car is in only fair condition and will not sell for more than the book value, Renee must get enough to at least pay off the loan. What is the range of the selling price?
149. **Hazardous to her health.** Trying to break her smoking habit, Jane calculates that she smokes only three full cigarettes a day, one after each meal. The rest of the time she smokes on the run and smokes only half of the cigarette. She estimates that she smokes the equivalent of 5 to 12 cigarettes per day. How many times a day does she light up on the run?
150. **Possible width.** The length of a rectangle is 20 meters longer than the width. The perimeter must be between 80 and 100 meters. What are the possible values for the width of the rectangle?

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151. **Higher education.** The annual numbers of bachelor's and master's degrees awarded can be approximated using the formulas
 $B = 16.45n + 980.20$
and $M = 7.79n + 287.87$,
where n is the number of years after 1985 (National Center for Education Statistics, www.nces.ed.gov). For example, $n = 2$ gives the numbers in 1987.
- How many bachelor's degrees were awarded in 1995?
 - In what year will the number of bachelor's degrees that are awarded reach 1.26 million?
 - What is the first year in which both B is greater than 1.3 million and M is greater than 0.5 million?
 - What is the first year in which either B is greater than 1.3 million or M is greater than 0.5 million?
152. **Senior citizens.** The number of senior citizens (65 years old and over) in the United States in millions in the year $1970 + n$ can be estimated by using the formula
 $S = 0.48n + 19.71$
(U.S. Bureau of the Census, www.census.gov). The percentage of senior citizens living below the poverty level in the year $1970 + n$ can be estimated by using the formula
 $p = -0.72n + 24.2$.
The variable n is the number of years after 1970.
- How many senior citizens were there in 1998?
 - In what year did the percentage of seniors living below the poverty level reach 2.6%?
 - What is the first year in which we can expect both the number of seniors to be greater than 36 million and fewer than 2.6% living below the poverty level?
153. **Famous battles.** In the Hundred Years' War, Henry V defeated a French army in the battle of Agincourt and Joan of Arc defeated an English army in the battle of Orleans (The Doubleday Almanac). Suppose you know only that these two famous battles were 14 years apart and that the battle of Agincourt occurred in 1415. Use an absolute value equation to find the possibilities for the year in which the battle of Orleans occurred.
154. **World records.** In July 1985 Steve Cram of Great Britain set a world record of 3 minutes 29.67 seconds for the 1500-meter race and a world record of 3 minutes 46.31 seconds for the 1-mile race (The Doubleday Almanac). Suppose you know only that these two events occurred 11 days apart and that the 1500-meter record was set on July 16. Use an absolute value equation to find the possible dates for the 1-mile record run.
155. **Weight difference.** Research at a major university has shown that identical twins generally differ by less than 6 pounds in body weight. If Kim weighs 127 pounds, then in what range is the weight of her identical twin sister Kathy?
156. **Intelligence quotient.** Jude's IQ score is more than 15 points away from Sherry's. If Sherry scored 110, then in what range is Jude's score?
157. **Unidentified flying objects.** The formula
 $S = -16t^2 + v_0t + s_0$
gives height in feet above the earth at time t seconds for an object projected into the air with an initial velocity of v_0 feet per second (ft/sec) from an initial height of s_0 feet. Two balls are tossed into the air simultaneously, one from the ground at 50 ft/sec and one from a height of 10 feet at 40 ft/sec. See the accompanying graph.
- Use the graph to estimate the time at which the balls are at the same height.
 - Find the time from part (a) algebraically.
 - For what values of t will their heights above the ground differ by less than 5 feet (while they are

both in the air)?

158. **Playing catch.** A circus clown at the top of a 60-foot platform is playing catch with another clown on the ground. The clown on the platform drops a ball at the same time as the one on the ground tosses a ball upward at 80 ft/sec. For what length of time is the distance between the balls less than or equal to 10 feet? (Hint: Use the formula given in Exercise 89. The initial velocity of a ball that is dropped is 0 ft/sec.)
159. **Percentage of full benefit.** The age at which you retire affects your Social Security benefits. The accompanying graph gives the percentage of full benefit for each age from 62 through 70, based on current legislation and retirement after the year 2005 (Source: Social Security Administration). What percentage of full benefit does a person receive if that person retires at age 63? At what age will a retiree receive the full benefit? For what ages do you receive more than the full benefit?
160. **Medicaid spending.** The payment in billions by Medicaid (health care for the poor) can be modeled by the equation
$$P = 12.6n + 81.3,$$
where n is the number of years since 1990 (Health Care Financing Administration, www.hcfa.gov).
a) What amount was paid out by Medicaid in 1995?
b) In what year will the payment reach \$220 billion?
c) Graph the equation for n ranging from 0 through 20.
161. **Women on the board.** The percentage of companies with at least one woman on the board is growing steadily (Forbes, February 10, 1997). The percentage can be approximated with the linear equation
$$p = 2n + 36,$$
where n is the number of years since 1980.
a) Find and interpret the p -intercept for the line.
b) Find and interpret the n -intercept.
c) Graph the line for n ranging from 0 through 20.
d) If this trend continues, then in what year would you expect to find nearly all companies having at least one woman on the board?
162. **Hazards of depth.** The table on page 169 shows the depth below sea level and atmospheric pressure (Encyclopedia of Sports Science, 1997). The equation
$$A = 0.03d + 1$$
expresses the atmospheric pressure in terms of the depth d .
a) Find the atmospheric pressure at the depth where nitrogen narcosis begins.
b) Find the maximum depth for intermediate divers.
c) Graph the equation for d ranging from 0 to 250 feet.
163. **Demand equation.** Helen's Health Foods usually sells 400 cans of ProPac Muscle Punch per week when the price is \$5 per can. After experimenting with prices for some time, Helen has determined that the weekly demand can be found by using the equation
$$d = 600 - 40p,$$
where d is the number of cans and p is the price per can.
a) Will Helen sell more or less Muscle Punch if she raises her price from \$5?
b) What happens to her sales every time she raises her price by \$1?
c) Graph the equation.
d) What is the maximum price that she can charge and still sell at least one can?

