

Math 120 Final Exam Review

Determine whether the relation is a function.

1) $\{(-7, -4), (-5, -7), (-2, -5), (2, -6)\}$

A) Not a function

B) Function

Determine whether the equation defines y as a function of x .

2) $y^2 = 4x$

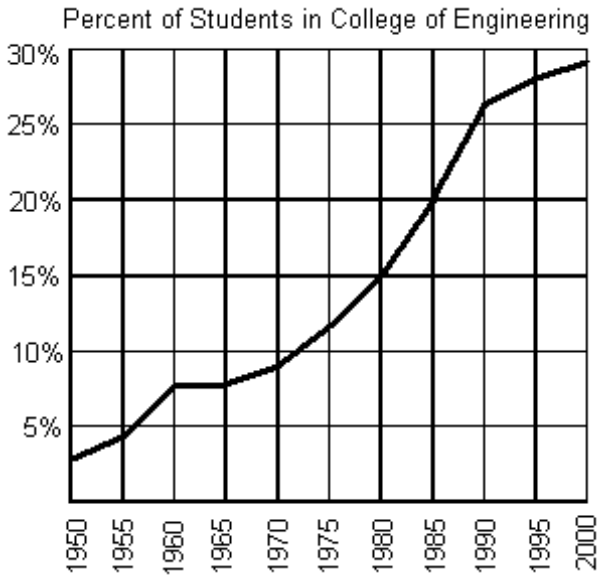
A) y is a function of x

B) y is not a function of x

Evaluate the function at the given value of the independent variable and simplify.

3) $f(x) = \frac{x^2 - 6}{x^3 + 3x}$; $f(3)$

The graph below shows the percentage of students enrolled in the College of Engineering at State University. Use the graph to answer the question.



4) Does the graph represent a function?

A) no

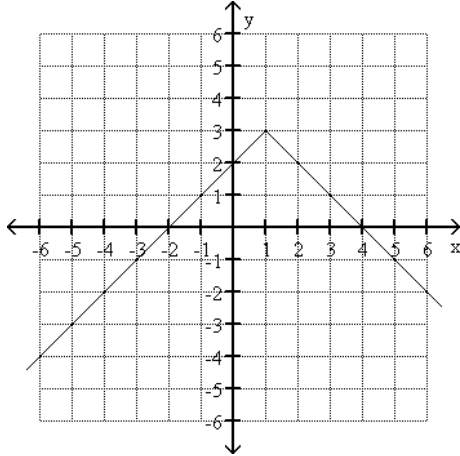
B) yes

5) Refer to the graph above #4. If f represents the function, find $f(1995)$.

6) Refer to the graph above #4. If $f(x) = 12\%$, what year is represented by x ?

Use the graph to determine the function's domain and range.

7)



A) domain: $(-\infty, \infty)$

range: $(-\infty, 3]$

C) domain: $(-\infty, \infty)$

range: $(-\infty, \infty)$

B) domain: $(-\infty, 1)$ or $(1, \infty)$

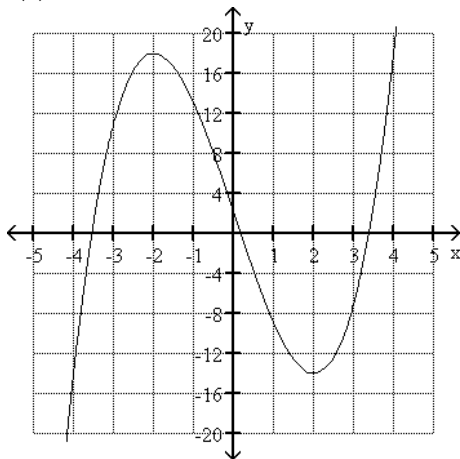
range: $(-\infty, 3)$ or $(3, \infty)$

D) domain: $(-\infty, 1]$

range: $(-\infty, 3]$

Use the graph of the given function to find any relative maxima and relative minima.

8) $f(x) = x^3 - 12x + 2$



Find and simplify the difference quotient $\frac{f(x+h) - f(x)}{h}$, $h \neq 0$ for the given function.

