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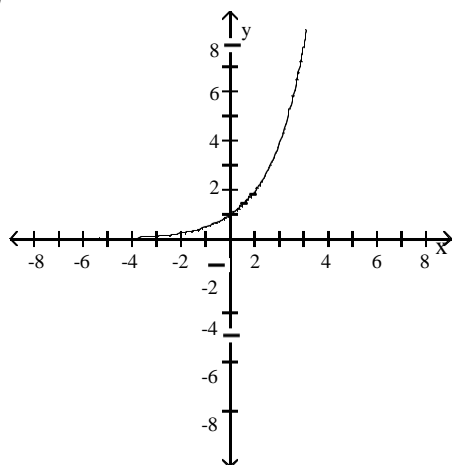
Solution manual:

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Match the graph to the function.

1)



A) $f(x) = 2^x - 1$

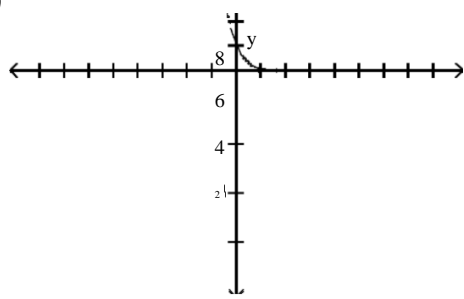
B) $f(x) = 2^x + 1$

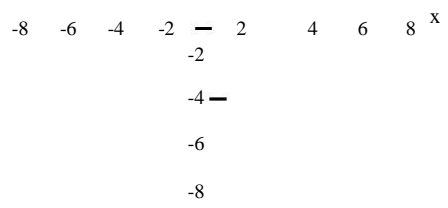
C) $f(x) = 2^{x-1}$

D) $f(x) = 2^x$

Answer: D

2)





A) $f(x) = -10^x$

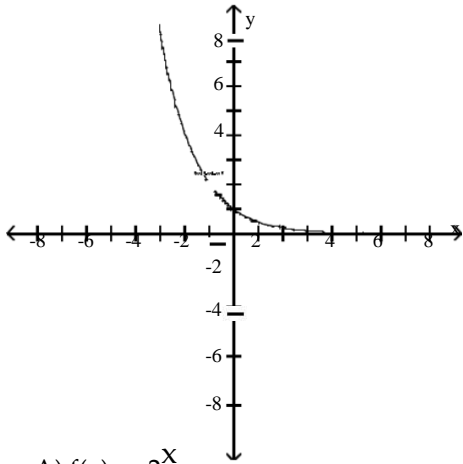
B) $f(x) = -\left(\frac{1}{10}\right)^x$

C) $f(x) = \left(\frac{1}{10}\right)^x$

D) $f(x) = 10^x$

Answer: C

3)



A) $f(x) = -2^x$

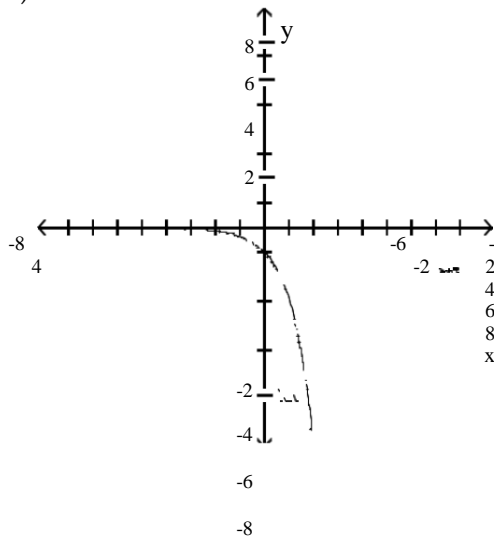
B) $f(x) = -2^{-x}$

C) $f(x) = 2^{-x}$

D) $f(x) = 2^x$

Answer: C

4)



A) $f(x) = 3^{-x}$

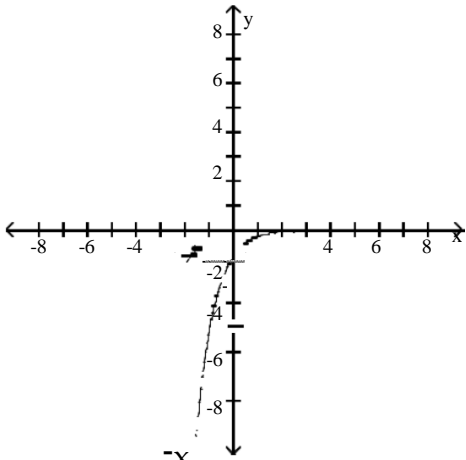
B) $f(x) = -3^{-x}$

C) $f(x) = 3^x$

D) $f(x) = -3^x$

Answer: D

5)



A) $f(x) = -4^{-x}$

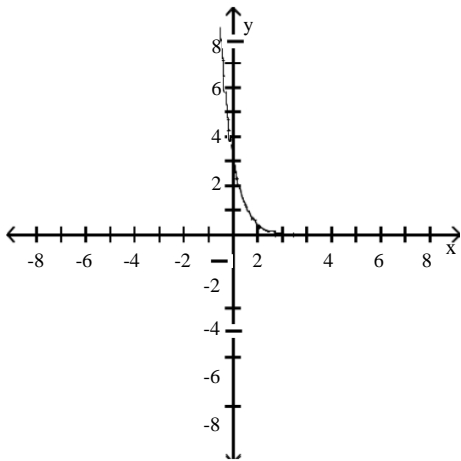
B) $f(x) = -4^x$

C) $f(x) = 4^x$

D) $f(x) = 4^{-x}$

Answer: A

6)



A) $f(x) = -3(7)^x$

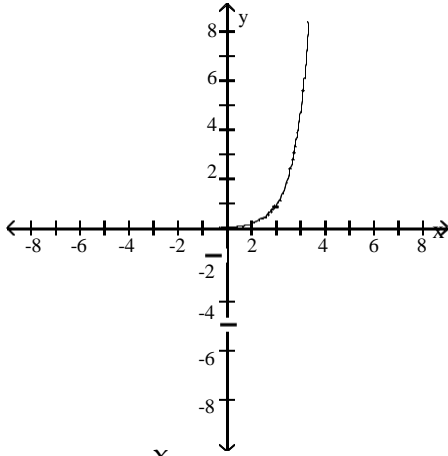
B) $f(x) = 3\left(\frac{1}{7}\right)^x$

C) $f(x) = -3\left(\frac{1}{7}\right)^x$

D) $f(x) = 3(7)^x$

Answer: B

7)



A) $f(x) = 5^x$

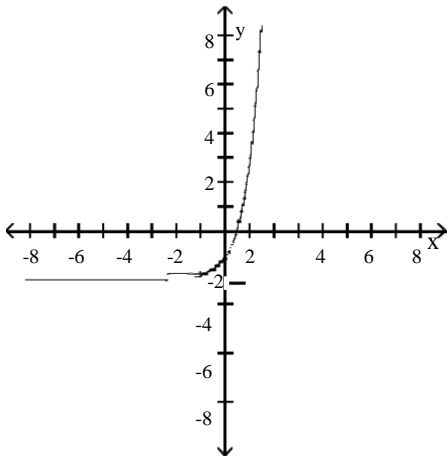
B) $f(x) = 5^{x-2}$

C) $f(x) = 5^x + 2$

D) $f(x) = 5^x - 2$

Answer: B

8)



A) $f(x) = 5^x - 2$

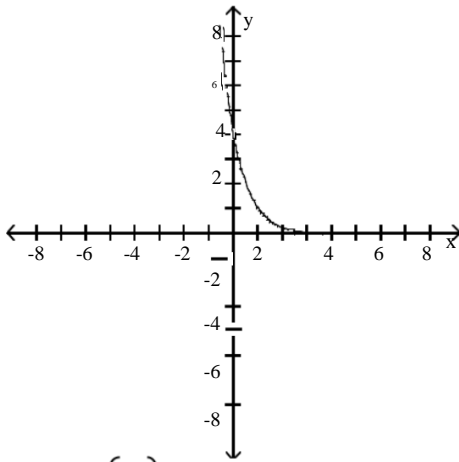
B) $f(x) = 5^x + 2$

C) $f(x) = 5^x$

D) $f(x) = 5^{x-2}$

Answer: A

9)



A) $y = \left(\frac{1}{4}\right)^{1-x}$

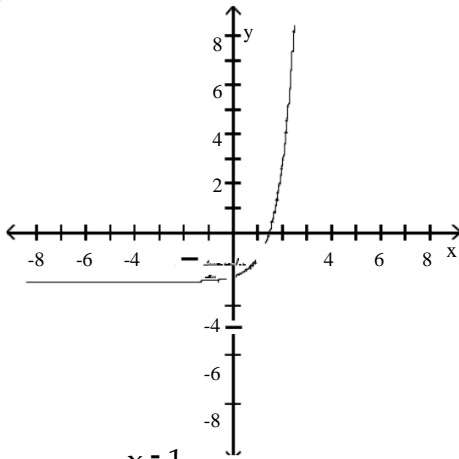
B) $y = 4^{x+1}$

C) $y = 4^{-x-1}$

D) $y = \left(\frac{1}{4}\right)^{x-1}$

Answer: D

10)



A) $y = 5^{x-1} - 2$

B) $y = \left(\frac{1}{5}\right)^{x+1} - 2$

C) $y = 5^{x+1} - 2$

D) $y = \left(\frac{1}{5}\right)^{x-1} - 2$

Answer: A

Solve the equation.

11) $4^x = 64$

- A) 16
- B) 3
- C) 2
- D) 4

Answer: B

12) $4^{-x} = 64^{-1}$

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

B) 16^{-1}

C) -3

D) 3

Answer: D

13) $3^{(12 - 3x)} = 729$

A) 243

B) 4

C) 2

D) -2

Answer: C

14) $3^{(1 + 2x)} = 27$

A) 3

B) 1

C) 9

D) -1

Answer: B

15) $4^{(7 - 3x)} = 16^{-1}$

A) 3

B) -3

C) 4

D) $\frac{1}{4}$

Answer: A

$$16) 5^x = 125^1$$

A) 3

B) ~~1~~3

C) ~~25~~1

D) -3

Answer: D

$$17) 4^{(7+3x)} = 16^1$$

A) 4

B) ~~1~~4

C) -3

D) 3

Answer: C

$$18) e^{-2x} = (e7)^{3-x}$$

A) ~~3~~5

B) ~~21~~5

C) ~~21~~5

D) 0

Answer: B

$$19) 2^{-|x|} = \frac{1}{8}$$

A) 3, -3

B) 2, -2

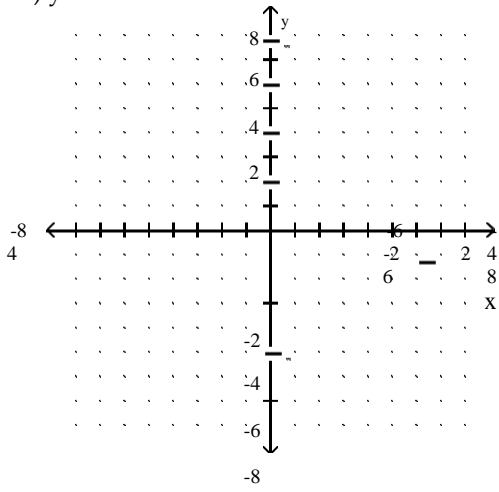
C) 3

D) 1, -1

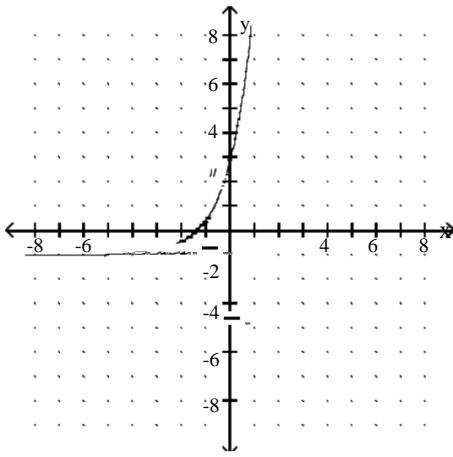
Answer: A

Graph the function.