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164. **Advertising blitz.** Furniture City in Toronto had \$24,000 to spend on advertising a year-end clearance sale. A 30-second radio ad costs \$300, and a 30-second local television ad costs \$400. To model this situation, the advertising manager wrote the equation $300x + 400y = 24,000$. What do x and y represent? Graph the equation. How many solutions are there to the equation, given that the number of ads of each type must be a whole number?
165. **Material allocation.** A tent maker had 4500 square yards of nylon tent material available. It takes 45 square yards of nylon to make an 8×10 tent and 50 square yards to make a 9×12 tent. To model this situation, the manager wrote the equation $45x + 50y = 4500$. What do x and y represent? Graph the equation. How many solutions are there to the equation, given that the number of tents of each type must be a whole number?
166. **Super cost.** The average cost of a 30-second ad during the 1995 super bowl was \$1 million, and in 1998 it was \$1.3 million (Detroit Free Press, January 6, 1998, www.freep.com).
- Find the slope of the line through $(95, 1,000,000)$ and $(98, 1,300,000)$ and interpret your result.
 - Use the accompanying graph to estimate the average cost of an ad in 1997.
 - What do you think the average cost will be in 2005?
167. **Retirement pay.** The annual Social Security benefit of a retiree depends on the age at the time of retirement. The accompanying graph gives the annual benefit for persons retiring at ages 62 through 70 in the year 2005 or later (Source: Social Security Administration). What is the annual benefit for a person who retires at age 64? At what retirement age does a person receive an annual benefit of \$11,600? Find the slope of each line segment on the graph, and interpret your results. Why do people who postpone retirement until 70 years of age get the highest benefit?
168. **Increasing training.** The accompanying graph shows the percentage of U.S. workers receiving training by their employers. The percentage went from 5% in 1981 to 16% in 1995. Find the slope of this line. Interpret your result.
169. **Saving for retirement.** Financial advisors at Fidelity Investments, Boston, use the accompanying table as a measure of whether a client is on the road to a comfortable retirement.
- Graph these points and draw a line through them.
 - What is the slope of the line?
 - By what percentage of your salary should you be increasing your savings every year?
170. Write an equation in slope-intercept form, if possible, for each line. See Example 6. In each case, make a sketch.
The line through $(0, 6)$ that is perpendicular to the line $y = 3x - 5$
171. The line through $(0, -1)$ that is perpendicular to the line $y = x$
172. The line with y -intercept $(0, 3)$ that is parallel to the line $2x + y = 5$
173. The line through the origin that is parallel to the line $2x - 5y = 8$
174. The line through $(2, 3)$ that runs parallel to the x -axis
175. The line through $(-3, 5)$ that runs parallel to the y -axis
176. The line through $(0, 4)$ and $(5, 0)$

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177. **Marginal cost.** A manufacturer plans to spend \$150,000 on research and development for a new lawn mower and then \$200 to manufacture each mower. The formula $C = 200n + 150,000$ gives the cost in dollars of n mowers. What is the cost of 5000 mowers? What is the cost of 5001 mowers? By how much did the one extra lawn mower increase the cost? (The increase in cost is called the marginal cost of the 5001st lawn mower.)
178. **Marginal revenue.** A defense attorney charges her client \$4000 plus \$120 per hour. The formula $R = 120n + 4000$ gives her revenue in dollars for n hours of work. What is her revenue for 100 hours of work? What is her revenue for 101 hours of work? By how much did the one extra hour of work increase the revenue? (The increase in revenue is called the marginal revenue for the 101st hour.)
179. **In-house training.** The accompanying graph shows the percentage of U.S. workers receiving training by their employers. The percentage went from 5% in year 0 (1981) to 16% in year 14 (1995).
- Find the slope of this line.
 - Write the equation of the line in slope-intercept form.
 - Use your equation to predict the percentage that will be receiving training in the year 2000.
180. **Women and marriage.** The percentage of women in the 20 to 24 age group who have never married went from 64% in year 0 (1970) to 33% in year 26 (1996) (Census Bureau, www.census.gov).
- Find the equation of the line through the two points (0, 0.64) and (26, 0.33) in slope-intercept form.
 - Use your equation to predict what the percentage will be in the year 2000.
181. **Pansies and snapdragons.** A nursery manager plans to spend \$100 on 6-packs of pansies at 50 cents per pack and snapdragons at 25 cents per pack. The equation $0.50x + 0.25y = 100$ can be used to model this situation.
- What do x and y represent?
 - Graph the equation.
 - Write the equation in slope-intercept form.
 - What is the slope of the line?
 - What does the slope tell you?
182. **Pens and pencils.** A bookstore manager plans to spend \$60 on pens at 30 cents each and pencils at 10 cents each. The equation $0.10x + 0.30y = 60$ can be used to model this situation.
- What do x and y represent?
 - Graph the equation.
 - Write the equation in slope-intercept form.
 - What is the slope of the line?
 - What does the slope tell you?
183. Find the equation of each line. Write each answer in standard form using only integers. See Example 2.
The line through the points (1, 2) and (5, 8)
184. The line through the points (3, 5) and (8, 15)
185. The line through the points (-2, -1) and (3, -4)
186. Find the equation of each line. Write each answer in slope-intercept form. See Examples 3 and 4.
The line contains the point (3, 4) and is perpendicular to $y = 3x - 1$.
187. The line contains the point (-2, 3) and is perpendicular to $y = 2x + 7$.