9) $f(x) = x^2 + 8x + 2$

A) 1

B) $\frac{2x^2 + 2x + 2xh + h^2 + h + 4}{h}$

C) $2x + h + 8$

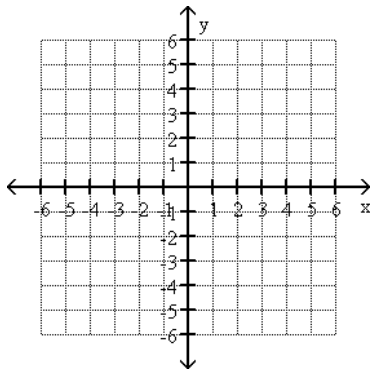
D) $2x + h + 2$

Use the given conditions to write an equation for the line in point-slope form.

10) Passing through $(3, 4)$ and $(7, 7)$

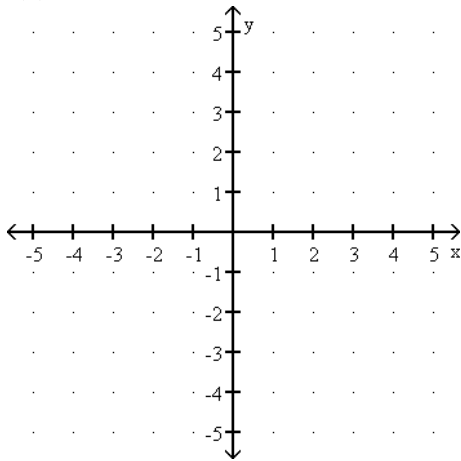
Graph the line whose equation is given.

11) $y = \frac{1}{2}x - 1$



Graph the equation in the rectangular coordinate system.

12) $f(x) = 4$



Solve.

13) The average value of a certain type of automobile was \$14,760 in 1991 and depreciated to \$4440 in 1994. Let y be the average value of the automobile in the year x , where $x = 0$ represents 1991. Write a linear equation that models the value of the automobile in terms of the year x .

A) $y = -3440x + 4440$

B) $y = -\frac{1}{3440}x - 4440$

C) $y = -3440x - 5880$

D) $y = -3440x + 14,760$

Use the given conditions to write an equation for the line in the indicated form.

14) Passing through $(4, 3)$ and perpendicular to the line whose equation is $y = \frac{1}{8}x + 8$;

slope-intercept form

A) $y = -8x + 35$

B) $y = 8x - 35$

C) $y = -\frac{1}{8}x - \frac{35}{8}$

D) $y = -8x - 35$

Find the average rate of change of the function from x_1 to x_2 .

15) $f(x) = \sqrt{2x}$ from $x_1 = 2$ to $x_2 = 8$

A) 2

B) $-\frac{3}{10}$

C) $\frac{1}{3}$

D) 7

Solve the problem.

16) Along with incomes, people's charitable contributions have steadily increased over the past few years. The table below shows the average deduction for charitable contributions reported on individual income tax returns for the period 1993 to 1998. Find the average annual increase between 1995 and 1997.

| Year | Charitable Contributions |
|------|--------------------------|
| 1993 | \$1650 |
| 1994 | \$2400 |
| 1995 | \$2480 |
| 1996 | \$2830 |
| 1997 | \$3050 |
| 1998 | \$3180 |

For the given functions f and g , find the indicated composition.

17) $f(x) = x^2 + 2x - 2$, $g(x) = x^2 - 2x - 4$

$(f \circ g)(-2)$

A) 22

B) 10

C) 18

D) 6

Find functions f and g so that $h(x) = (f \circ g)(x)$.

18) $h(x) = \frac{1}{x^2 - 4}$

Find the inverse of the one-to-one function.

19) $f(x) = (x + 7)^3$

A) $f^{-1}(x) = \sqrt[3]{x} + 7$

B) $f^{-1}(x) = \sqrt[3]{x} - 7$

C) $f^{-1}(x) = \sqrt{x} - 7$

D) $f^{-1}(x) = \sqrt[3]{x} - 343$

Determine which two functions are inverses of each other.