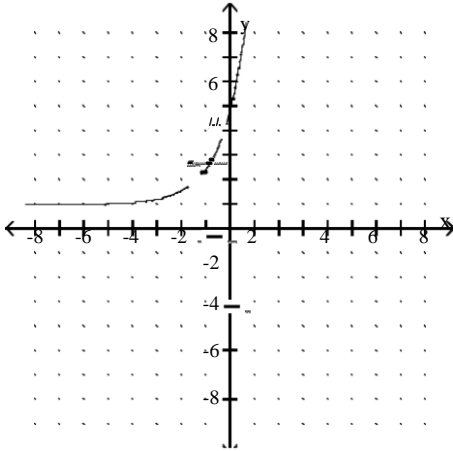
20) $y = 4e^x - 1$



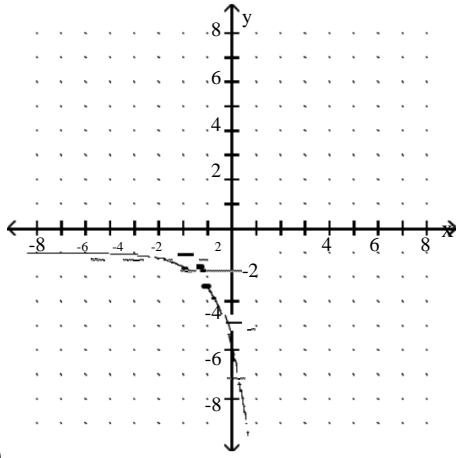
A)



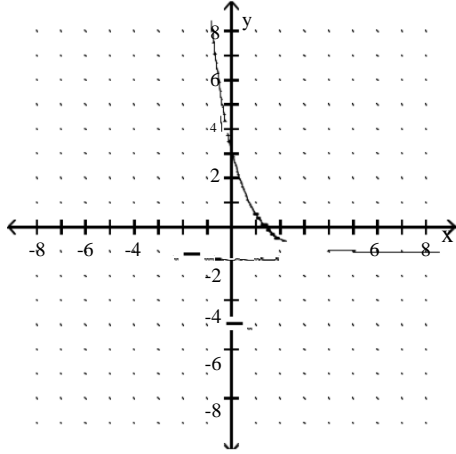
B)



C)

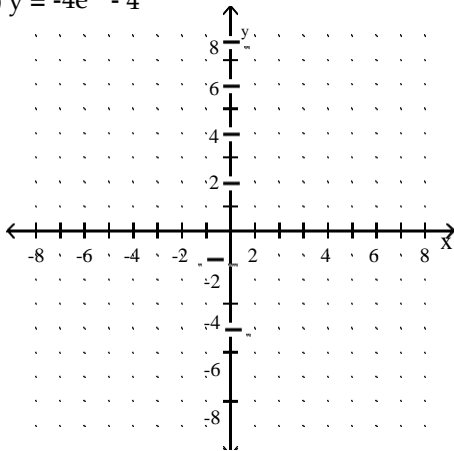


D)

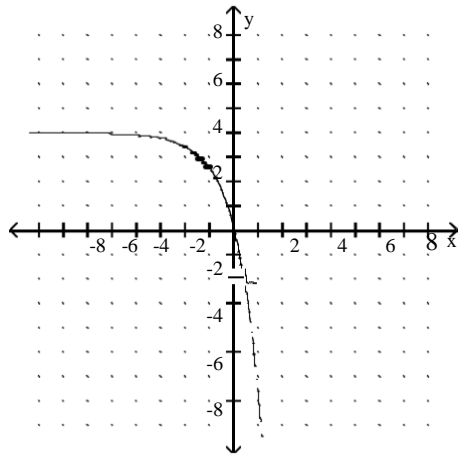


Answer: A

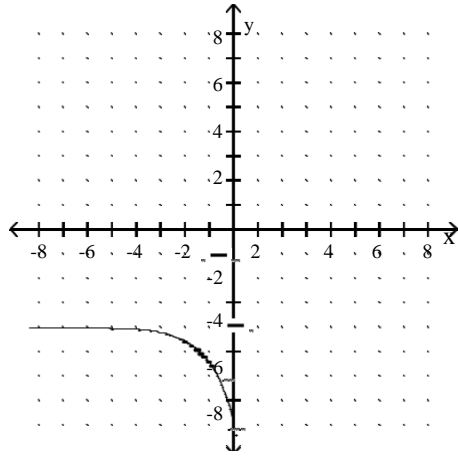
21) $y = -4e^x - 4$



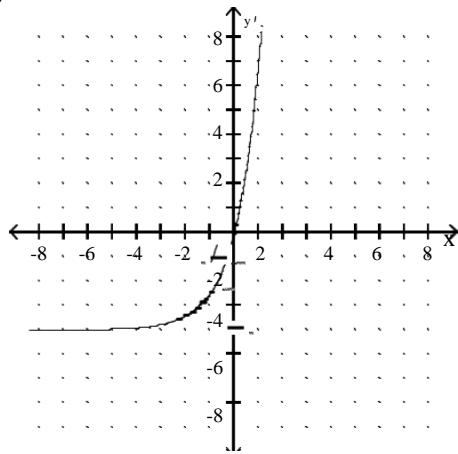
A)



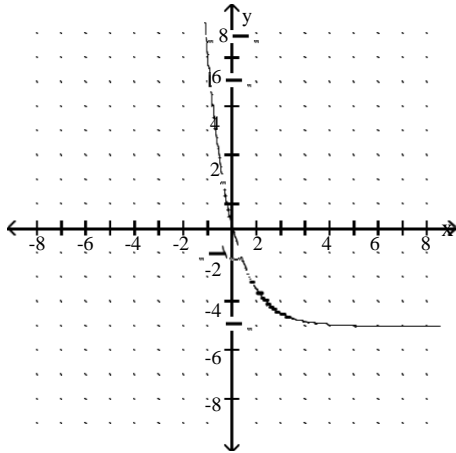
B)



C)

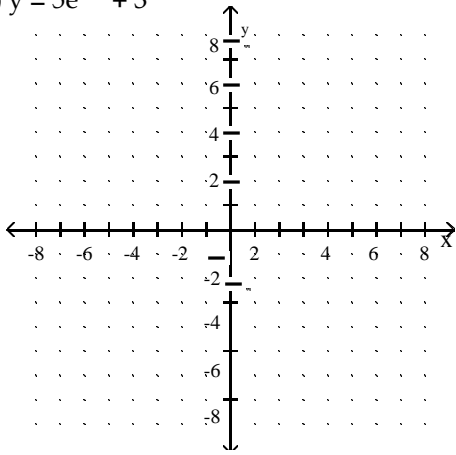


D)

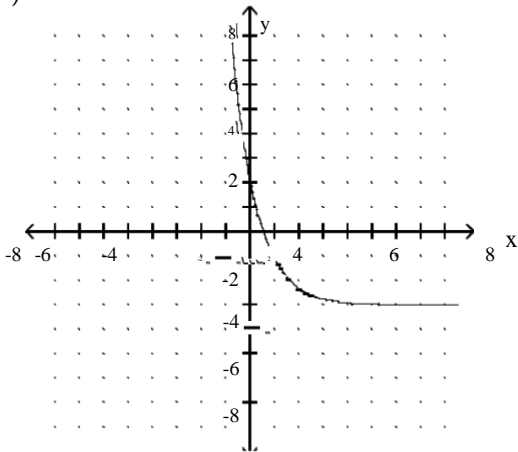


Answer: B

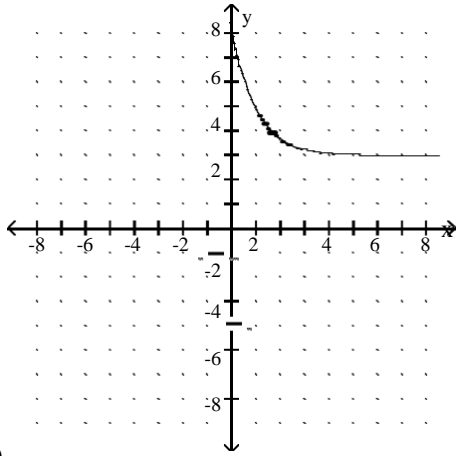
22) $y = 5e^{-x} + 3$



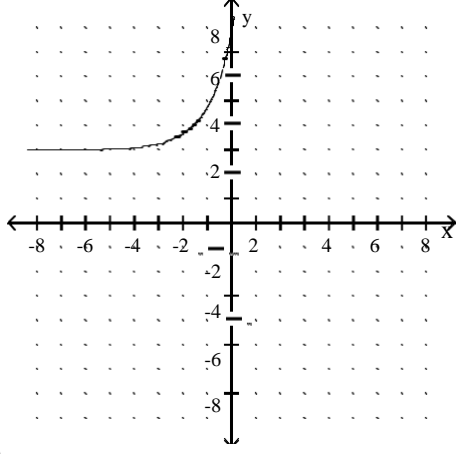
A)



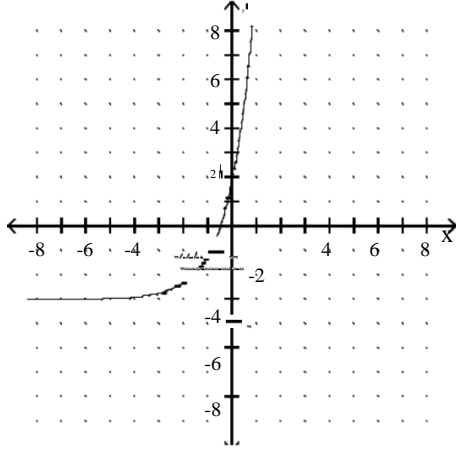
B)



C)

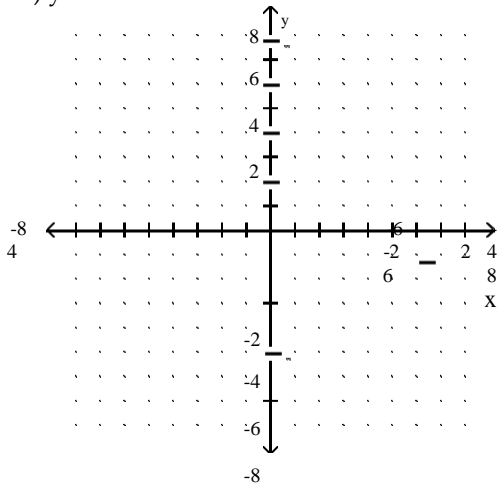


D)

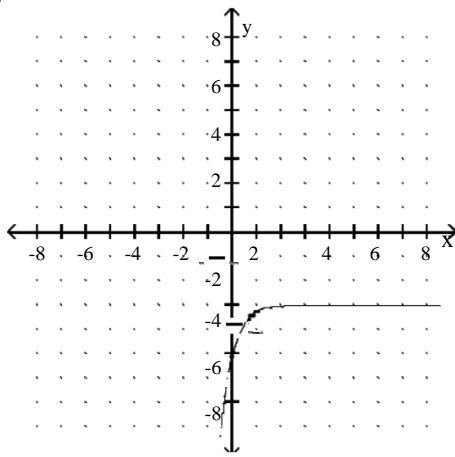


Answer: B

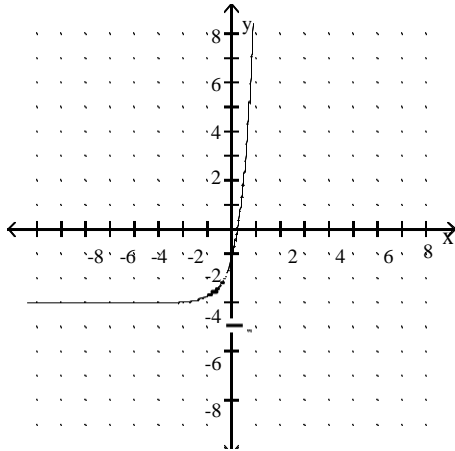
23) $y = 2e^{-2x} - 3$



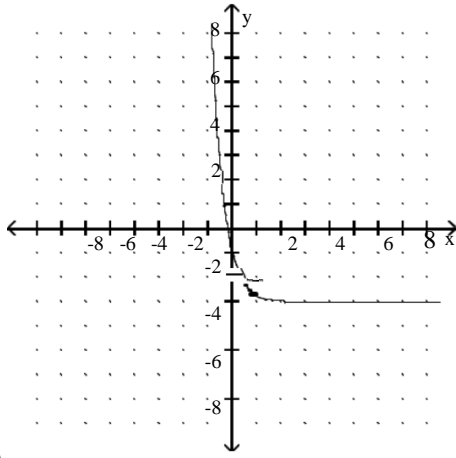
A)



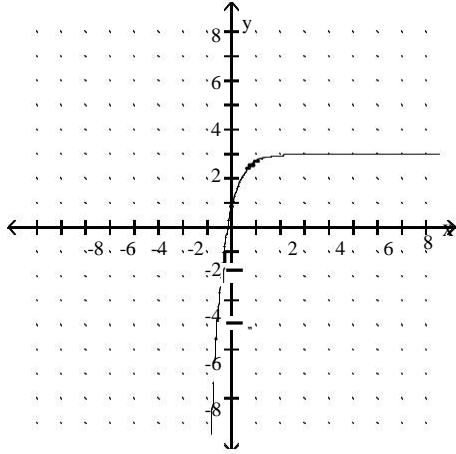
B)



C)

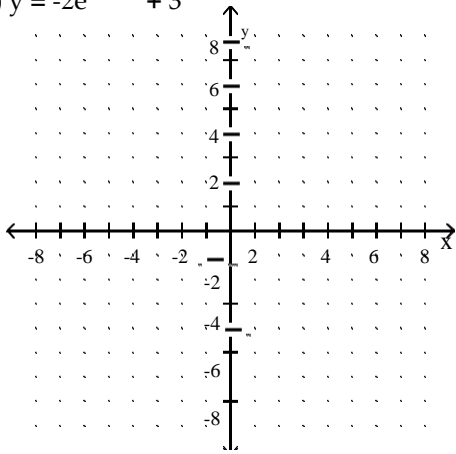


D)

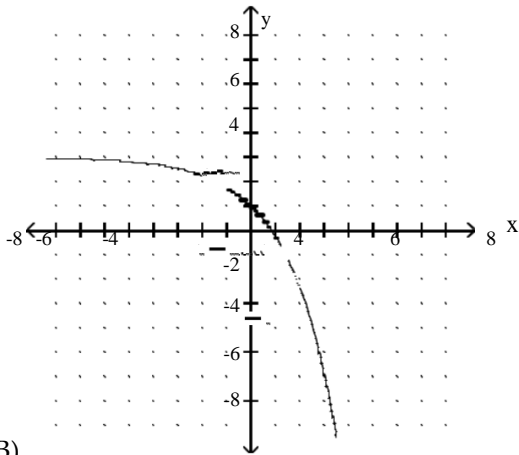


Answer: C

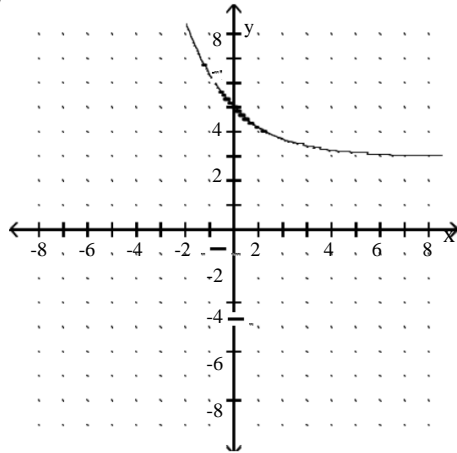
24) $y = -2e^{-x/2} + 3$



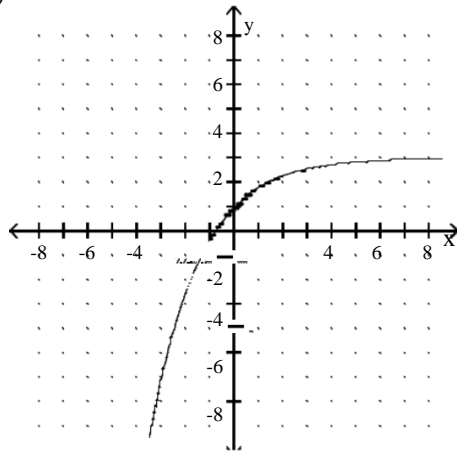
A)



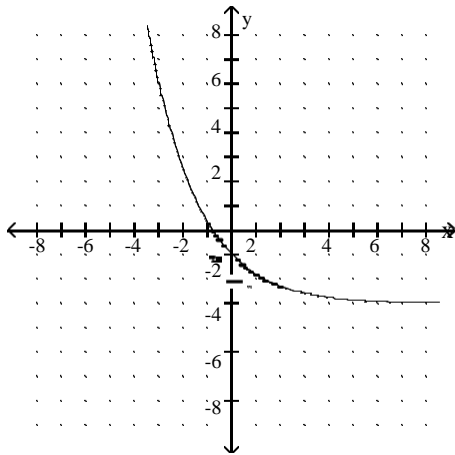
B)



C)



D)



Answer: C

Solve the problem.