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188. The line is parallel to $y = x - 9$ and goes through the point $(7, 10)$.
189. The line is perpendicular to $3x - 2y = 10$ and passes through the point $(1, 1)$.
190. The line is parallel to $2x + y = 8$ and contains the point $(-1, -3)$.
191. The line goes through $(-1, 2)$ and is perpendicular to $3x + y = 5$.
192. **Automated tellers.** ATM volume reached 10.6 billion transactions in 1996 (Electronic Commerce Data Base). The accompanying graph shows the steady growth of automatic tellers.
- Write the equation of the line through $(92, 7.0)$ and $(96, 10.6)$.
 - Use the equation to predict the number of transactions at automated teller machines in the year 2005?
193. **Direct deposit.** In 1994, one-third of all workers participated in direct deposit of their paychecks and this number is expected to reach three-fourths by the year 2000. (New York Automated Clearing House, www.nyach.org).
- Write the equation of the line through $(1993, 1/3)$ and $(2000, 3/4)$.
 - Use the accompanying graph to predict the year in which 100% of all workers will participate in direct deposit of their paychecks.
 - Use the equation from part (a) to predict the year in which 100% of all workers will participate in direct deposit of their paychecks.
194. **Gross domestic product.** The U.S. per capita gross domestic product went from \$14,000 in 1970 to \$18,000 in 1992 (World Resources, 1997).
- Write the equation of the line through the points $(1970, 14,000)$ and $(1992, 18,000)$.
 - What do x and y represent in your equation?
 - Graph the equation
 - By how much is the gross domestic product increasing per year?
 - Use your equation to predict the per capita gross domestic product in the year 2000.
195. **Body-mass index.** The body mass index BMI is used to assess the level of fat in a person's body. When Tim weighed 147 pounds his BMI was 23.4. When his weight went to 185, his BMI was 29.5.
- Find the equation of the line through $(147, 23.4)$ and $(185, 29.5)$.
 - What do x and y represent in your equation?
 - Graph the equation.
 - Interpret the slope of this line.
 - What is his BMI when his weight is 160?
196. **Profit per share.** In the 1980s, People's Gas had a profit per share, P , that was determined by the equation $P = 0.35x + 4.60$, where x ranges from 0 to 9 corresponding to the years 1980 to 1989. What was the profit per share in 1987? Sketch the graph of this formula for x ranging from 0 to 9.
197. **Loan value of a car.** For the first 6 years the loan value of a \$30,000 Corvette is determined by the formula $V = -4000a + 30,000$, where a is the age in years of the Corvette. What is the loan value of this automobile when it is 5 years old? Sketch the graph of this formula for a between 0 and 6 inclusive.
198. **Plumbing problems.** When Millie called Pete's Plumbing, Pete worked 2 hours and charged her \$70. When her neighbor Rosalee called Pete, he worked 4 hours and charged her \$110. Pete's charge is a linear function of the number of hours he works. Find a formula for this function. How much will

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Pete charge for working 7 hours at Fred's house?

199. **Interior angles.** The sum of the measures of the interior angles of a triangle is 180° . The sum of the measures of the interior angles of a square is 360° . The sum S of the measures of the interior angles of any n -sided polygon is a linear function of the number of sides n . Express S as a linear function of n . What is the sum of the measures of the interior angles of an octagon?
200. **If the shoe fits.** If a child's foot is 7.75 inches long, then the child wears a size 13 shoe. If the child has a foot that is 5.75 inches long, then the child wears a size 7 shoe. The shoe size S is a linear function of the length of the foot L .
- Write a linear equation expressing S as a function of L .
 - What size shoe fits a child with a 6.25-inch foot?
201. **Celsius to Fahrenheit.** Fahrenheit temperature F is a linear function of Celsius temperature C . When $C = 0$, $F = 32$. When $C = 100$, $F = 212$. Use the point-slope form to write F as a linear function of C . What is the Fahrenheit temperature when $C = 45$?
202. **Velocity of a projectile.** The velocity v of a projectile is a linear function of the time t that it is in the air. A ball is thrown downward from the top of a tall building. Its velocity is 42 feet per second after 1 second and 74 feet per second after 2 seconds. Write v as a linear function of t . What is the velocity when $t = 3.5$ seconds?
203. **Natural gas.** The cost C of natural gas is a linear function of the number n of cubic feet of gas used. The cost of 1000 cubic feet of gas is \$39, and the cost of 3000 cubic feet of gas is \$99. Express C as a linear function of n . What is the cost of 2400 cubic feet of gas?
204. **Expansion joint.** The width of an expansion joint on the Carl T. Hull bridge is a linear function of the temperature of the roadway. When the temperature is 90°F , the width is 0.75 inch. When the temperature is 30°F , the width is 1.25 inches. Express w as a linear function of t . What is the width of the joint when the temperature is 80°F ?
205. **Perimeter of a rectangle.** The perimeter P of a rectangle with a fixed width is a linear function of its length. The perimeter is 28 inches when the length is 6.5 inches, and the perimeter is 36 inches when the length is 10.5 inches. Write P as a linear function of L . What is the perimeter when $L = 40$ feet? What is the fixed width of the rectangle?
206. **Stretching a spring.** The amount A that a spring stretches beyond its natural length is a linear function of the weight w placed on the spring. A weight of 3 pounds stretches a certain spring 1.8 inches and a weight of 5 pounds stretches the same spring 3 inches. Express A as a linear function of w . How much will the spring stretch with a weight of 6 pounds?
207. **Velocity of a bullet.** If a gun is fired straight upward, then the velocity v of the bullet is a linear function of the time t that has elapsed since the gun was fired. Suppose that the bullet leaves the gun at 100 feet per second (time $t = 0$) and that after 2 seconds its velocity is 36 feet per second. Express v as a linear function of t . What is the velocity after 3 seconds?
208. **Enzyme concentration.** The amount of light absorbed by a certain liquid is a linear function of the concentration of an enzyme in the liquid. A concentration of 2 mg/ml (milligrams per milliliter) produces an absorption of 0.16 and a concentration of 5 mg/ml produces an absorption of 0.40. Express the absorption a as a linear function of the concentration c . What should the absorption be if the concentration is 3 mg/ml? Use the accompanying graph to estimate the concentration when the

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absorption is 0.50.