20) $f(x) = \frac{x - 3}{3}$ $g(x) = 3x - 3$ $h(x) = \frac{x + 3}{3}$

A) $f(x)$ and $h(x)$

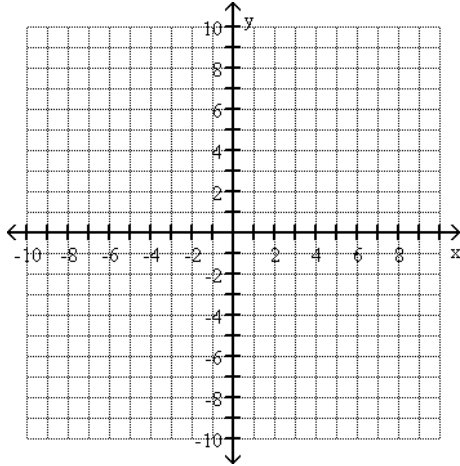
B) $f(x)$ and $g(x)$

C) $g(x)$ and $h(x)$

D) None

Graph f as a solid line and f^{-1} as a dashed line in the same rectangular coordinate space. Use interval notation to give the domain and range of f and f^{-1} .

21) $f(x) = x^2 - 8, x \geq 0$



Find all values of x satisfying the given conditions.

22) $f(x) = 8x + 4(3 + x), g(x) = 3(x - 6) + 10x,$ and $f(x) = g(x)$

A) $\{-30\}$

B) $\{30\}$

C) $\{9\}$

D) $\{-9\}$

Find the zero of the function.

23) $f(x) = 2[2x - (3x - 7)] - 6(x - 7)$

Solve the equation.

24) $\frac{8x}{9} - x = \frac{x}{36} - \frac{5}{4}$

25) $\frac{9}{x+3} - \frac{7}{x-3} = \frac{2}{x^2 - 9}$

Solve the problem.

26) The function $f(x) = \frac{24,000 + 280x}{x}$ models the average cost per unit, $f(x)$, for Electrostuff to manufacture x units

of Electrogadget IV. How many units must the company produce to have an average cost per unit of \$440?

A) 86 units

B) 150 units

C) 175 units

D) 152 units

Use the five-step strategy for solving word problems to find the number or numbers described in the following exercise.

27) When 80% of a number is added to the number, the result is 144. What is the number?

Find all values of x satisfying the given conditions.

28) $f(x) = x, g(x) = 7 + x, h(x) = 3(x - 8) + 10x,$ and the sum of 8 times the outputs of f and 4 times the outputs of g is equal to those of h .

A) $\{-52\}$

B) $\{-15\}$

C) $\{52\}$

D) $\{15\}$

Solve the problem.

- 29) You inherit \$10,000 with the stipulation that for the first year the money must be invested in two stocks paying 6% and 11% annual interest, respectively. How much should be invested at each rate if the total interest earned for the year is to be \$900?
- 30) After a 9% price reduction, a boat sold for \$28,210. What was the boat's price before the reduction? (Round to the nearest cent, if necessary.)
 A) \$30,748.90 B) \$313,444.44 C) \$2538.90 D) \$31,000
- 31) The length of a rectangular room is 7 feet longer than twice the width. If the room's perimeter is 194 feet, what are the room's dimensions?

Solve the equation by factoring.

32) $x^2 = x + 20$

Solve the equation by the square root property.

33) $2(x - 9)^2 = 14$

- A) {2, 16} B) $\{-9 \pm \sqrt{7}\}$ C) $\{9 \pm \sqrt{7}\}$ D) {-16, -2}

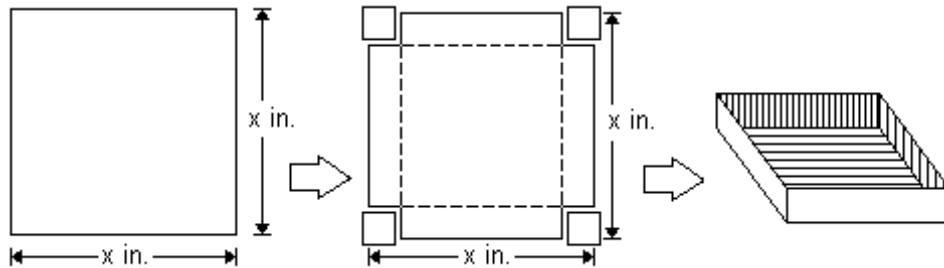
Solve the equation using the quadratic formula.