25) Find the amount of interest earned on the following deposit: \$1000 at 6% compounded annually for 8 years

- A) \$593.85
- B) \$689.48
- C) \$1593.85
- D) \$503.63

Answer: A

26) How long will it take for prices in the economy to double at a 5% annual inflation rate? Round to the nearest hundredth when necessary.

- A) 22.52 yr
- B) 23.45 yr
- C) 14.21 yr
- D) 11.9 yr

Answer: C

27) An economist predicts that the buying power $B(x)$ of a dollar x years from now will decrease according to the formula $B(x) = 0.46^x$. How much will today's dollar be worth in 3 years? Round to the nearest cent.

- A) \$0.10
- B) \$0.79
- C) \$1.66
- D) \$1.38

Answer: A

28) Find the interest earned on \$11,000 invested for 5 years at 6.7% interest compounded quarterly. Round to the nearest cent.

- A) \$4334.74
- B) \$1.39
- C) \$15,334.74
- D) \$1987.77

Answer: A

- 29) Find the interest earned on \$9000 invested for 6 years at 6.8% interest compounded monthly. Round to the nearest cent.
- A) \$4528.02
 - B) \$4487.93
 - C) \$4355.80
 - D) \$4518.69

Answer: D

- 30) Suppose that the number of bacteria in a culture after x hours is given by $f(x) = 1000 \cdot 5^{0.125x}$. How many bacteria are in the culture after 10 hours?
- A) 828,614 bacteria
 - B) 13,133 bacteria
 - C) 7477 bacteria
 - D) 3 bacteria

Answer: C

- 31) Suppose that the number of bacteria in a culture after x hours is given by $f(x) = 500 \cdot 6^{0.5x}$. How many bacteria are in the culture after 4 hours?
- A) 39 bacteria
 - B) 18,000 bacteria
 - C) 1661 bacteria
 - D) 134 bacteria

Answer: B

- 32) The population of a particular city is increasing at a rate proportional to its size. It follows the function $P(t) = 1 + ke^{0.04t}$ where k is a constant and t is the time in years. If the current population is 37,000, in how many years is the population expected to be 92,500?
- A) 147 yr
 - B) 10 yr
 - C) 23 yr
 - D) 13 yr

Answer: C

- 33) The number of dislocated electric impulses per cubic inch in a transformer increases when lightning strikes by $D = 9200(5)^X$, where x is the time in milliseconds of the lightning strike. Find the number of dislocated impulses at $x = 0$ and $x = 4$.
- A) 46,000; 5,750,000
 - B) 9200; 5,750,000
 - C) 9200; 28,750,000
 - D) 9200; 184,000

Answer: B

- 34) The number of bacteria growing in an incubation culture increases with time according to $B = 7800(5)^X$, where x is time in days. Find the number of bacteria when $x = 0$ and $x = 4$.
- A) 39,000 bacteria, 4,875,000 bacteria
 - B) 7800 bacteria, 24,375,000 bacteria
 - C) 7800 bacteria, 156,000 bacteria
 - D) 7800 bacteria, 4,875,000 bacteria

Answer: D

35) The number of books in a small library increases according to the function $B = 5400e^{0.02t}$, where t is measured in years. How many books will the library have after 9 years?

- A) 9260 books
- B) 4022 books
- C) 8173 books
- D) 6465 books

Answer: D

Write the exponential equation in logarithmic form.

36) $7^2 = 49$

- A) $\log_2 49 = 7$
- B) $\log_{49} 7 = 2$
- C) $\log_7 2 = 49$
- D) $\log_7 49 = 2$

Answer: D

37) $4^2 = 16$

- A) $\log_4 16 = 2$
- B) $\log_2 16 = 4$
- C) $\log_{16} 4 = 2$
- D) $\log_4 2 = 16$

Answer: A

38) $4^{-2} = \frac{1}{16}$

A) $\log_4 \frac{1}{16} = -2$

B) $\log_4^{-2} = \frac{1}{16}$

C) $\log_{-2} \frac{1}{16} = 4$

D) $\log_{1/16} 4 = -2$

Answer: A

39) $\left(\frac{3}{2}\right)^{-2} = \frac{4}{9}$

A) $\log_{3/2} (-2) = \frac{4}{9}$

B) $\log_{4/9} (-2) = \frac{3}{2}$

C) $\log_{3/2} \frac{4}{9} = -2$

D) $\log_{4/9} \frac{3}{2} = -2$

Answer: C

Write the logarithmic equation in exponential form.

$$40) \log_4 16^{-1} = -2$$

$$A) 4^{16} = 2$$

$$B) 4^{-2} = 16^{-1}$$

$$C) \left(16^{-1} \right)^2 = 4$$

$$D) 2^4 = 16^{-1}$$

Answer: B

$$41) \log_2 8 = 3$$

$$A) 8^3 = 2$$

$$B) 2^3 = 8$$

$$C) 2^8 = 3$$

$$D) 3^2 = 8$$

Answer: B

$$42) \log 0.00001 = -5$$

$$A) 10^{-5} = 0.00001$$

$$B) 10^{0.00001} = -5$$

$$C) 0.00001^{-5} = 10$$

$$D) -5^{10} = 0.00001$$

Answer: A

$$43) \log_2 16 = 4$$

$$A) 2^4 = 16 + 1$$

$$B) 2^4 = 4$$

$$C) 2^4 = 16^{-1}$$

$$D) 2^4 = 16$$

Answer: D

$$44) \log 100 = 2$$

$$A) 10^2 = 100^{-1}$$

$$B) 10^2 = 100$$

$$C) 10^2 = 1000$$

$$D) 10^2 = 2$$

Answer: B

45) $\ln x = 7$

A) $x^7 = e$

B) $e^x = 7$

C) $e^7 = x$

D) $7^e = x$

Answer: C

46) $\ln \frac{1}{e^6} = -6$

A) $\left(\frac{1}{e}\right)^6 = -6$

B) $-6^e = \frac{1}{6e}$

C) $e^{-6} = \frac{1}{e^6}$

D) $\left(\frac{1}{e}\right)^{-6} = -6$

Answer: C

47) $\ln e^8 = 8$

A) $\ln e^8 = e^8$

B) $e^8 = e^8$

C) $e^8 = 8$

D) $\ln 8 = 8$

Answer: B

48) $\ln e^{1/8} = \frac{1}{8}$

A) $e^8 = e^{1/8}$

B) $e^{1/8} = e^{1/8}$

C) $e^{1/8} = \frac{1}{8}$

D) $\ln \frac{1}{8} = e^{1/8}$

Answer: B

Evaluate the logarithm without using a calculator.

49) $\log_4 64$

A) 12

B) 3

C) 64

D) 4

Answer: B

50) $\log_4 \frac{1}{4}$

- A) -1
- B) 4
- C) 0
- D) 1

Answer: A

51) $\log_7 \frac{1}{49}$

- A) -7
- B) 7
- C) -2
- D) 2

Answer: C

52) $\log_{10} 10$

- A) 10
- B) 0
- C) -1
- D) 1

Answer: D

53) $\log_9 \frac{1}{729}$

- A) -81
- B) 3
- C) -3
- D) 81

Answer: C

54) $\log_8 32$

- A) $\frac{5}{4}$
- B) $\frac{4}{3}$
- C) $\frac{3}{2}$
- D) $\frac{5}{3}$

Answer: D

55) $\ln e$

- A) -1
- B) 0
- C) e
- D) 1

Answer: D

56) $\ln 1$

- A) -1
- B) e
- C) 0
- D) 1

Answer: C

57) $\log_4 \sqrt[4]{\frac{1}{2}}$

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

Answer: A

58) $\ln e^{5/7}$

- A) $\frac{7}{5}$
- B) $\frac{7}{5} e$
- C) $\frac{5}{7} e$
- D) $\frac{5}{7}$

Answer: D

Rewrite the expression as a sum, difference, or product of simpler logarithms.

59) $\log_8 11x$

- A) $\log_4 11 + \log_4 x$
- B) $\log_8 11 - \log_8 x$
- C) $\log_8 11 + \log_8 x$
- D) $\log_4 11 - \log_4 x$

Answer: C

60) $\log_6 xy$

- A) $\log_3 x - \log_3 y$
- B) $\log_6 x + \log_6 y$
- C) $\log_6 x - \log_6 y$
- D) $\log_3 x + \log_3 y$

Answer: B

$$61) \log_4 \frac{9}{10}$$

- A) $\log_4 9 + \log_4 10$
- B) $\log_4 10 - \log_4 9$
- C) $\log_4 9 - \log_4 10$
- D) $\log_2 9 - \log_2 10$

Answer: C

$$62) \log_4 \frac{\sqrt{6}}{11}$$

- A) $\left(\frac{1}{2}\right) \log_4 6 + \log_4 11$
- B) $\left(\frac{1}{2}\right) \log_2 6 - \log_2 11$
- C) $\left(\frac{1}{2}\right) \log_4 6 - \log_4 11$
- D) $\log_4 11 - \left(\frac{1}{2}\right) \log_4 6$

Answer: C

$$63) \log_5 \frac{3p}{5k}$$

- A) $\log_5 3p - \log_5 5k$
- B) $\frac{\log_5 3 \log_5 p}{\log_5 k}$
- C) $\log_5 3 + \log_5 p - 1 - \log_5 k$
- D) $\frac{\log_5 3 + \log_5 p}{1 + \log_5 k}$

Answer: C

$$64) \log_5 \frac{2\sqrt[5]{64}}{\sqrt{3}}$$

- A) $\frac{\log_5 2 + 5 \log_5 6}{4 \log_5 3}$
- B) $\frac{\log_5 2 + \frac{1}{5} \log_5 6}{\frac{1}{4} \log_5 3}$
- C) $\log_5 2 + \frac{1}{5} \log_5 6 - \frac{1}{4} \log_5 3$

Answer: C

Use the properties of logarithms to find the value of the expression.

65) Let $\log_b A = 2$ and $\log_b B = -3$. Find $\log_b AB$.

- A) -6
- B) -1
- C) 6
- D) 5

Answer: B

66) Let $\log_b A = 4$ and $\log_b B = -20$. Find $\log_b A^4 B$.

- A) 24
- B) $-\frac{1}{5}$
- C) -16
- D) $\frac{1}{5}$

Answer: A

67) Let $\log_b A = 3$ and $\log_b B = -4$. Find $\log_b B^2$.

- A) -16
- B) 6
- C) 16
- D) -8

Answer: D

68) Let $\log_b A = 3$ and $\log_b B = -2$. Find $\log_b 2\sqrt[3]{AB}$.

- A) $2\sqrt[3]{6}$
- B) 2.449
- C) 0.500
- D) -2.449

Answer: C

69) Let $\log_b A = 2.518$ and $\log_b B = 0.186$. Find $\log_b AB$.

- A) 13.538
- B) 2.704
- C) 0.468
- D) 2.332

Answer: B

70) Let $\log_b A = 3.098$ and $\log_b B = 0.234$. Find $\log_b A^3 B$.

- A) 0.725
- B) 3.098
- C) 3.332
- D) 2.864

Answer: D

71) Let $\log_b 6 = a$ and $\log_b 3 = c$. Find $\log_b (216b^5)$.

- A) $3b + a - 5$
- B) $3a + 5$
- C) $3ab$
- D) $3(a + b)$

Answer: B

Use natural logarithms to evaluate the logarithm to the nearest thousandth.

72) $\log_9 33$

- A) 1.519
- B) 0.628
- C) 1.591
- D) 3.667

Answer: C

73) $\log_2 0.358$

- A) -0.675
- B) 5.587
- C) -1.482
- D) -0.446

Answer: C

74) $\log_{7.9} 192$

- A) 24.304
- B) 2.283
- C) 0.393
- D) 2.544

Answer: D

75) $\log_{3.4} 2.3$

- A) 0.676
- B) 0.681
- C) 0.362
- D) 1.469

Answer: B

76) $\log_{\sqrt{3}} 180.1$

- A) 0.106
- B) 0.239
- C) 4.727
- D) 9.455

Answer: D

Solve the equation.

77) $\log 3x = \log 2 + \log (x + 5)$

A) -10

B) 10

C) 2

D) $\frac{7}{2}$

Answer: B

78) $\log (x + 5) = \log (2x + 3)$

A) $-\frac{2}{3}$

B) 2

C) -2

D) 8

Answer: B

79) $\log_2 x = 3$

A) 6

B) 8

C) 1.58

D) 9

Answer: B

80) $\log_y 13 = 2$

A) $\frac{13}{2}$

B) $13^{1/2}$

C) $2^{1/13}$

D) 13^2

Answer: B

81) $\log (3 + x) - \log (x - 4) = \log 2$

A) -11

B) 11

C) $\frac{3}{2}$

D) No solution

Answer: B

82) $\log_7 (5x - 3) = \log_7 (2x + 6)$

A) 3

B) 3

C) 1

D) No solution

Answer: A

83) $\log_8(6x + 5) = \log_8(6x + 7)$

A) - 6

B) $\frac{5}{7}$

C) 0

D) No solution

Answer: D

84) $\log_9 x^2 = \log_9(4x + 12)$

A) 6, -2

B) $\frac{2}{3}$

C) 6

D) No solution

Answer: A

85) $\frac{1}{2} \log_2 x^2 = \log_4 4x$

A) 4, 0

B) 4

C) 8

D) No solution

Answer: B

Solve the equation. Round decimal answers to the nearest thousandth.