209. **Basal energy requirement.** The basal energy requirement B is the number of calories that a person needs to maintain the life processes. B depends on the height, weight, and age of the person. For a 28-year-old female with a height of 160 cm, B is a linear function of the person's weight w (in kilograms). For a weight of 45 kg, B is 1300 calories. For a weight of 50 kg, B is 1365 calories. Express B as a linear function of w . What is B for a 28-year-old 160-cm female who weighs 53.2 kg?
210. **Threshold weight.** The threshold weight for an individual is the weight beyond which the risk of death increases significantly. For middle-aged males the function $W(h) = 0.000534h^3$ expresses the threshold weight in pounds as a function of the height h in inches. Find $W(70)$. Find the threshold weight for a 6' 2" middle-aged male.
211. **Pole vaulting.** The height a pole vaulter attains is a function of the vaulter's velocity on the runway. The function
- $$h(v) = \frac{1}{64}v^2$$
- gives the height in feet as a function of the velocity v in feet per second.
- Find $h(35)$ to the nearest tenth of an inch.
 - Who gains more height from an increase of 1 ft/sec in velocity: a fast runner or a slow runner?
212. **Credit card fees.** A certain credit card company gets 4% of each charge, and the retailer receives the rest. At the end of a billing period the retailer receives a statement showing only the retailer's portion of each transaction. Express the original amount charged C as a function of the retailer's portion r .
213. **More credit card fees.** Suppose that the amount charged on the credit card in the previous exercise includes 8% sales tax. The credit card company does not get any of the sales tax. In this case the retailer's portion of each transaction includes sales tax on the original cost of the goods. Express the original amount charged C as a function of the retailer's portion.
214. **Profitable pumps.** Walter Waterman, of Walter's Water Pumps in Winnipeg has found that when he produces x water pumps per month, his revenue is $x^2 + 400x + 300$ dollars. His cost for producing x water pumps per month is $x^2 + 300x - 200$ dollars. Write a polynomial that represents his monthly profit for x water pumps. Evaluate this profit polynomial for $x = 50$.
215. **Manufacturing costs.** Ace manufacturing has determined that the cost of labor for producing x transmissions is $0.3x^2 + 400x + 550$ dollars, while the cost of materials is $0.1x^2 + 50x + 800$ dollars.
- Write a polynomial that represents the total cost of materials and labor for producing x transmissions.
 - Evaluate the total cost polynomial for $x = 500$.
 - Find the cost of labor for 500 transmissions and the cost of materials for 500 transmissions
216. **Perimeter of a triangle.** The shortest side of a triangle is x meters, and the other two sides are $3x + 1$ and $2x + 4$ meters. Write a polynomial that represents the perimeter and then evaluate the perimeter polynomial if x is 4 meters.
217. **Perimeter of a rectangle.** The width of a rectangular playground is $2x - 5$ feet, and the length is $3x + 9$ feet. Write a polynomial that represents the perimeter and then evaluate this perimeter polynomial if x is 4 feet.

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218. **Before and after.** Jessica traveled $2x + 50$ miles in the morning and $3x - 10$ miles in the afternoon. Write a polynomial that represents the total distance that she traveled. Find the total distance if $x = 20$.
219. **Total distance.** Hanson drove his rig at x mph for 3 hours, then increased his speed to $x + 15$ mph and drove for 2 more hours. Write a polynomial that represents the total distance that he traveled. Find the total distance if $x = 45$ mph.
220. **Sky divers.** Bob and Betty simultaneously jump from two airplanes at different altitudes. Bob's altitude t seconds after leaving the plane is $-16t^2 + 6600$ feet. Betty's altitude t seconds after leaving the plane is $-16t^2 + 7400$ feet. Write a polynomial that represents the difference between their altitudes t seconds after leaving the planes. What is the difference between their altitudes 3 seconds after leaving the planes?
221. **Height difference.** A red ball and a green ball are simultaneously tossed into the air. The red ball is given an initial velocity of 96 feet per second, and its height t seconds after it is tossed is $-16t^2 + 96t$ feet. The green ball is given an initial velocity of 30 feet per second, and its height t seconds after it is tossed is $-16t^2 + 80t$ feet.
- Find a polynomial that represents the difference in the heights of the two balls.
 - How much higher is the red ball 2 seconds after the balls are tossed?
 - In reality, when does the difference in the heights stop increasing?
222. **Total interest.** Donald received $0.08(x + 554)$ dollars interest on one investment and $0.09(x + 335)$ interest on another investment. Write a polynomial that represents the total interest he received. What is the total interest if $x = 1000$?
223. **Total acid.** Deborah figured that the amount of acid in one bottle of solution is $0.12x$ milliliters and the amount of acid in another bottle of solution is $0.22(75 - x)$ milliliters. Find a polynomial that represents the total amount of acid. What is the total amount of acid if $x = 50$?
224. **Harris-Benedict for females.** The Harris-Benedict polynomial $655.1 + 9.56w + 1.85h - 4.68a$ represents the number of calories needed to maintain a female at rest for 24 hours, where w is her weight in kilograms, h is her height in centimeters, and a is her age. Find the number of calories needed by a 30-year old 54-kilogram female who is 157 centimeters tall.
225. **Harris-Benedict for males.** The Harris-Benedict polynomial $66.5 + 13.75w + 5.0h + 6.78a$ represents the number of calories needed to maintain a male at rest for 24 hours, where w is his weight in kilograms, h is his height in centimeters, and a is his age. Find the number of calories needed by a 40-year-old 90-kilogram male who is 185 centimeters tall.
226. **Office space.** The length of a professor's office is x feet, and the width is $x + 4$ feet. Write a polynomial that represents the area. Find the area if $x = 10$ ft.
227. **Swimming space.** The length of a rectangular swimming pool is $2x - 1$ meters, and the width is $x = 2$ meters. Write a polynomial that represents the area. Find the area if x is 5 meters.
228. **Area of a truss.** A roof truss is in the shape of a triangle with a height of x feet and a base of $2x + 1$ feet. Write a polynomial that represents the area of the triangle. What is the area if x is 5 feet?
229. **Volume of a box.** The length, width, and height of a box are x , $2x$, and $3x - 5$ inches, respectively. Write a polynomial that represents its volume.