34) $6x^2 + 10x + 3 = 0$

- A) $\left\{ \frac{-10 - \sqrt{7}}{6}, \frac{-10 + \sqrt{7}}{6} \right\}$ B) $\left\{ \frac{-5 - \sqrt{43}}{6}, \frac{-5 + \sqrt{43}}{6} \right\}$
 C) $\left\{ \frac{-5 - \sqrt{7}}{6}, \frac{-5 + \sqrt{7}}{6} \right\}$ D) $\left\{ \frac{-5 - \sqrt{7}}{12}, \frac{-5 + \sqrt{7}}{12} \right\}$

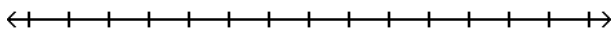
Solve the problem.

- 35) A ladder that is 10 feet long is 6 feet from the base of a wall. How far up the wall does the ladder reach?
- 36) Suppose that an open box is to be made from a square sheet of cardboard by cutting out 4-inch squares from each corner as shown and then folding along the dotted lines. If the box is to have a volume of 400 cubic inches, find the original dimensions of the sheet of cardboard.



Solve the linear inequality. Other than \emptyset , use interval notation to express the solution set and graph the solution set on a number line.

37) $-24x + 20 \leq -4(5x - 6)$



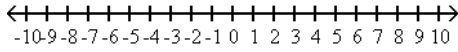
Use interval notation to represent all values of x satisfying the given conditions.

38) $f(x) = 4x - 5$, $g(x) = 3x - 9$, and $f(x) > g(x)$

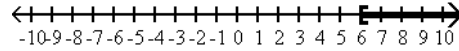
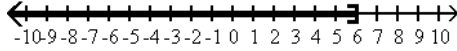
- A) $[-4, \infty)$ B) $(-14, \infty)$ C) $(-\infty, -4]$ D) $(-4, \infty)$

Solve the linear inequality. Other than \emptyset , use interval notation to express the solution set and graph the solution set on a number line.

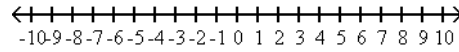
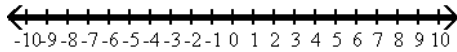
39) $7(x + 4) \geq 6(x - 3) + x$



- A) $(-\infty, 6]$ B) $[6, \infty)$

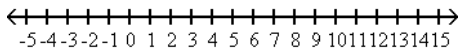


- C) $(-\infty, \infty)$ D) \emptyset



Solve the compound inequality. Other than \emptyset , use interval notation to express the solution set and graph the solution set on a number line.

40) $14 \leq \frac{5}{3}x + 9 < 29$



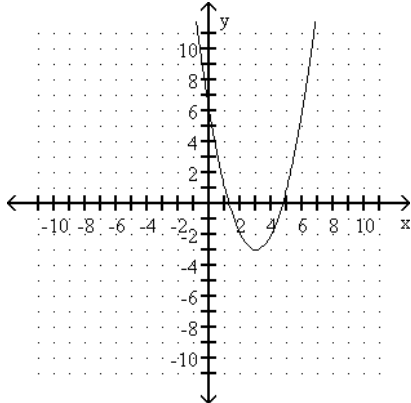
Solve the problem.

41) Greg is opening a car wash. He estimates his cost function as $C(x) = 9000 + 0.09x$ and his revenue function as $R(x) = 1.95x$, where x is the number of cars washed in a six-month period. Find the number of cars that must be washed in a six-month period for Greg to make a profit.

- A) At least 484 cars B) At least 48,388 cars C) At least 4839 cars D) At least 3839 cars

The graph of a quadratic function is given. Determine the function's equation.

42)



Determine whether the given quadratic function has a minimum value or maximum value. Then find the coordinates of the minimum or maximum point.