86) $2^x = 13$

A) 3.700

B) 6.500

C) 1.872

D) 0.270

Answer: A

87) $e^{-0.02x} = 0.05$

A) 149.787

B) -2.5

C) 2.996

D) -149.787

Answer: A

88) $e^{y+8} = 2$

A) -7.307

B) -7.699

C) 0.087

D) 8.693

Answer: A

89) $4^{(3x - 2)} = 11$

- A) 1.583
- B) 1.243
- C) 1.004
- D) -0.090

Answer: B

90) $6e^{5x + 1} = 18$

- A) -0.104
- B) 3.400
- C) 0.420
- D) 0.020

Answer: D

91) $8e^{4x+9} = 2$

- A) -4.507
- B) -0.687
- C) -2.597
- D) -3.813

Answer: C

92) $100.68^x = 90.89^x$

- A) -8.96
- B) 0.21
- C) 0.164
- D) 0.000

Answer: D

Write the expression using base e rather than base 10.

93) $10^{x + 9}$

- A) $10e^{x + 9}$
- B) $e(\ln 10)(x + 9)$
- C) $e10(x + 9)$
- D) $(x + 9)e^{10}$

Answer: B

94) 10^{x^7}

- A) $e(\ln 10)x^7$
- B) $x^7 e^{10}$
- C) $e10x^7$
- D) $10e^{x^7}$

Answer: A

Approximate the expression in the form a^x without using e. Round to the nearest thousandth when necessary.

95) e^{8x}

A) 285.005^x

B) 21.746^x

C) 2.079^x

D) 2980.958^x

Answer: D

96) e^{-4x}

A) 0.68^x

B) -10.873^x

C) 0.018^x

D) -1.386^x

Answer: C

Find the domain of the function.

97) $f(x) = \log(x - 6)$

A) $x > 0$

B) $x > -6$

C) $x > 6$

D) $x > 1$

Answer: C

98) $f(x) = \ln(-5 - x)$

A) $x > -5$

B) $x < -5$

C) $x > 5$

D) $x < 5$

Answer: B

99) $f(x) = \log_8(4 - x^2)$

A) $-2 < x < 2$

B) $-4 < x < 4$

C) $-2 \leq x \leq 2$

D) $x < -2$ and $x > 2$

Answer: A

100) $f(x) = \ln(7x - x^2)$

A) $-7 \leq x < 0$

B) $x \leq 7$

C) $0 < x < 7$

D) $-7 < x < 7$

Answer: C

Solve the problem.

101) Sonja and Chris both accept new jobs on March 1, 2001. Sonja starts at \$44,000 with a raise each March 1 of 3%. Chris starts at \$27,000 with a raise on March 1 of each year of 6%. In what year will Chris' salary exceed Sonja's?

- A) 2018
- B) 2019
- C) 2017
- D) 2016

Answer: B

102) A college student invests \$8000 in an account paying 8% per year compounded annually. In how many years will the amount at least double? Round to the nearest tenth when necessary.

- A) 16.3 yr
- B) 14.3 yr
- C) 11.9 yr
- D) 9 yr

Answer: D

103) How long will it take for prices in the economy to double at a 4% annual inflation rate? Round to the nearest hundredth when necessary.

- A) 28.01 yr
- B) 14.21 yr
- C) 17.67 yr
- D) 23.45 yr

Answer: C

104) Assume the cost of a car is \$27,000. With continuous compounding in effect, find the number of years it would take to double the cost of the car at an annual inflation rate of 4%. Round to the nearest hundredth.

- A) 2.55 yr
- B) 272.42 yr
- C) 255.09 yr
- D) 17.33 yr

Answer: D

105) Suppose the consumption of electricity grows at 8% per year, compounded continuously. Find the number of years before the use of electricity has tripled. Round to the nearest hundredth.

- A) 0.14 yr
- B) 37.50 yr
- C) 13.73 yr
- D) 1.37 yr

Answer: C

106) The purchasing power of a dollar is decreasing at the rate of 4% annually, compounded continuously. How long will it take for the purchasing power of \$1.00 to be worth \$0.36? Round to the nearest hundredth.

- A) 2.55 yr
- B) 9.00 yr
- C) 25.54 yr
- D) 0.26 yr

Answer: C

107) At what interest rate must \$4400 be compounded annually to equal \$8711.70 after 14 years? Round to the nearest percent.

- A) 4%
- B) 5%
- C) 7%
- D) 6%

Answer: B

108) Kimberly invested \$4000 in her savings account for 5 years. When she withdrew it, she had \$5647.96. Interest was compounded continuously. What was the interest rate on the account? Round to the nearest tenth of a percent when necessary.

- A) 7.05%
- B) 6.9%
- C) 7%
- D) 6.8%

Answer: B

109) The magnitude of an earthquake, measured on the Richter scale, is given by $R(I) = \log \frac{I}{I_0}$, where I is the

amplitude registered on a seismograph located 100 km from the epicenter of the earthquake, and I_0 is the amplitude of a certain small size earthquake. Find the Richter scale rating of an earthquake with an amplitude of 63,096 I_0 .

- A) 4.8
- B) 0.48
- C) 11.1
- D) 3.8

Answer: A

110) The magnitude of an earthquake, measured on the Richter scale, is given by $R(I) = \log \frac{I}{I_0}$, where I is the

amplitude registered on a seismograph located 100 km from the epicenter of the earthquake, and I_0 is the amplitude of a certain small size earthquake. An earthquake measured 4.5 on the Richter scale. Express this reading in terms of I_0 .

- A) 25,119 I_0
- B) 3162 I_0
- C) 90 I_0
- D) 31,623 I_0

Answer: D

- 111) The magnitude of an earthquake, measured on the Richter scale, is given by $R(I) = \log \frac{I}{I_0}$, where I is the amplitude registered on a seismograph located 100 km from the epicenter of the earthquake, and I_0 is the amplitude of a certain small size earthquake. Find the Richter scale rating of an earthquake with an amplitude of $10^{5.9} I_0$.
- A) 5.9
 - B) 15.9
 - C) 4.1
 - D) 13.6

Answer: A

- 112) A certain noise has intensity $8.62 \times 10^8 I_0$. What is the decibel rating of this sound? Use the formula $D = 10 \log \frac{I}{I_0}$, where I_0 is a faint threshold sound, and I is the intensity of the sound."
- A) 206 decibels
 - B) 89 decibels
 - C) 9 decibels
 - D) 79 decibels

Answer: B

- 113) The pH of a solution is defined as $\text{pH} = -\log[\text{H}^+]$, where $[\text{H}^+]$ is the concentration of hydrogen ions in the solution. The pH of pure water is 7, while the pH of lemon juice is about 2. How much greater is the concentration of hydrogen ions in lemon juice than in pure water?
- A) 5 times greater
 - B) 10 times greater
 - C) 100,000 times greater
 - D) 10,000 times greater

Answer: C

- 114) An RC circuit is a simple electronic circuit consisting of a resistor, a capacitor, and a battery. The current i in the circuit at some time t after the battery is connected is $i = \frac{V}{R} e^{-t/(RC)}$, where V is the battery's voltage, R is the resistance, and C is the capacitance. Solve this equation for C .

A) $C = \frac{t}{R \ln \left(\frac{V}{iR} \right)}$

B) $C = \frac{Ve^{-t}}{R^2 C}$

C) $C = \frac{-R}{t \ln \left(\frac{iR}{V} \right)}$

D) $C = \frac{V}{R} e^{-t/(iR)}$

Answer: A

115) One hundred rats are being trained to run through a maze and are rewarded when they run through it correctly. Once a rat successfully runs the maze, it continues to run the maze correctly in all subsequent trials. The number of rats that run the maze *incorrectly* after t attempts is given approximately by $N(t) = 100e^{-.14t}$. Find the number of trials required such that only 45% of the rats are running the maze

incorrectly. Round to the nearest trial.

- A) 5 trials
- B) 23 trials
- C) 6 trials
- D) 27 trials

Answer: C

116) The population growth of an animal species is described by $F(t) = 300 + 80 \log_3(2t + 1)$ where t is measured in months. Find the population of this species in an area 1 month(s) after the species is introduced.

- A) 200
- B) 540
- C) 290
- D) 380

Answer: D

117) Coyotes are one of the few species of North American animals with an expanding range. The future population of coyotes in a region of Mississippi can be modeled by the equation $P = 59 + 16 \ln(14t + 1)$, where t is time in years. Use the equation to determine when the population will reach 140. (Round to the nearest tenth of a year.)

- A) 11.4 yr
- B) 11.5 yr
- C) 11.2 yr
- D) 8248.4 yr

Answer: C

118) Find the effective rate corresponding to the nominal rate. 6% compounded monthly. Round to the nearest hundredth.

- A) 6.23%
- B) 6.17%
- C) 6.12%
- D) 6.26%

Answer: B

119) Find the effective rate corresponding to the nominal rate. 6% compounded quarterly. Round to the nearest hundredth.

- A) 6.20%
- B) 6.09%
- C) 6.14%
- D) 6.23%

Answer: C

120) Find the present value of the deposit. \$5000 at 4% compounded monthly for 5 years. Round to the nearest cent.

- A) \$4115.02
- B) \$6084.98
- C) \$4095.02
- D) \$6104.98

Answer: C

- 121) Find the present value of the deposit. \$7000 at 6% compounded quarterly for 3 years. Round to the nearest cent.
- A) \$5854.71
 - B) \$8369.33
 - C) \$5872.71
 - D) \$8351.33

Answer: A

- 122) Find the present value of the deposit. \$500 at 7% compounded continuously for 10 years. Round to the nearest dollar.
- A) \$7240
 - B) \$10,690
 - C) \$248
 - D) \$3547

Answer: C

- 123) Find the present value of the deposit. \$10,000 at 4% compounded continuously for 10 years. Round to the nearest dollar.
- A) \$122,941
 - B) \$417,587
 - C) \$167,587
 - D) \$6703

Answer: D

- 124) Barbara knows that she will need to buy a new car in 5 years. The car will cost \$15,000 by then. How much should she invest now at 6%, compounded quarterly, so that she will have enough to buy a new car? Round to the nearest cent.
- A) \$10,574.41
 - B) \$11,881.40
 - C) \$12,939.13
 - D) \$11,137.06

Answer: D

- 125) Southwest Dry Cleaners believes that it will need new equipment in 6 years. The equipment will cost \$26,000. What lump sum should be invested today at 6% compounded semiannually, to yield \$26,000? Round to the nearest cent.
- A) \$21,894.60
 - B) \$23,593.24
 - C) \$18,235.88
 - D) \$21,731.62

Answer: C

- 126) An investment of \$13,335 earns 8% interest compounded monthly for 2 years. (a) What is the value of the investment after 2 years? (b) If money can be deposited at 6% compounded quarterly, find the present value of the investment. Round to the nearest cent.
- A) (a) \$15,536.88
(b) \$14,518.42
 - B) (a) \$15,640.46
(b) \$13,884.21
 - C) (a) \$14,063.02
(b) \$14,092.47
 - D) (a) \$16,640.46
(b) \$15,518.42

Answer: B

- 127) If money can be invested at 6% compounded quarterly, which is larger -- \$1000 now or the present value of \$1210 left at 6% interest for 5 years?
- A) \$1000 now
 - B) Present value of \$1210 left for 5 years

Answer: A

- 128) A certificate of deposit pays 5% interest compounded quarterly. What effective interest rate does the CD pay? Round to the nearest tenth when necessary.
- A) 5.8%
 - B) 5.1%
 - C) 4%
 - D) 21.6%

Answer: B

- 129) The sales of a new model of notebook computer are approximated by: $S(x) = 4000 - 14,000e^{-x/9}$, where x represents the number of months the computer has been on the market and S represents sales in thousands of dollars. In how many months will the sales reach \$2,200,000? Round to the nearest month.
- A) 18 months
 - B) 21 months
 - C) 28 months
 - D) 25 months

Answer: A

- 130) The sales of a mature product (one which has passed its peak) will decline by the function $S(t) = S_0 e^{-at}$, where t is time in years. Find the sales after 11 years if $a = 0.24$ and $S_0 = 20,700$. Round to the nearest sale.
- A) 16,283 sales
 - B) 1477 sales
 - C) 1162 sales
 - D) 739 sales

Answer: B

- 131) The number of books in a small library increases according to the function $B = 2100e^{0.03t}$, where t is measured in years. How many books will the library have after 8 years? Round to the nearest book.
- A) 3649 books
 - B) 1302 books
 - C) 2997 books
 - D) 2670 books

Answer: D

- 132) In the formula $N = Ie^{kt}$, N is the number of items in terms of an initial population I at a given time t and k is a growth constant equal to the percent of growth per unit time. How long will it take for the population of a certain country to double if its annual growth rate is 6%? Round to the nearest year.
- A) 33 yr
 - B) 5 yr
 - C) 1 yr
 - D) 12 yr

Answer: D

- 133) In the formula $N = Ie^{kt}$, N is the number of items in terms of an initial population I at a given time t and k is a growth constant equal to the percent of growth per unit time. How long will it take for the population of a certain country to triple if its annual growth rate is 0.5%? Round to the nearest year.
- A) 600 yr
 - B) 220 yr
 - C) 1 yr
 - D) 95 yr

Answer: B

- 134) In the formula $N = Ie^{kt}$, N is the number of items in terms of an initial population I at a given time t and k is a growth constant equal to the percent of growth per unit time. There are currently 73 million cars in a certain country, increasing by 3.8% annually. How many years will it take for this country to have 101 million cars? Round to the nearest year.
- A) 4 yr
 - B) 9 yr
 - C) 7 yr
 - D) 88 yr

Answer: B

- 135) The number of acres in a landfill decreases according to the function $B = 6200e^{-0.03t}$, where t is measured in years. How many acres will the landfill have after 5 years?
- A) 11,762 acres
 - B) 5336 acres
 - C) 5108 acres
 - D) 4389 acres