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230. **Number pairs.** If two numbers differ by 5, then what polynomial represents their product?
231. **Number pairs.** If two numbers have a sum of 9, then what polynomial represents their product?
232. **Area of a rectangle.** The length of a rectangle is $2.3x + 1.2$ meters, and its width is $3.5x + 5.1$ meters. What polynomial represents its area?
233. **Patchwork.** A quilt patch cut in the shape of a triangle has a base of $5x$ inches and a height of $1.732x$ inches. What polynomial represents its area?
234. **Total revenue.** If a promoter charges p dollars per ticket for a concert in Tulsa, then she expects to sell $40,000 - 1000p$ tickets to the concert. How many tickets will she sell if the tickets are \$10 each? Find the total revenue when the tickets are \$10 each. What polynomial represents the total revenue expected for the concert when the tickets are p dollars each?
235. **Manufacturing shirts.** If a manufacturer charges p dollars each for rugby shirts, then he expects to sell $2000 - 100p$ shirts per week. What polynomial represents the total revenue expected for a week? How many shirts will be sold if the manufacturer charges \$20 each for the shirts? Find the total revenue when the shirts are sold for \$20 each. Use the bar graph to determine the price that will give the maximum total revenue.
236. **Periodic deposits.** At the beginning of each year for 5 years, an investor invests \$10 in a mutual fund with an average annual return of r . If we let $x = 1 + r$, then at the end of the first year (just before the next investment) the value is $10x$ dollars. Because \$10 is then added to the $10x$ dollars, the amount at the end of the second year is $(10x + 10)x$ dollars. Find a polynomial that represents the value of the investment at the end of the fifth year. Evaluate this polynomial if $r = 10\%$.
237. **Increasing deposits.** At the beginning of each year for 5 years, an investor invests in a mutual fund with an average annual return of r . The first year, she invests \$10; the second year, she invests \$20; the third year, she invests \$30; the fourth year, she invests \$40; the fifth year, she invests \$50. Let $x = 1 + r$ as in Exercise 101 and write a polynomial in x that represents the value of the investment at the end of the fifth year. Evaluate this polynomial for $r = 8\%$.
238. **Area of a rug.** Find a trinomial that represents the area of a rectangular rug whose sides are $x + 3$ feet and $2x - 1$ feet.
239. **Area of a parallelogram.** Find a trinomial that represents the area of a parallelogram whose base is $3x + 2$ meters and whose height is $2x + 3$ meters.
240. **Area of a sail.** The sail of a tall ship is triangular in shape with a base of $4.57x + 3$ meters and a height of $2.3x - 1.33$ meters. Find a polynomial that represents the area of the triangle.
241. **Area of a square.** A square has a side of length $1.732x + 1.414$ meters. Find a polynomial that represents its area.
242. **Exploration.** Find the area of each of the four regions shown in the figure. What is the total area of the four regions? What does this exercise illustrate?
243. **Shrinking garden.** Rose's garden is a square with sides of length x feet. Next spring she plans to make it rectangular by lengthening one side 5 feet and shortening the other side by 5 feet. What polynomial represents the new area? By how much will the area of the new garden differ from that of

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the old garden?

244. **Square lot.** Sam lives on a lot that he thought was a square, 157 feet by 157 feet. When he had it surveyed, he discovered that one side was actually 2 feet longer than he thought and the other was actually 2 feet shorter than he thought. How much less area does he have than he thought he had?
245. **Area of a circle.** Find a polynomial that represents the area of a circle whose radius is $b + 1$ meters. Use the value 3.14 for π .
246. **Comparing dartboards.** A toy store sells two sizes of circular dartboards. The larger of the two has a radius that is 3 inches greater than that of the other. The radius of the smaller dartboard is t inches. Find a polynomial that represents the difference in area between the two dartboards.
247. **Poiseuille's law.** According to the nineteenth-century physician Poiseuille, the velocity (in centimeters per second) of blood r centimeters from the center of an artery of radius R centimeters is given by
$$v = k(R - r)(R + r)$$
where k is a constant. Rewrite the formula using a special product rule.
248. **Going in circles.** A promoter is planning a circular race track with an inside radius of r feet and a width of w feet. The cost in dollars for paving the track is given by the formula
$$C = 1.2\pi[(r + w)^2 - r^2]$$
Use a special product rule to simplify this formula. What is the cost of paving the track if the inside radius is 1000 feet and the width of the track is 40 feet?
249. **Compounded annually.** P dollars is invested at annual interest rate r for 2 years. If the interest is compounded annually, then the polynomial $P(1 + r)^2$ represents the value of the investment after 2 years. Rewrite this expression without parentheses. Evaluate the polynomial if $P = \$200$ and $r = 10\%$.
250. **Compounded semiannually.** P dollars is invested at annual interest rate r for 1 year. If the interest is compounded semiannually, then the polynomial $P(1 + \frac{r}{2})^2$ represents the value of the investment after 1 year. Rewrite this expression without parentheses. Evaluate the polynomial if $P = \$200$ and $r = 10\%$.
251. **Investing in treasury bills.** An investment advisor uses the polynomial $P(1 + r)^{10}$ to predict the value in 10 years of a client's investment of P dollars with an average annual return r . The accompanying graph shows historic average annual returns for the last 20 years for various asset classes (T. Rowe Price, www.troweprice.com). Use the historical average return to predict the value in 10 years of an investment of \$10,000 in U.S. treasury bills?
252. **Comparing investments.** How much more would the investment in Exercise 89 be worth in 10 years if the client invests in large company stocks rather than U.S. treasury bills?
253. Find the quotient and remainder for each division. Check by using the fact that $\text{dividend} = (\text{divisor})(\text{quotient}) + \text{remainder}$. See Example 4.
 $(x^2 + 5x + 13) \div (x + 3)$
254. **Area of a rectangle.** The area of a rectangular billboard is $x^2 + x - 30$ square meters. If the length is $x + 6$ meters, find a binomial that represents the width.