43) $f(x) = -x^2 - 2x - 9$

- A) minimum; $(-1, -8)$
C) maximum; $(-8, -1)$

- B) maximum; $(-1, -8)$
D) minimum; $(-8, -1)$

Solve the problem.

- 44) A rain gutter is made from sheets of aluminum that are 18 inches wide by turning up the edges to form right angles. Determine the depth of the gutter that will maximize its cross-sectional area and allow the greatest amount of water to flow.

Find the y-intercept of the polynomial function.

45) $f(x) = (x + 1)(x - 2)(x - 1)^2$

Use the Leading Coefficient Test to determine the end behavior of the polynomial function.

46) $f(x) = 4x^3 + 5x^3 - x^5$

- A) falls to the left and falls to the right
C) rises to the left and rises to the right

- B) falls to the left and rises to the right
D) rises to the left and falls to the right

Solve the problem.

- 47) The following table shows the number of fires in a county for the years 1994-1998, where 1 represents 1994, 2 represents 1995, and so on.

| Year, x | Fires, T |
|---------|----------|
| 1994, 1 | 2935.42 |
| 1995, 2 | 2998.4 |
| 1996, 3 | 3040.96 |
| 1997, 4 | 3077.32 |
| 1998, 5 | 3123.7 |

This data can be approximated using the third-degree polynomial

$$T(x) = -0.63x^3 + 0.57x^2 + 61.68x + 2873.8.$$

Use the Leading Coefficient Test to determine the end behavior to the right for the graph of T. Will this function be useful in modeling the number of fires over an extended period of time? Explain your answer.

- A) The graph of T approaches zero for large values of x. This means that T will not be useful in modeling the number of fires over an extended period.
B) The graph of T increases without bound to the right. This means that as x increases, the values of T will become large and positive and, since the values of T will become so large, the function will no longer model the number of fires.
C) The graph of T decreases without bound to the right. This means that as x increases, the values of T will become more and more negative and the function will no longer model the number of fires.
D) The graph of T decreases without bound to the right. Since the number of larceny thefts will eventually decrease, the function T will be useful in modeling the number of fires over an extended period of time.

Find the zeros for the polynomial function and give the multiplicity for each zero. State whether the graph crosses the x-axis or touches the x-axis and turns around, at each zero.

48) $f(x) = 5(x + 1)(x + 3)^4$

- A) -1, multiplicity 1, touches x-axis and turns around; -3, multiplicity 4, crosses x-axis
- B) 1, multiplicity 1, crosses x-axis; 3, multiplicity 4, touches x-axis and turns around
- C) 1, multiplicity 1, touches x-axis and turns around; 3, multiplicity 4, crosses x-axis
- D) -1, multiplicity 1, crosses x-axis; -3, multiplicity 4, touches x-axis and turns around

Write the equation of a polynomial function with the given characteristics. Use a leading coefficient of 1 or -1 and make the degree of the function as small as possible.

49) Touches the x-axis at 0 and crosses the x-axis at 2; lies below the x-axis between 0 and 2.

- A) $f(x) = -x^3 + 2x^2$
- B) $f(x) = x^3 - 2x^2$
- C) $f(x) = x^3 + 2x^2$
- D) $f(x) = -x^3 - 2x^2$

Determine the maximum possible number of turning points for the graph of the function.

50) $f(x) = (2x + 7)^4(x^4 + 5)(x + 7)$

- A) 4
- B) 9
- C) 18
- D) 8

Find the domain of the rational function.

51) $f(x) = \frac{x + 2}{x^2 - 16x}$

- A) $\{x \mid x \neq -4, x \neq 4, x \neq -2\}$
- B) $\{x \mid x \neq 0, x \neq 16\}$
- C) $\{x \mid x \neq -4, x \neq 4\}$
- D) all real numbers

Find the vertical asymptotes, if any, of the graph of the rational function.

52) $f(x) = \frac{x - 2}{x(x + 1)}$

Find the horizontal asymptote, if any, of the graph of the rational function.