Answer: B

- 136) A bacteria colony doubles in 5 hr. How long does it take the colony to triple? Use $N = N_0 2^{t/T}$, where N_0 is the initial number of bacteria and T is the time in hours it takes the colony to double. (Round to the nearest hundredth, as necessary.)
- A) 15 hr
 - B) 2.03 hr
 - C) 7.92 hr
 - D) 7.5 hr

Answer: C

- 137) The population of a small country increases according to the function $B = 1,100,000e^{0.05t}$, where t is measured in years. How many people will the country have after 9 years?
- A) 878,358 people
 - B) 1,725,143 people
 - C) 3,100,221 people
 - D) 381,466 people

Answer: B

- 138) Use the formula $P = Ie^{kt}$. A bacterial culture has an initial population of 10,000. If its population declines to 5000 in 6 hours, what will it be at the end of 8 hours?
- A) 1985 bacteria
 - B) 4353 bacteria
 - C) 3969 bacteria
 - D) 2500 bacteria

Answer: C

- 139) In the formula $A(t) = A_0e^{kt}$, $A(t)$ is the amount of radioactive material remaining from an initial amount A_0 at a given time t and k is a negative constant determined by the nature of the material. A certain radioactive isotope has a half-life of approximately 1950 years. How many years would be required for a given amount of this isotope to decay to 45% of that amount?
- A) 2201 yr
 - B) 2246 yr
 - C) 1072.5 yr
 - D) 1682 yr

Answer: B

- 140) In the formula $A(t) = A_0e^{kt}$, $A(t)$ is the amount of radioactive material remaining from an initial amount A_0 at a given time t and k is a negative constant determined by the nature of the material. An artifact is discovered at a certain site. If it has 74% of the carbon-14 it originally contained, what is the approximate age of the artifact, rounded to the nearest year? (carbon-14 decays at the rate of 0.0125% annually.)
- A) 2080 yr
 - B) 5920 yr
 - C) 2409 yr
 - D) 1046 yr

Answer: C

- 141) In the formula $A(t) = A_0 e^{kt}$, $A(t)$ is the amount of radioactive material remaining from an initial amount A_0 at a given time t and k is a negative constant determined by the nature of the material. A certain radioactive isotope decays at a rate of 0.3% annually. Determine the half-life of this isotope, to the nearest year.
- A) 231 yr
 - B) 167 yr
 - C) 2 yr
 - D) 100 yr

Answer: A

- 142) The amount of particulate matter left in solution during a filtering process decreases by the equation $P = 600(2)^{-0.6n}$, where n is the number of filtering steps. Find the amounts left for $n = 0$ and $n = 5$. (Round to the nearest whole number.)
- A) 1200, 75
 - B) 600, 75
 - C) 600, 19
 - D) 600, 4800

Answer: B

- 143) The decay of 279 mg of an isotope is given by $A(t) = 279e^{-0.012t}$, where t is time in years. Find the amount left after 60 years.
- A) 68 mg
 - B) 136 mg
 - C) 134 mg
 - D) 276 mg

Answer: B

- 144) Newton's law of cooling states that the temperature $f(t)$ of a body at time t is given by: $f(t) = T_0 + Ce^{-kt}$, where C and k are constants and T_0 is the temperature of the environment in which the object rests. If $C = -28.5$ and $k = 0.04$ and t is in hours, how long will it take for a frozen roast to thaw to a temperature of 0°C in a refrigerator that is at 5°C ? Round your answer to the nearest hour.
- A) 44 hr
 - B) 48 hr
 - C) 42 hr
 - D) 38 hr

Answer: A

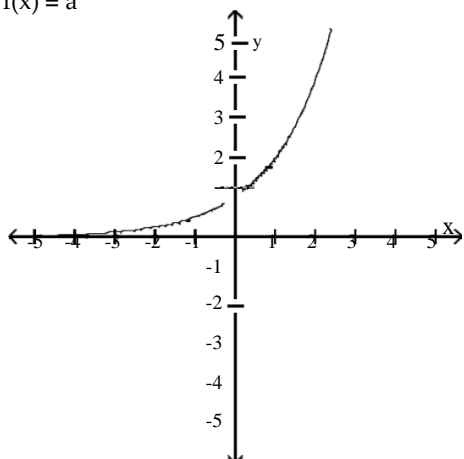
- 145) Newton's law of cooling states that the temperature $f(t)$ of a body at time t is given by: $f(t) = T_0 + Ce^{-kt}$, where C and k are constants and T_0 is the temperature of the environment in which the object rests. If $C = 280$ and $k = 0.17$ and t is in minutes, how long will it take for a glass baking dish containing brownies to cool to a comfortable-to-touch temperature of 93°F in a room that is at 72°F ? Round your answer to the nearest minute.
- A) 15 min
 - B) 10 min
 - C) 19 min
 - D) 12 min

Answer: A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

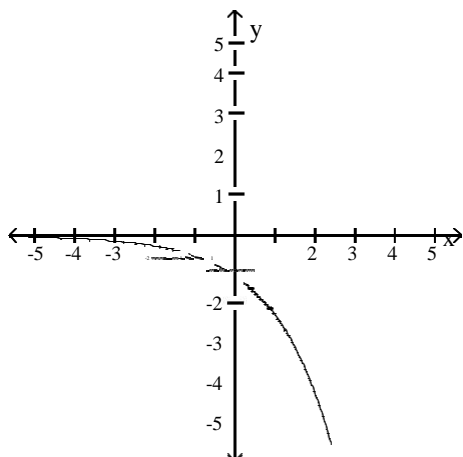
Provide an appropriate response.

146) $f(x) = a^x$



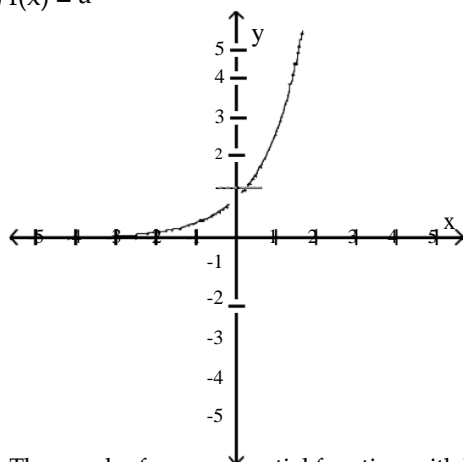
The graph of an exponential function with base a is given. Sketch the graph of $g(x) = -a^x$. Give the domain and range of g .

Answer:



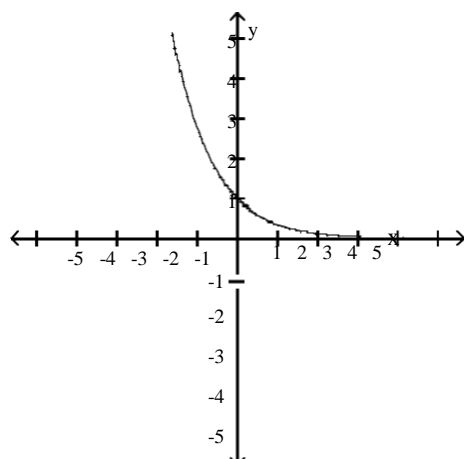
domain: $(-\infty, \infty)$, range: $(-\infty, 0)$

147) $f(x) = a^x$



The graph of an exponential function with base a is given. Sketch the graph of $h(x) = a^{-x}$. Give the domain and range of h .

Answer:



domain: $(-\infty, \infty)$, range: $(0, \infty)$

148) Explain how the graph of $y = 3^{x-5} - 5$ can be obtained from the graph of $y = 3^x$.
 Answer: The graph is shifted 5 units to the right and 5 units down.

149) Explain how the graph of $y = (1/2)^x - 3$ can be obtained from the graph of $y = 2^x$.
 Answer: The graph is reflected over the y-axis and then shifted 3 units down.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Convert the degree measure to radians. Leave the answer as a multiple of π .

150) 90°

A) $-\frac{\pi}{2}$

B) $-\frac{\pi}{8}$

C) $-\frac{\pi}{3}$

D) $-\frac{\pi}{4}$

Answer: A

151) -30°

A) ~~$-\frac{\pi}{8}$~~

B) ~~$-\frac{\pi}{5}$~~

C) ~~$-\frac{\pi}{6}$~~

D) ~~$-\frac{\pi}{7}$~~

Answer: C

152) 570°

A) ~~$\frac{19\pi}{3}$~~

B) ~~$\frac{19\pi}{12}$~~

C) ~~$\frac{19\pi}{6}$~~

D) ~~$\frac{19\pi}{5}$~~

Answer: C

153) 630°

A) ~~$\frac{7\pi}{4}$~~

B) ~~$\frac{7\pi}{2}$~~

C) ~~$\frac{7\pi}{2}$~~

D) 7π

Answer: B

154) 330°

A) $\frac{12\pi}{7}$

B) $\frac{11\pi}{6}$

C) $\frac{10\pi}{5}$

D) $\frac{5}{3}\pi$

Answer: B

155) 162°

A) $\frac{9\pi}{10}$

B) $\frac{4\pi}{5}$

C) $\frac{9\pi}{5}$

D) π

Answer: A

156) 470°

A) $\frac{47\pi}{9}$

B) $\frac{11\pi}{18}$

C) $\frac{47\pi}{18}$

D) $\frac{47\pi}{36}$

Answer: C

157) 370°

A) $\frac{37}{36}\pi$

B) $\frac{37}{9}\pi$

C) $\frac{1}{18}\pi$

D) $\frac{37}{18}\pi$

Answer: D

Convert the radian measure to degrees.

158) $\frac{\pi}{4}$

- A) 90°
- B) 45°
- C) 22.5°
- D) 32.5°

Answer: B

159) $-\frac{\pi}{3}$

- A) -120°
- B) -60°
- C) -40°
- D) -30°

Answer: B

160) $-\frac{11\pi}{2}$

- A) 1980°
- B) 495°
- C) 990°
- D) 505°

Answer: C

161) $-\frac{5\pi}{2}$

- A) -225°
- B) -450°
- C) -235°
- D) -900°

Answer: B

Find the indicated trigonometric function for θ , given that θ is an angle in standard position with the terminal side defined by the given point.

162) $(18, 24)$; find $\sin \theta$

- A) $\frac{4}{3}$
- B) $\frac{3}{4}$
- C) $\frac{4}{5}$
- D) $\frac{3}{5}$

Answer: C

163) (12, 16); find $\cos \theta$

A) $\frac{3}{4}$

B) $\frac{4}{3}$

C) $\frac{4}{5}$

D) $\frac{3}{5}$

Answer: D

164) (-15, 36); find $\sin \theta$

A) $-\frac{12}{13}$

B) $\frac{12}{13}$

C) $\frac{13}{5}$

D) $-\frac{13}{5}$

Answer: B

165) (-20, -48); find $\cos \theta$

A) $-\frac{13}{5}$

B) $\frac{13}{5}$

C) $-\frac{12}{13}$

D) $-\frac{13}{5}$

Answer: A

166) (-10, 24); find $\sec \theta$

A) $\frac{13}{5}$

B) $-\frac{13}{5}$

C) $-\frac{13}{5}$

D) $-\frac{13}{12}$

Answer: C

167) (21, 28); find $\csc \theta$

A) $\frac{5}{4}$

B) $\frac{4}{3}$

C) $\frac{5}{3}$

D) $\frac{3}{4}$

Answer: A

168) (15, -20); find $\csc \theta$

A) $\frac{4}{5}$

B) $-\frac{5}{3}$

C) $-\frac{5}{4}$

D) $\frac{5}{4}$

Answer: C

169) (-6, 9); find $\tan \theta$

A) $-\frac{6}{11}$

B) $-\frac{3}{2}$

C) $\frac{9}{11}$

D) $-\frac{2}{3}$

Answer: B

170) (4, 8); find $\cot \theta$

A) $\frac{8}{9}$

B) $\frac{4}{9}$

C) $\frac{1}{2}$

D) 2

Answer: C

If θ is an angle in the indicated quadrant, determine whether the given function is positive or negative.

171) II, $\sec \theta$

- A) Positive
- B) Negative

Answer: B

172) III, $\cot \theta$

- A) Positive
- B) Negative

Answer: A

173) IV, $\cot \theta$

- A) Negative
- B) Positive

Answer: A

174) II, $\sin \theta$

- A) Positive
- B) Negative

Answer: A

175) III, $\cos \theta$

- A) Negative
- B) Positive

Answer: A

176) IV, $\sin \theta$

- A) Positive
- B) Negative

Answer: B

177) II, $\tan \theta$

- A) Positive
- B) Negative

Answer: B

178) III, $\csc \theta$

- A) Negative
- B) Positive

Answer: A

179) IV, $\sec \theta$

- A) Negative
- B) Positive

Answer: B

180) I, $\csc \theta$

- A) Positive
- B) Negative

Answer: A

Give the exact value.

181) $\cot 30^\circ$

A) 1

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

C) $\frac{\sqrt{3}}{2}$

D) $\sqrt{3}$

Answer: D

182) $\sin 60^\circ$

A) $\frac{1}{2}$

B) $\frac{\sqrt{3}}{2}$

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

D) $\frac{\sqrt{2}}{2}$

Answer: B

183) $\cos 45^\circ$

A) $\frac{\sqrt{3}}{2}$

B) $\frac{1}{2}$

C) $\frac{\sqrt{2}}{2}$

D) $\sqrt{2}$

Answer: C

184) $\cos 210^\circ$

A) $\frac{\sqrt{3}}{2}$

B) $-\frac{\sqrt{3}}{2}$

C) $-\frac{\sqrt{2}}{2}$

D) $\frac{\sqrt{2}}{2}$

Answer: B

185) $\tan 300^\circ$

A) $\sqrt{3}$

B) $-\sqrt{3}$

C) $-\frac{\sqrt{3}}{3}$

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

Answer: B

186) $\cot 120^\circ$

A) $-\frac{\sqrt{3}}{3}$

B) $-\sqrt{3}$

C) -1

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

Answer: A

187) $\sec 240^\circ$

A) 2

B) -2

C) $\frac{2\sqrt{3}}{3}$

D) $-\frac{2\sqrt{3}}{3}$

Answer: B

188) $\sec 150^\circ$

A) $-\sqrt{2}$

B) $\sqrt{2}$

C) $-\frac{2\sqrt{3}}{3}$

D) $\frac{2\sqrt{3}}{3}$

Answer: C

189) $\csc 240^\circ$

A) -2

B) 2

C) $-\frac{2\sqrt{3}}{3}$

-
—
D) $\frac{2\sqrt{3}}{3}$

Answer: C

190) $\csc 330^\circ$

A) -2

B) $-\frac{2\sqrt{3}}{3}$

C) $\frac{2\sqrt{3}}{3}$

D) 2

Answer: A

Find the exact value of the following expression without using a calculator.