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255. **Perimeter of a rectangle.** The perimeter of a rectangular backyard is $6x + 6$ yards. If the width is x yards, find a binomial that represents the length.
256. **Long-term investing.** Sheila invested P dollars at annual rate r for 10 years. At the end of 10 years her investment was worth $P(1 + r)^{10}$ dollars. She then reinvested this money for another 5 years at annual rate r . At the end of the second time period her investment was worth $P(1 + r)^{10}(1 + r)^5$ dollars. Which law of exponents can be used to simplify the last expression? Simplify it.
257. **CD rollover.** Ronnie invested P dollars in a 2-year CD with an annual rate of return of r . After the CD rolled over two times, its value was $P((1 + r)^2)^3$. Which law of exponents can be used to simplify the expression? Simplify it.
258. **Distance to the sun.** The distance from the earth to the sun is 93 million miles. Express this distance in feet. (1 mile = 5280 feet.)
259. **Speed of light.** The speed of light is 9.83569×10^8 feet per second. How long does it take light to travel from the sun to the earth? See Exercise 99.
260. **Warp drive, Scotty.** How long does it take a spacecraft traveling at 2×10^{35} miles per hour (warp factor 4) to travel 93 million miles.
261. **Area of a dot.** If the radius of a very small circle is 2.35×10^{-8} centimeters, then what is the circle's area?
262. **Circumference of a circle.** If the circumference of a circle is 5.68×10^9 feet, then what is its radius?
263. **Diameter of a circle.** If the diameter of a circle is 1.3×10^{-12} meters, then what is its radius?
264. **Extracting metals from ore.** Thomas Sherwood studied the relationship between the concentration of a metal in commercial ore and the price of the metal. The accompanying graph shows the Sherwood plot with the locations of several metals marked. Even though the scales on this graph are not typical, the graph can be read in the same manner as other graphs. Note also that a concentration of 100 is 100%.
- Use the figure to estimate the price of copper (Cu) and its concentration in commercial ore.
 - Use the figure to estimate the price of a metal that has a concentration of $10 \square 6$ percent in commercial ore.
 - Would the four points shown in the graph lie along a straight line if they were plotted in our usual coordinate system?
265. **Recycling metals.** The accompanying graph shows the prices of various metals that are being recycled and the minimum concentration in waste required for recycling. The straight line is the line from the figure for Exercise 105. Points above the line correspond to metals for which it is economically feasible to increase recycling efforts.
- Use the figure to estimate the price of mercury (Hg) and the minimum concentration in waste required for recycling mercury.
 - Use the figure to estimate the price of silver (Ag) and the minimum concentration in waste required for recycling silver.
266. **Present value.** The present value P that will amount to A dollars in n years with interest compounded annually at annual interest rate r , is given by
- $$P = A(1 + r)^{-n}$$

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Find the present value that will amount to \$50,000 in 20 years at 8% compounded annually.

267. **Investing in stocks.** U.S. small company stocks have returned an average of 14.9% annually for the last 50 years (T. Rowe Price, www.troweprice.com). Use the present value formula from the previous exercise to find the amount invested today in small company stocks that would be worth \$1 million in 50 years, assuming that small company stocks continue to return 14.9% annually for the next 50 years.
268. Find the prime factorization of each integer. See Examples 1 and 2.
269. Find the greatest common factor (GCF) for each group of integers. See Example 3.
270. **Uniform motion.** Helen traveled a distance of $20x + 40$ miles at 20 miles per hour on the Yellowhead Highway. Find a binomial that represents the time that she traveled.
271. **Area of a painting.** A rectangular painting with a width of x centimeters has an area of $x^2 + 50x$ square centimeters. Find a binomial that represents the length.
272. **Tomato soup.** The amount of metal S (in square inches) that it takes to make a can for tomato soup is a function of the radius r and height h :
$$S = 2\pi r^2 + 2\pi rh$$
 - Rewrite this formula by factoring out the greatest common factor on the right-hand side.
 - If $h = 5$ in., then S is a function of r . Write a formula for that function.
 - The accompanying graph shows S for r between 1 in. and 3 in. (with $h = 5$ in.). Which of these r -values gives the maximum surface area?
273. **Amount of an investment.** The amount of an investment of P dollars for t years at simple interest rate r is given by $A = P + Prt$.
 - Rewrite this formula by factoring out the greatest common factor on the right-hand side.
 - Find A if \$8300 is invested for 3 years at a simple interest rate of 15%.
274. **Skydiving.** The height (in feet) above the earth for a sky diver t seconds after jumping from an airplane at 6400 ft is approximated by the formula $h = -16t^2 + 6400$, provided that $t < 5$. Rewrite the formula with the right-hand side factored completely. Use your revised formula to find h when $t = 2$.
275. **Demand for pools.** Tropical Pools sells an aboveground model for p dollars each. The monthly revenue from the sale of this model is a function of the price, given by $R = -0.08p^2 + 300p$. Revenue is the product of the price p and the demand (quantity sold).
 - Factor out the price on the right-hand side of the formula.
 - What is an expression for the monthly demand?
 - What is the monthly demand for this pool when the price is \$3000?
 - Use the graph on page 290 to estimate the price at which the revenue is maximized. Approximately how many pools will be sold monthly at this price?
 - What is the approximate maximum revenue?
 - Use the accompanying graph to estimate the price at which the revenue is zero.
276. **Volume of a tank.** The volume of a fish tank with a square base and height y is $y^3 - 6y^2 + 9y$ cubic inches. Find the length of a side of the square base.
277. **Area of a deck.** A rectangular deck has an area of $x^2 + 6x + 8$ square feet and a width of $x + 2$ feet. Find the length of the deck.