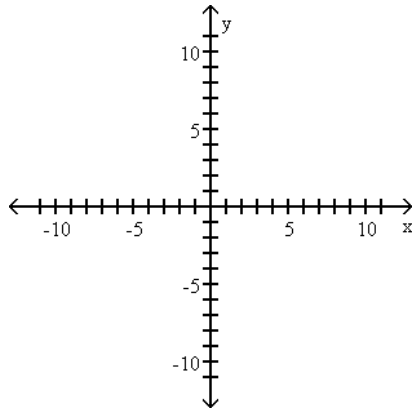
53) $f(x) = \frac{10x}{2x^2 + 1}$

54) $f(x) = \frac{-4x + 3}{5x - 3}$

- A) $y = -1$
- B) $y = -4$
- C) $y = -\frac{4}{5}$
- D) no horizontal asymptote

Graph the rational function.

$$55) f(x) = \frac{2x}{x^2 - 4}$$



Solve the problem.

- 56) A drug is injected into a patient and the concentration of the drug is monitored. The drug's concentration, $C(t)$, in milligrams after t hours is modeled by

$$C(t) = \frac{5t}{2t^2 + 2}$$

What is the horizontal asymptote for this function? Describe what this means in practical terms.

- A) $y = 1.25$; After 1.25 hours, the concentration of the drug is at its greatest.
B) $y = 0$; 0 is the final amount, in milligrams, of the drug that will be left in the patient's bloodstream.
C) $y = 2.50$; After 2.50 hours, the concentration of the drug is at its greatest.
D) $y = 2.50$; 2.50 is the final amount, in milligrams, of the drug that will be left in the patient's bloodstream.
- 57) y varies directly as z and $y = 160$ when $z = 16$. Find y when $z = 15$.
- A) 225 B) 256 C) 100 D) 150

Write an equation that expresses the relationship. Use k as the constant of variation.

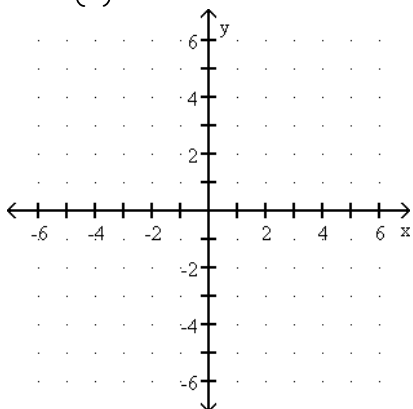
- 58) The intensity I of light varies inversely as the square of the distance D from the source. If the intensity of illumination on a screen 28 ft from a light is 2.5 foot-candles, find the intensity on a screen 40 ft from the light.
- A) 1.75 foot-candles B) 3.57 foot-candles C) 1.225 foot-candles D) 5.1 foot-candles

Solve the problem.

- 59) Body-mass index, or BMI, takes both weight and height into account when assessing whether an individual is underweight or overweight. BMI varies directly as one's weight, in pounds, and inversely as the square of one's height, in inches. In adults, normal values for the BMI are between 20 and 25. A person who weighs 170 pounds and is 71 inches tall has a BMI of 23.71. What is the BMI, to the nearest tenth, for a person who weighs 122 pounds and who is 66 inches tall?
- 60) A city is growing at the rate of 0.8% annually. If there were 3,980,000 residents in the city in 1995, find how many (to the nearest ten-thousand) are living in that city in 2000. Use $y = 3,980,000(2.7)^{0.008t}$.
- A) 4,140,000 B) 10,750,000 C) 430,000 D) 4,170,000

Graph the function by making a table of coordinates.

61) $f(x) = \left(\frac{5}{2}\right)^x$



Solve the problem.

62) The size of the raccoon population at a national park increases at the rate of 4.6% per year. If the size of the current population is 127, find how many raccoons there should be in 5 years. Use the function $f(x) = 127e^{0.046t}$ and round to the nearest whole number.

- A) 158 B) 164 C) 160 D) 162

Use the compound interest formulas $A = P\left(1 + \frac{r}{n}\right)^{nt}$ and $A = Pe^{rt}$ to solve.

63) Suppose that you have \$4000 to invest. Which investment yields the greater return over 7 years: 8.75% compounded continuously or 8.9% compounded semiannually?