191) $\csc^{-1} 6$

A) $\frac{1}{2}$

B) 2

C) $\frac{2\sqrt{3}}{3}$

D) $\sqrt{2}$

Answer: B

192) $\sec^{-1} 3$

A) $\frac{2\sqrt{3}}{3}$

B) 2

C) $\frac{\sqrt{3}}{2}$

D) $\sqrt{2}$

Answer: B

193) $\cos^{-1} \frac{\pi}{4}$

A) $\frac{\sqrt{2}}{2}$

B) $\frac{\sqrt{2}}{2}$

C) $\frac{1}{2}$

D) $\frac{\sqrt{3}}{2}$

Answer: B

194) $\sin \frac{5\pi}{4}$

A) $\frac{\sqrt{2}}{2}$

B) $\frac{\sqrt{3}}{2}$

C) $-\frac{\sqrt{3}}{2}$

D) $-\frac{\sqrt{2}}{2}$

Answer: D

195) $\cos \frac{11\pi}{6}$

A) $\frac{1}{2}$

B) $-\frac{\sqrt{3}}{2}$

C) $-\frac{1}{2}$

D) $\frac{\sqrt{3}}{2}$

Answer: D

196) $\tan \frac{5\pi}{3}$

A) $\sqrt{3}$

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

C) $\frac{\sqrt{3}}{2}$

D) $-\sqrt{3}$

Answer: D

197) $\csc \frac{5\pi}{3}$

A) $-\frac{2\sqrt{3}}{3}$

B) $-\sqrt{3}$

C) $-\frac{1}{2}$

D) $-\sqrt{2}$

Answer: A

198) $\sec \frac{5\pi}{4}$

A) $-\sqrt{2}$

B) $\frac{\sqrt{2}}{2}$

C) -2

D) $\frac{2\sqrt{3}}{3}$

Answer: A

199) $\cot \frac{11\pi}{6}$

A) $-\sqrt{3}$

B) $\sqrt{3}$

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

D) $-\sqrt{3}$

Answer: B

200) $\sec(\pi)$

A) 1

B) 0

C) -1

D) Undefined

Answer: C

Find all values of x between 0 and 2π that satisfy the equation.

201) $\cos x = \frac{\sqrt{3}}{2}$

A) $\frac{\pi}{6}, \frac{11\pi}{6}$

B) $\frac{\pi}{3}, \frac{2\pi}{3}$

C) $\frac{\pi}{4}, \frac{7\pi}{4}$

D) $\frac{\pi}{6}, \frac{5\pi}{6}$

Answer: A

$$202) \sin x = \frac{1}{2}$$

A) $\frac{\pi}{6}, \frac{5\pi}{6}$

B) $\frac{5\pi}{4}, \frac{7\pi}{4}$

C) $\frac{\pi}{3}, \frac{5\pi}{3}$

D) $\frac{\pi}{6}, \frac{11\pi}{6}$

Answer: A

$$203) \tan x = \frac{1}{\sqrt{3}}$$

A) $\frac{5\pi}{6}, \frac{11\pi}{6}$

B) $\frac{3\pi}{4}, \frac{7\pi}{4}$

C) $-\frac{\pi}{6}, \frac{7\pi}{6}$

D) $-\frac{\pi}{3}, \frac{4\pi}{3}$

Answer: C

$$204) \csc x = 2$$

A) $\frac{3\pi}{4}, \frac{7\pi}{4}$

B) $-\frac{\pi}{6}, \frac{11\pi}{6}$

C) $-\frac{\pi}{3}, \frac{5\pi}{3}$

D) $-\frac{\pi}{6}, \frac{5\pi}{6}$

Answer: D

$$205) \sec x = -\sqrt{2}$$

A) $\frac{3\pi}{4}, \frac{5\pi}{4}$

B) $-\frac{\pi}{4}, \frac{7\pi}{4}$

C) $\frac{5\pi}{4}, \frac{7\pi}{4}$

D) $\frac{2\pi}{3}, \frac{4\pi}{3}$

$\frac{4\pi}{3}$ Answer: A

Use a calculator to find the function value to four decimal places.

206) $\sin 72.9^\circ$

- A) 3.2505
- B) -0.5999
- C) 0.9558
- D) 0.2940

Answer: C

207) $\cos 27.2^\circ$

- A) 0.4571
- B) 0.8894
- C) 0.5139
- D) -0.4763

Answer: B

208) $\cot 70.7^\circ$

- A) 0.3502
- B) -70.5904
- C) 0.9438
- D) 2.8555

Answer: A

209) $\tan 47.7^\circ$

- A) 1.0990
- B) 0.6496
- C) 0.7396
- D) 0.9099

Answer: A

210) $\csc 75.1^\circ$

- A) 1.0348
- B) -0.2938
- C) 0.9664
- D) 0.2571

Answer: A

211) $\tan 459^\circ$

- A) 2.6051
- B) -0.1564
- C) -6.3138
- D) -1.2349

Answer: C

212) $\sin 0.1630$

- A) 0.1645
- B) 0.1623
- C) 1.0134
- D) 0.9867

Answer: B

213) $\sec 0.56$

- A) 0.6269
- B) 0.5312
- C) 1.1803
- D) 0.8473

Answer: C

214) $\tan 3.95$

- A) 1.0471
- B) -0.7232
- C) -0.6907
- D) -1.4479

Answer: A

Give the amplitude or period as requested.

215) Amplitude of $f(x) = 3 \sin x$

- A) 2π
- B) 3
- C) 3π
- D) $-\pi^2 3$

Answer: B

216) Amplitude of $f(x) = -3 \sin 5x$

- A) $-\pi^2 3$
- B) $\frac{3}{5}$
- C) $-\pi^2 5$
- D) 3

Answer: D

217) Period of $f(x) = \sin 5x$

- A) $\frac{-2\pi}{5}$
- B) 1
- C) 5
- D) 2π

Answer: A

218) Amplitude of $f(x) = \frac{1}{3} \cos 4x$

A) $\frac{4\pi}{3}$

B) 4

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

D) $\frac{\pi}{4}$

Answer: C

219) Period of $f(x) = \cos 3x$

A) $\frac{2\pi}{3}$

B) 2π

C) 3

D) 1

Answer: A

220) Period of $f(x) = 4 \cos \frac{1}{2} x$

A) 4

B) $\frac{4\pi}{2}$

C) $\frac{\pi}{2}$

D) 4π

Answer: D

221) Period of $f(x) = 3 \cos x$

A) 3

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

C) 2π

D) π

Answer: C

222) Amplitude of $f(t) = -2 \cos \left(\frac{\pi}{7} t + 9 \right)$

A) 2

B) 9

C) -2

D) 14

Answer: A

223) Period of $f(t) = 3 \cos\left(\frac{\pi}{5}t - 4\right)$

- A) 10π
- B) $\frac{\pi}{5}$
- C) 5
- D) 10

Answer: D

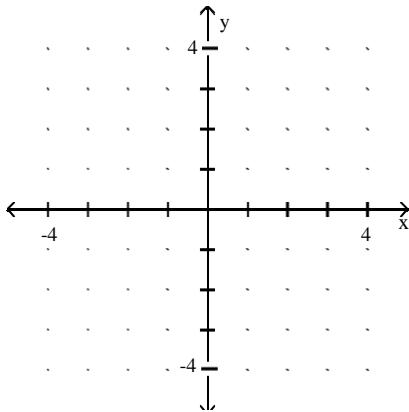
224) Period of $f(x) = 2 \cos(7\pi x + 2)$

- A) $\frac{2\pi}{7}$
- B) 7π
- C) $\frac{2}{7}$
- D) 2

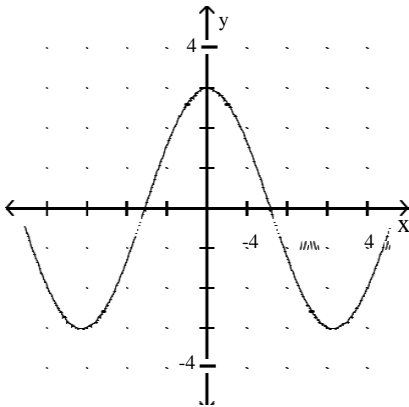
Answer: C

Graph the function.

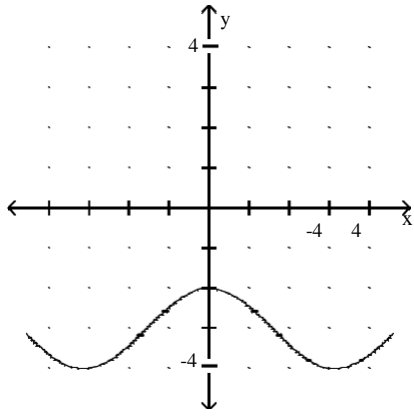
225) $y = 3 \cos x$



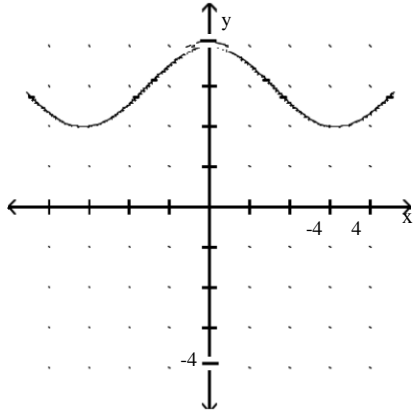
A)



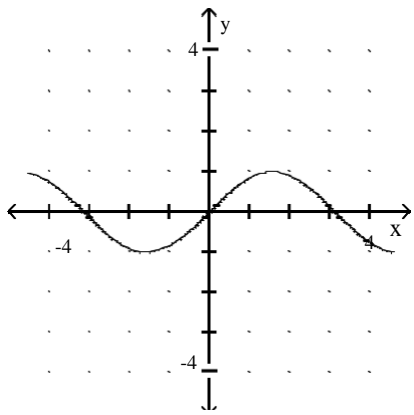
B)



C)

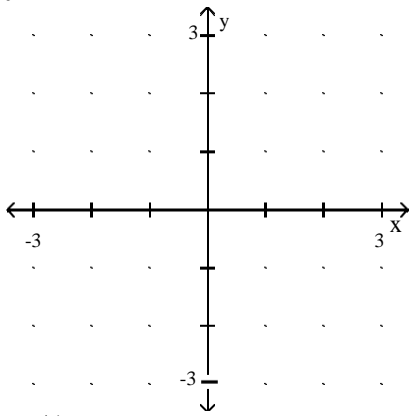


D)

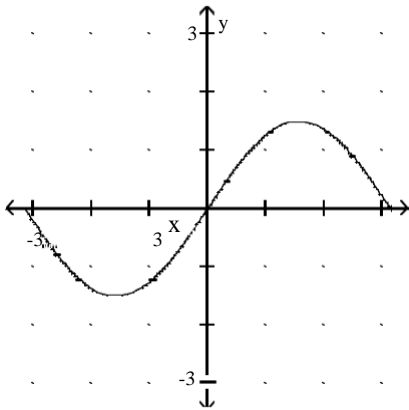


Answer: A

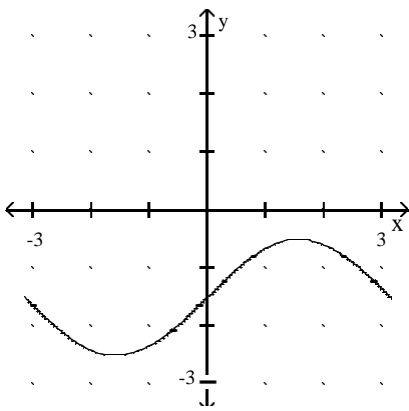
226) $y = 1.5 \sin x$



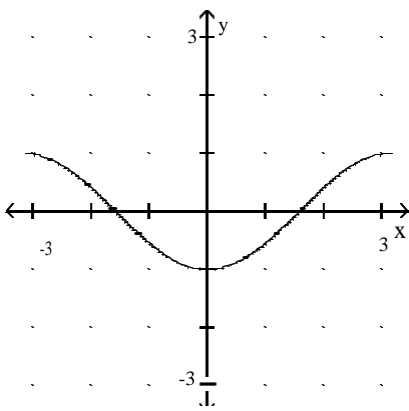
A)



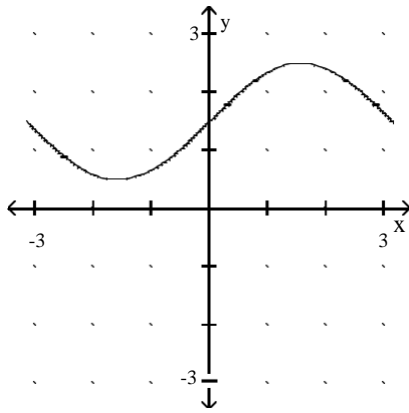
B)



C)

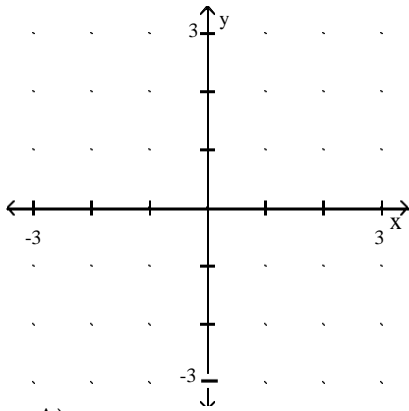


D)