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278. **Area of a sail.** A triangular sail has an area of $x^2 + 5x + 6$ square meters and a height of $x + 3$ meters. Find the length of the sail's base.
279. **Volume of a cube.** Hector designed a cubic box with volume x^3 cubic feet. After increasing the dimensions of the bottom, the box has a volume of $x^3 + 8x^2 + 15x$ cubic feet. If each of the dimensions of the bottom was increased by a whole number of feet, then how much was each increase?
280. **Volume of a container.** A cubic shipping container had a volume of a^3 cubic meters. The height was decreased by a whole number of meters and the width was increased by a whole number of meters so that the volume of the container is now $a^3 + 2a^2 - 3a$ cubic meters. By how many meters were the height and width changed?
281. **Height of a ball.** If a ball is thrown upward at 40 feet per second from a rooftop 24 feet above the ground, then its height above the ground t seconds after it is thrown is given by $h = -16t^2 + 40t + 24$. Rewrite this formula with the polynomial on the right-hand side factored completely. Use the factored version of the formula to find h when $t = 3$.
282. **Worker efficiency.** In a study of worker efficiency at Wong Laboratories it was found that the number of components assembled per hour by the average worker t hours after starting work could be modeled by the function $N(t) = -3t^3 + 23t^2 + 8t$.
- Rewrite the formula by factoring the right-hand side completely.
 - Use the factored version of the formula to find $N(3)$.
 - Use the accompanying graph to estimate the time at which the workers are most efficient.
 - Use the accompanying graph to estimate the maximum number of components assembled per hour during an 8-hour shift.
283. **Increasing cube.** Each of the three dimensions of a cube with a volume of x^3 cubic centimeters is increased by a whole number of centimeters. If the new volume is $x^3 + 10x^2 + 31x + 30$ cubic centimeters and the new height is $x + 2$ centimeters, then what are the new length and width?
284. **Decreasing cube.** Each of the three dimensions of a cube with a volume of y^3 cubic centimeters is decreased by a whole number of centimeters. If the new volume is $y^3 - 13y^2 + 54y - 72$ cubic centimeters and the new width is $y - 6$ centimeters, then what are the new length and height?
285. **Dimensions of a rectangle.** The perimeter of a rectangle is 34 feet, and the diagonal is 13 feet long. What are the length and width of the rectangle?
286. **Address book.** The perimeter of the cover of an address book is 14 inches, and the diagonal measures 5 inches. What are the length and width of the cover?
287. **Violla's bathroom.** The length of Violla's bathroom is 2 feet longer than twice the width. If the diagonal measures 13 feet, then what are the length and width?
288. **Rectangular stage.** One side of a rectangular stage is 2 meters longer than the other. If the diagonal is 10 meters, then what are the lengths of the sides?
289. **Consecutive integers.** The sum of the squares of two consecutive integers is 13. Find the integers.
290. **Consecutive integers.** The sum of the squares of two consecutive even integers is 52. Find the integers.

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291. **Two numbers.** The sum of two numbers is 11, and their product is 30. Find the numbers.
292. **Missing ages.** Molly's age is twice Anita's. If the sum of the squares of their ages is 80, then what are their ages?
293. **Skydiving.** If there were no air resistance, then the height (in feet) above the earth for a sky diver t seconds after jumping from an airplane at 10,000 feet would be given by $h(t) = -16t^2 + 10,000$.
- Find the time that it would take to fall to earth with no air resistance, that is, find t for which $h(t) = 0$. A sky diver actually gets about twice as much free fall time due to air resistance.
 - Use the accompanying graph to determine whether the sky diver (with no air resistance) falls farther in the first 5 seconds or the last 5 seconds of the fall.
 - Is the sky diver's velocity increasing or decreasing as she falls?
294. **Skydiving.** If a sky diver jumps from an airplane at a height of 8256 feet, then for the first 5 seconds, her height above the earth is approximated by the formula $h = -16t^2 + 8256$. How many seconds does it take her to reach 8000 feet.
295. **Throwing a sandbag.** If a balloonist throws a sandbag downward at 24 feet per second from an altitude of 720 feet, then its height (in feet) above the ground after t seconds is given by $S = -16t^2 - 24t + 720$. How long does it take for the sandbag to reach the earth? (On the ground, $S = 0$.)
296. **Throwing a sandbag.** If the balloonist of the previous exercise throws his sandbag downward from an altitude of 128 feet with an initial velocity of 32 feet per second, then its altitude after t seconds is given by the formula $S = -16t^2 - 32t + 128$. How long does it take for the sandbag to reach the earth?
297. **Glass prism.** One end of a glass prism is in the shape of a triangle with a height that is 1 inch longer than twice the base. If the area of the triangle is 39 square inches, then how long are the base and height?
298. **Areas of two circles.** The radius of a circle is 1 meter longer than the radius of another circle. If their areas differ by 5π square meters, then what is the radius of each?
299. **Changing area.** Last year Otto's garden was square. This year he plans to make it smaller by shortening one side 5 feet and the other 8 feet. If the area of the smaller garden will be 180 square feet, then what was the size of Otto's garden last year?
300. **Dimensions of a box.** Rosita's Christmas present from Carlos is in a box that has a width that is 3 inches shorter than the height. The length of the base is 5 inches longer than the height. If the area of the base is 84 square inches, then what is the height of the package?
301. **Flying a kite.** Imelda and Gordon have designed a new kite. While Imelda is flying the kite, Gordon is standing directly below it. The kite is designed so that its altitude is always 20 feet larger than the distance between Imelda and Gordon. What is the altitude of the kite when it is 100 feet from Imelda?
302. **Avoiding a collision.** A car is traveling on a road that is perpendicular to a railroad track. When the car is 30 meters from the crossing, the car's new collision detector warns the driver that there is a train 50 meters from the car and heading toward the same crossing. How far is the train from the crossing?