Write the equation in its equivalent exponential form.

64) $\log_3 x = 2$

- A) $3^2 = x$ B) $2^3 = x$ C) $x^2 = 3$ D) $3^x = 2$

Write the equation in its equivalent logarithmic form.

65) $\sqrt[3]{216} = 6$

Evaluate the expression without using a calculator.

66) $\log_6 \sqrt{6}$

- A) 6 B) $\frac{1}{6}$ C) 1 D) $\frac{1}{2}$

67) $2^{\log_2 12}$

Solve the problem.

68) Use the formula $R = \log\left(\frac{a}{T}\right) + B$ to find the intensity R on the Richter scale, given that amplitude a is 443 micrometers, time T between waves is 2.8 seconds, and B is 2.1. Round answer to one decimal place.

- A) 4.3 B) 7.2 C) 8 D) 2.2

Evaluate or simplify the expression without using a calculator.

69) $\ln \sqrt[3]{e}$

A) $3e$

B) $\frac{e}{3}$

C) 3

D) $\frac{1}{3}$

Use properties of logarithms to expand the logarithmic expression as much as possible. Where possible, evaluate logarithmic expressions without using a calculator.

70) $\log_2 \left(\frac{x^3}{y^8} \right)$

Use common logarithms or natural logarithms and a calculator to evaluate to four decimal places

71) $\log_{25} 369$

Use properties of logarithms to condense the logarithmic expression. Write the expression as a single logarithm whose coefficient is 1. Where possible, evaluate logarithmic expressions.

72) $5\log_b y + 2\log_b z$

A) $\log_b (yz)^7$

B) $\log_b y^5 z^2$

C) $10\log_b yz$

D) $7\log_b yz$

Solve the equation by expressing each side as a power of the same base and then equating exponents.

73) $2(1 + 2x) = 8$

Solve the exponential equation. Use a calculator to obtain a decimal approximation, correct to two decimal places, for the solution.

74) $e^{2x} = 8$

A) 1.04

B) 4.16

C) 10.87

D) 0.09

Solve the logarithmic equation. Be sure to reject any value that is not in the domain of the original logarithmic expressions. Give the exact answer.

75) $\log_4 (x - 2) = -3$

A) $\left\{ -\frac{127}{64} \right\}$

B) $\left\{ -\frac{127}{81} \right\}$

C) $\left\{ \frac{129}{64} \right\}$

D) $\left\{ \frac{43}{27} \right\}$

Solve the problem.

76) The formula $A = 226e^{0.037t}$ models the population of a particular city, in thousands, t years after 1998. When will the population of the city reach 327 thousand?

77) The function $f(x) = 1 + 1.3 \ln(x + 1)$ models the average number of free-throws a basketball player can make consecutively during practice as a function of time, where x is the number of consecutive days the basketball player has practiced for two hours. After how many days of practice can the basketball player make an average of 7 consecutive free throws?

A) 470 days

B) 102 days

C) 100 days

D) 472 days

Solve.

78) The function $A = A_0 e^{-0.01155x}$ models the amount in pounds of a particular radioactive material stored in a concrete vault, where x is the number of years since the material was put into the vault. If 900 pounds of the material are initially put into the vault, how many pounds will be left after 180 years?

79) The population of a particular country was 29 million in 1982; in 1996, it was 37 million. The exponential growth function $A = 29e^{kt}$ describes the population of this country t years after 1982. Use the fact that 14 years after 1982 the population increased by 8 million to find k to three decimal places.

- A) 0.017 B) 0.149 C) 0.027 D) 0.498

80) A fossilized leaf contains 28% of its normal amount of carbon 14. How old is the fossil (to the nearest year)? Use $A = A_0e^{-0.000121t}$.

- A) 2649 B) 26,873 C) 34,489 D) 10,520

Solve the problem.

81) The logistic growth function $f(t) = \frac{36,000}{1 + 1199e^{-1.6t}}$ models the number of people who have become ill with a particular infection t weeks after its initial outbreak in a particular community. How many people were ill after 3 weeks?

- A) 36,010 people B) 3313 people C) 90 people D) 37,200 people