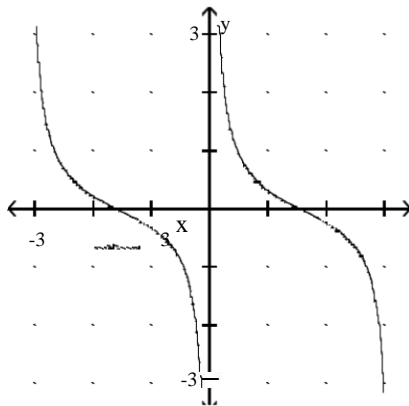


Answer: A

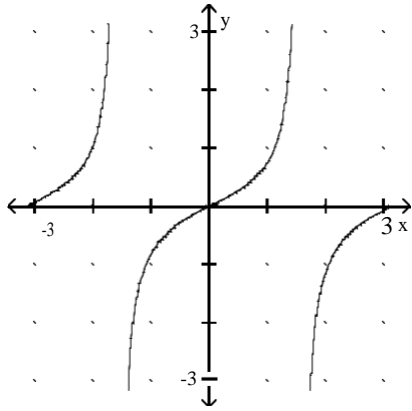
227) $y = \frac{1}{2} \tan x$



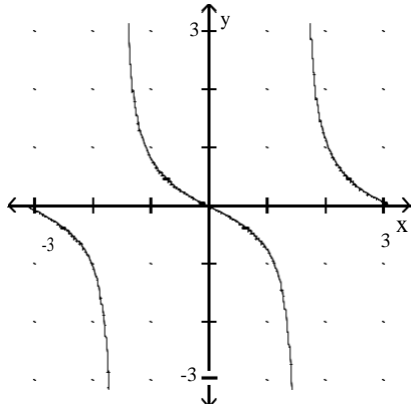
A)



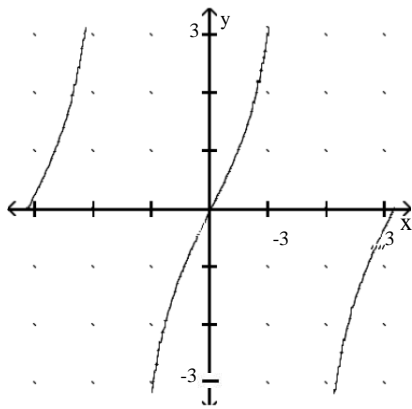
B)



C)

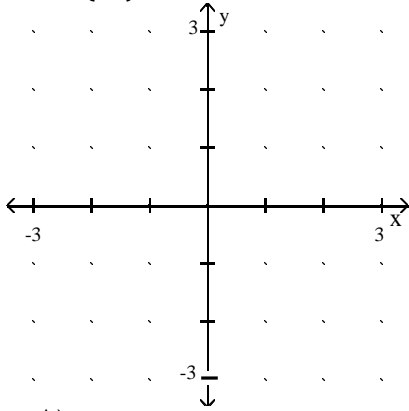


D)

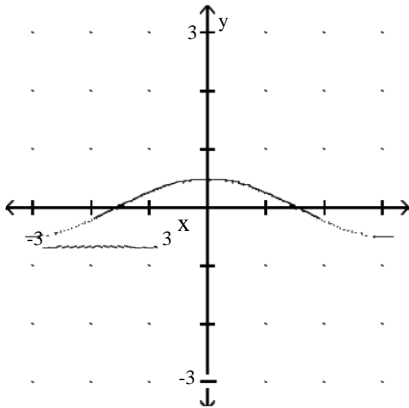


Answer: B

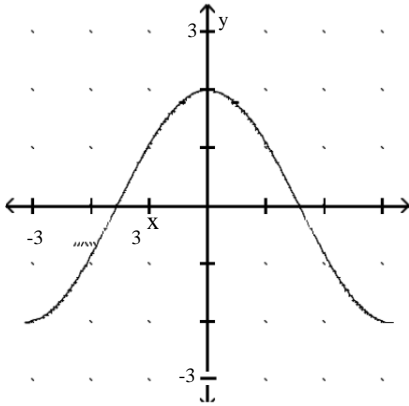
228) $y = \cos\left(\frac{1}{2}x\right)$



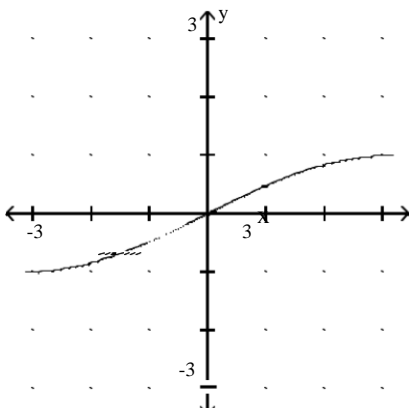
A)



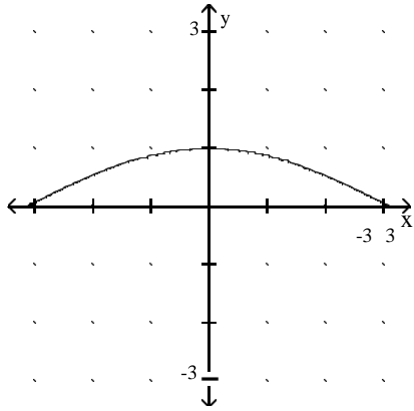
B)



C)

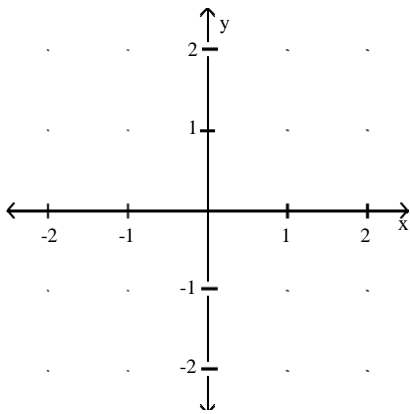


D)

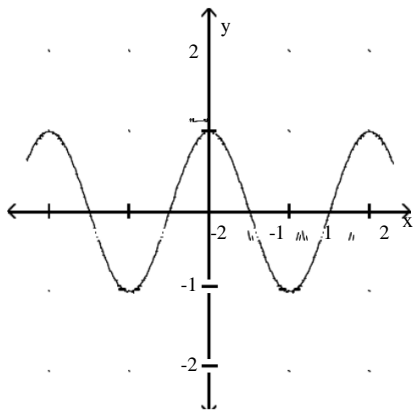


Answer: D

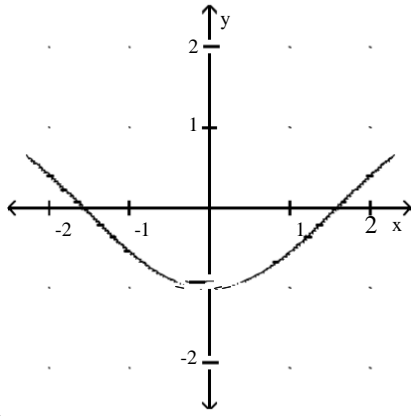
229) $y = -\cos(\pi x)$



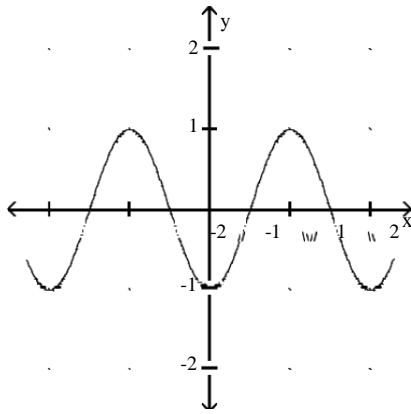
A)



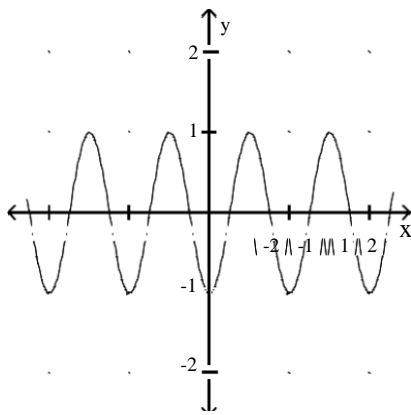
B)



C)

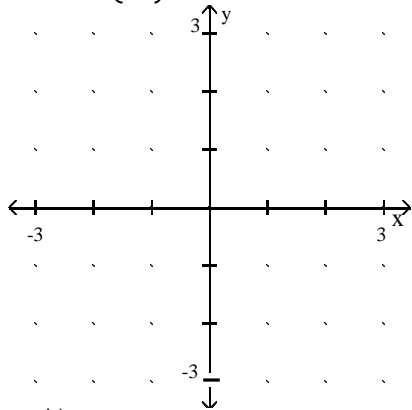


D)

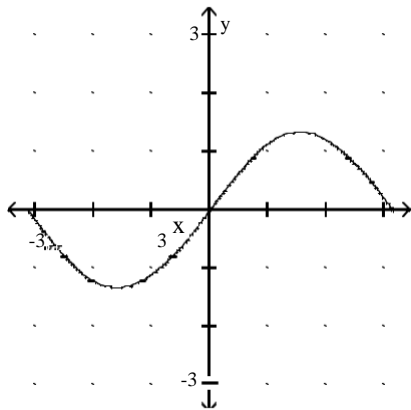


Answer: C

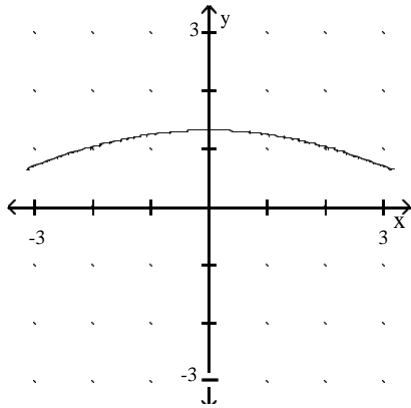
$$230) y = 4 \sin \left(\frac{1}{3}x \right)$$



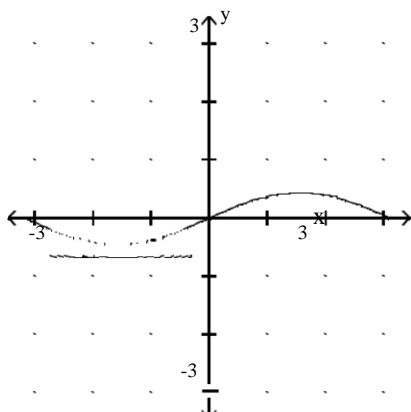
A)



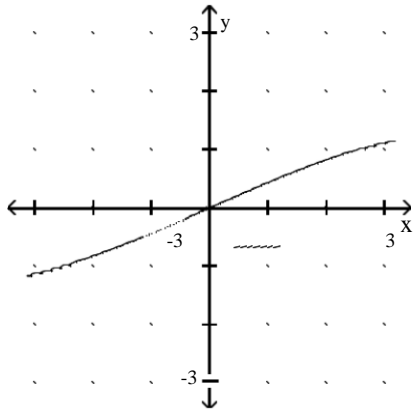
B)



C)

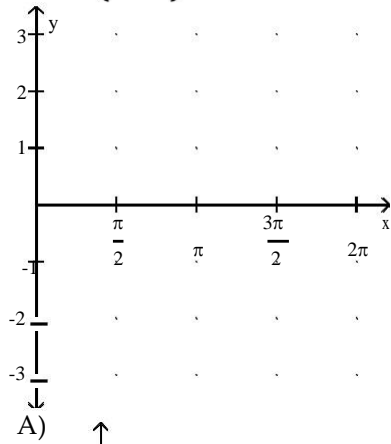


D)

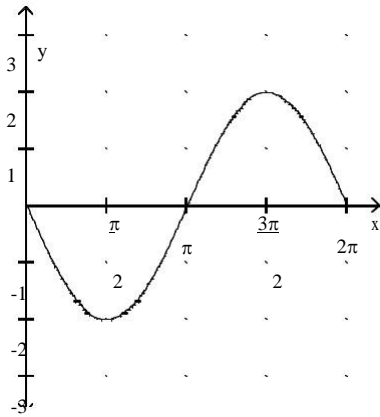


Answer: D

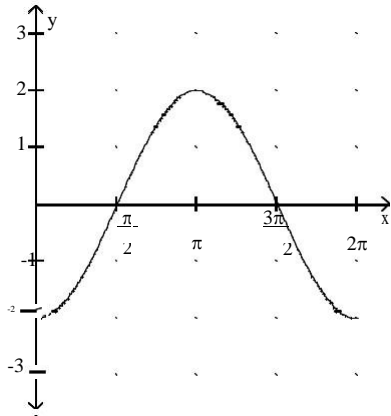
$$231) y = -2 \cos \left(x + \frac{\pi}{2} \right)$$



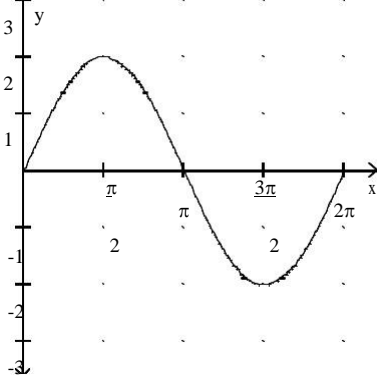
A)



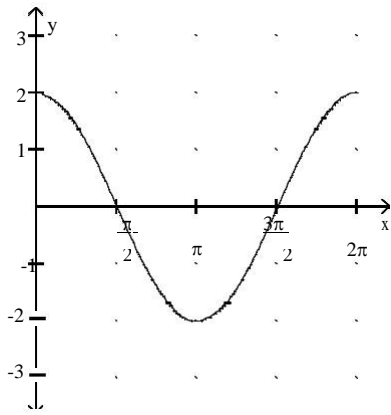
B)



C)

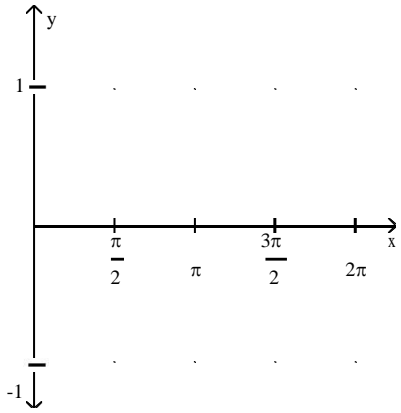


D)