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303. **Carpeting two rooms.** Virginia is buying carpet for two square rooms. One room is 3 yards wider than the other. If she needs 45 square yards of carpet, then what are the dimensions of each room?
304. **Winter wheat.** While finding the amount of seed needed to plant his three square wheat fields, Hank observed that the side of one field was 1 kilometer longer than the side of the smallest field and that the side of the largest field was 3 kilometers longer than the side of the smallest field. If the total area of the three fields is 38 square kilometers, then what is the area of each field?
305. **Sailing to Miami.** At point A the captain of a ship determined that the distance to Miami was 13 miles. If she sailed north to point B and then west to Miami, the distance would be 17 miles. If the distance from point A to point B is greater than the distance from point B to Miami, then how far is it from point A to point B?
306. **Buried treasure.** Ahmed has half of a treasure map, which indicates that the treasure is buried in the desert $2x + 6$ paces from Castle Rock. Vanessa has the other half of the map. Her half indicates that to find the treasure, one must get to Castle Rock, walk x paces to the north, and then walk $2x + 4$ paces to the east. If they share their information, then they can find x and save a lot of digging. What is x ?
307. **Emerging markets.** Catarina's investment of \$16,000 in an emerging market fund grew to \$25,000 in 2 years. Find the average annual rate of return by solving the equation $16,000(1 + r)^2 = 25,000$.
308. **Venture capital.** Henry invested \$12,000 in a new restaurant. When the restaurant was sold 2 years later, he received \$27,000. Find his average annual return by solving the equation $12,000(1 + r)^2 = 27,000$.
309. If Sergio drove 300 miles at $x + 10$ miles per hour, then how many hours did he drive?
310. If Carrie walked 40 miles in x hours, then how fast did she walk?
311. If $x + 4$ pounds of peaches cost \$4.50, then what is the cost per pound?
312. If 9 pounds of pears cost x dollars, then what is the price per pound?
313. If Ayesha can clean the entire swimming pool in x hours, then how much of the pool does she clean per hour?
314. If Ramon can mow the entire lawn in $x - 3$ hours, then how much of the lawn does he mow per hour?
315. **Annual reports.** The Crest Meat Company found that the cost per report for printing x annual reports at Peppy Printing is given by the formula
- $$C(x) = \frac{150 + 0.60x}{x}$$
- where $C(x)$ is in dollars.
- Use the accompanying graph to estimate the cost per report for printing 1000 reports.
 - Use the formula to find the cost per report for printing 1000, 5000, and 10,000 reports.
 - What happens to the cost per report as the number of reports gets very large?
316. **Toxic pollutants.** The annual cost in dollars for removing $p\%$ of the toxic chemicals from a town's water supply is given by the formula

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$$C(p) = \frac{500000}{100 - p}$$

- a) Use the accompanying graph to estimate the cost for removing 90% and 95% of the toxic chemicals.
- b) Use the formula to determine the cost for removing 99.5% of the toxic chemicals.
- c) What happens to the cost as the percentage of pollutants removed approaches 100%?
317. **Distance.** Florence averaged $\frac{26.2}{x}$ mph for the x hours in which she ran the Boston Marathon. If she ran at that same rate for $\frac{1}{2}$ hour in the Manchac Fun Run, then how many miles did she run at Manchac?
318. **Work.** Henry sold 120 magazine subscriptions in $x + 2$ days. If he sold at the same rate for another week, then how many magazines did he sell in the extra week?
319. **Area of a rectangle.** If the length of a rectangular flag is x meters and its width is $\frac{5}{x}$ meters, then what is the area of the rectangle?
320. **Area of a triangle.** If the base of a triangle is $8x + 16$ yards and its height is $\frac{1}{x+2}$ yards, then what is the area of the triangle?
321. Build each rational expression into an equivalent rational expression with the indicated denominator.
322. Find the LCD for the given rational expressions, and convert each rational expression into an equivalent rational expression with the LCD as the denominator.
323. **Perimeter of a rectangle.** Suppose that the length of a rectangle is $\frac{3}{x}$ feet and its width is $\frac{5}{2x}$ feet. Find a rational expression for the perimeter of the rectangle.
324. **Perimeter of a triangle.** The lengths of the sides of a triangle are $\frac{1}{x}$, $\frac{1}{2x}$, and $\frac{2}{3x}$ meters. Find a rational expression for the perimeter of the triangle.
325. **Traveling time.** Janet drove 120 miles at x mph before 6:00 A.M. After 6:00 A.M., she increased her speed by 5 mph and drove 195 additional miles. Use the fact that $T=D/R$ to complete the following table.
Write a rational expression for her total traveling time. Evaluate the expression for $x = 60$.
326. **Traveling time.** After leaving Moose Jaw, Hanson drove 200 kilometers at x km/hr and then decreased his speed by 20 km/hr and drove 240 additional kilometers. Make a table like the one in Exercise 61. Write a rational expression for his total traveling time. Evaluate the expression for $x = 100$.
327. **House painting.** Kent can paint a certain house by himself in x days. His helper Keith can paint the same house by himself in $x + 3$ days. Suppose that they work together on the job for 2 days. To complete the table, use the fact that the work completed is the product of the rate and the time. Write a rational expression for the fraction of the house that they complete by working together for 2 days. Evaluate the expression for $x = 6$.