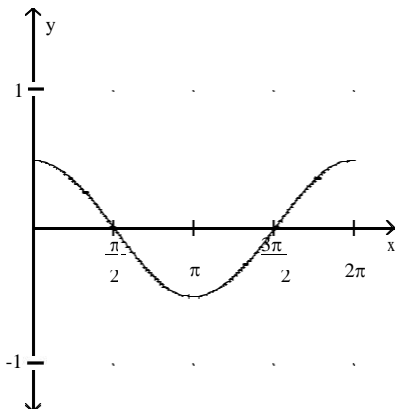


Answer: C

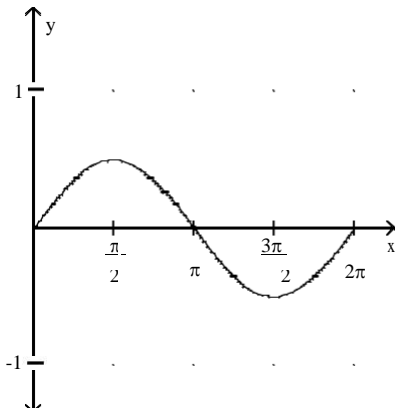
232) $y = \frac{1}{2} \sin(x + \pi)$



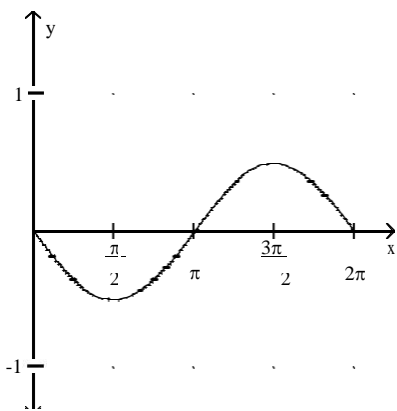
A)



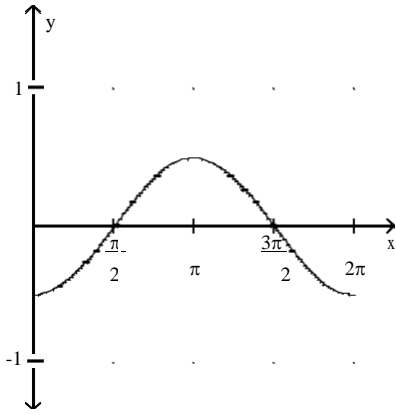
B)



C)

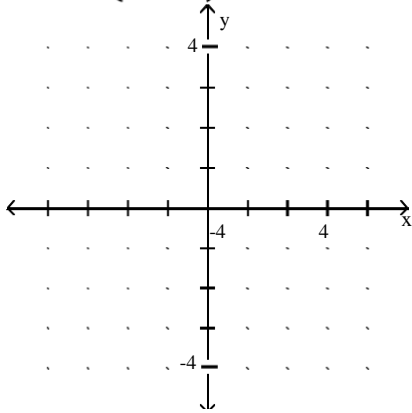


D)

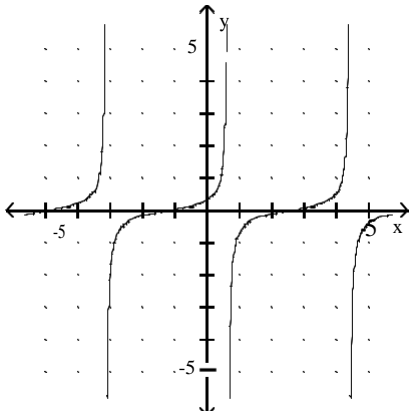


Answer: C

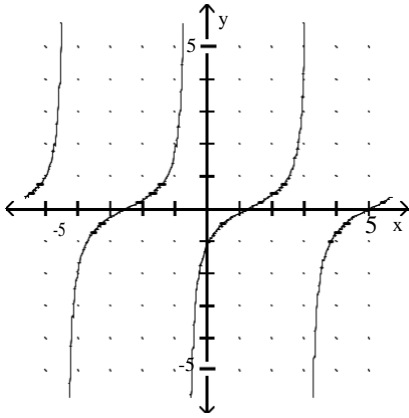
$$233) y = 3.5 \tan \left(6x + \frac{\pi}{3} \right)$$



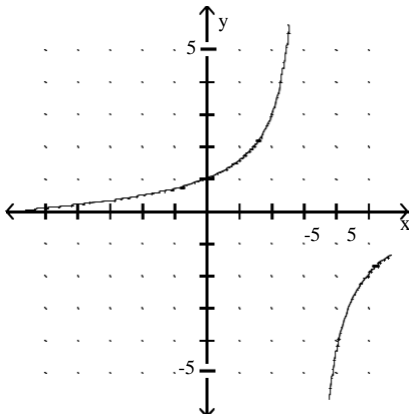
A)



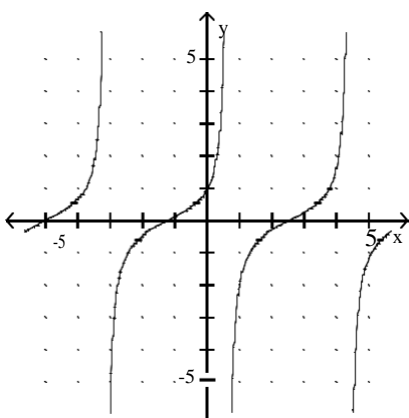
B)



C)

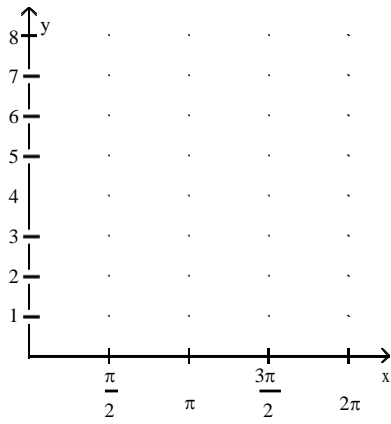


D)

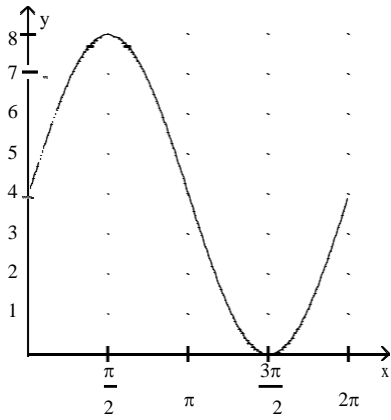


Answer: D

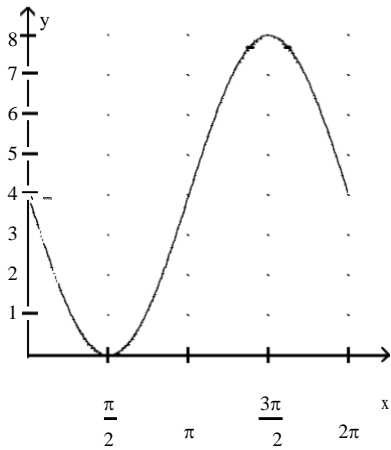
234) $y = 4 \sin(x - \pi) + 4$



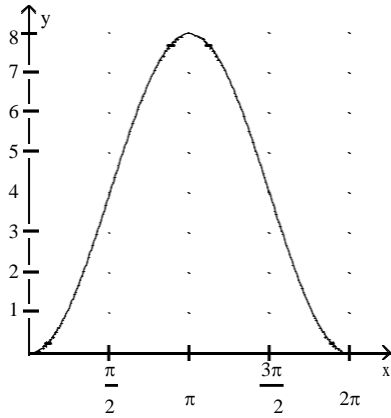
A)



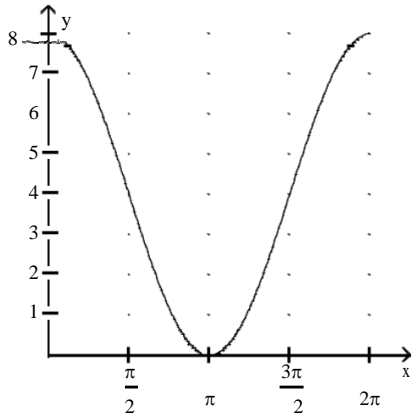
B)



C)



D)



Answer: B

Solve the problem.

235) Sales of snow shovels are seasonal. Suppose the sale of snow shovels in Maine is approximated by

$s(t) = 10,000 + 10,000 \cos\left[\frac{\pi}{6}t\right]$, where t is time in months and $t = 0$ is October. What are the sales in December?

- A) 15,000 snow shovels
- B) 13,900 snow shovels
- C) 18,660 snow shovels
- D) 17,071 snow shovels

Answer: A

236) The temperature in Fairbanks is approximated by $T(x) = 37 \sin\left[\frac{2\pi}{365}(x - 101)\right] + 25$, where $T(x)$ is the temperature on day x , with $x = 1$ corresponding to Jan 1 and $x = 365$ corresponding to Dec 31. Estimate the temperature, to the nearest degree, on day 345.

- A) -32°
- B) -25°
- C) 338°
- D) -7°

Answer: D

- 237) A scientist studying ocean tides places an 8 ft high marker in the water at 6 am on a Monday morning. At that time the water is about 5.5 ft high and receding. The scientist observes that the water reaches its lowest level, 0.1 ft, at 9:18 am and then begins to rise. Assume that the water level, in feet, is given by

$$h(t) = 4.9 \sin\left(\frac{2\pi}{12}t\right) + 5,$$

where t represents the number of hours after midnight. (In other words, the marker was placed in the water when $t = 6$.) Find the first time interval during which the marker is completely underwater.

- A) Approximately from 1:42 pm to 5:18 pm Monday
- B) Approximately from 11:24 pm Monday to 2:00 am Tuesday
- C) Approximately from 1:18 am to 4:54 am Tuesday
- D) Approximately from 2:06 pm to 4:24 pm Monday

Answer: A

- 238) The voltage E in an electrical circuit is given by $E = 7.1 \cos(60\pi t)$, where t is time measured in seconds. Find the period.

- A) 30
- B) 30π
- C) 30^1
- D) 30^π

Answer: C

- 239) The total sales in dollars of some small businesses fluctuates according to the equation $S = A + B \sin\left(\frac{\pi}{6}x\right)$, where x is the time in months, with $x = 1$ corresponding to January, $A = 8500$, and $B = 4200$. Determine the month with the greatest total sales and give the sales in that month.

- A) September; \$4300
- B) December; \$12,700
- C) June; \$8500
- D) March; \$12,700

Answer: D

- 240) The total sales in dollars of some small businesses fluctuates according to the equation $S = A + B \sin\left(\frac{\pi}{6}x\right)$, where x is the time in months, with $x = 1$ corresponding to January, $A = 7200$, and $B = 3300$. Determine the month with the least sales and give the sales in that month.

- A) December; \$7200
- B) March; \$10,500
- C) June; \$3300
- D) September; \$3900

Answer: D

241) The motion of a spring-mass system is described by the equation $y = 9 \left(\sin \pi t - \frac{1}{2} \right)$, where y is the distance in feet from the equilibrium position and t is time in seconds. If the weight is 23 feet from the ceiling in a state of equilibrium, find the time at which the weight first passes the equilibrium position.

- A) $\frac{1}{4}$ sec
- B) 1 sec
- C) $\frac{1}{8}$ sec
- D) 4 sec

Answer: A

242) The motion of a spring-mass system is described by the equation $y = 2 \left(\sin \pi t - \frac{1}{2} \right)$, where y is the distance in feet from the equilibrium position and t is time in seconds. If the weight is 22 feet from the ceiling in a state of equilibrium, find the closest the weight will ever be to the ceiling.

- A) 24 ft
- B) 22 ft
- C) 20 ft
- D) 2 ft

Answer: C

243) The motion of a spring-mass system is described by the equation $y = \left(11 \sin \pi t - \frac{\pi}{4} \right)$, where y is the distance in feet from the equilibrium position and t is time in seconds. If the weight is 22 feet from the ceiling in a state of equilibrium, find the distance from the ceiling at time $t = 3$.

- A) 32 ft
- B) 34 ft
- C) 28 ft
- D) 30 ft

Answer: D

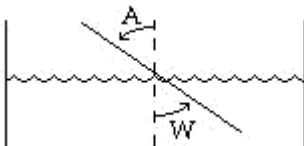
244) The position of a weight attached to a spring is $s(t) = -6 \cos(12\pi t)$ inches after t seconds. What is the maximum height that the weight reaches above the equilibrium position and when does it first reach the maximum height?

- A) The maximum height of 6 inches is first reached after 0.08 seconds.
- B) The maximum height of 6 inches is first reached after 6 seconds.
- C) The maximum height of 12 inches is first reached after 6 seconds.
- D) The maximum height of 12 inches is first reached after 3 seconds.

Answer: A

245) The index of refraction for air, I_a , is 1.0003. The index of refraction for water, I_w , is 1.3. If $\frac{I_w}{I_a} = \frac{\sin A}{\sin W}$, and

$A = 31.5^\circ$, find W to the nearest tenth.



- A) 20.7°
- B) 23.7°
- C) 22.7°
- D) 21.7°

Answer: B

246) Snell's Law states that $\frac{I_1}{I_2} = \frac{\sin \theta_1}{\sin \theta_2}$. Use this law to find the requested value. If $c_1 = 7 \times 10^6$, $\theta_1 = 43^\circ$, and $\sin \theta_2$

$\theta_2 = 38^\circ$, find c_2 .

- A) $c_2 = 6.08 \times 10^8$
- B) $c_2 = 6.32 \times 10^5$
- C) $c_2 = 6.32 \times 10^6$
- D) $c_2 = 6.85 \times 10^6$

Answer: C

247) Snell's Law states that $\frac{I_1}{I_2} = \frac{\sin \theta_1}{\sin \theta_2}$. Use this law to find the requested value. If $c_2 = 2.1 \times 10^8$, $\theta_1 = 57^\circ$ and $\sin \theta_2$

$\theta_2 = 36^\circ$, find c_1 .

- A) $c_1 = 2.67 \times 10^8$
- B) $c_1 = 1.98 \times 10^7$
- C) $c_1 = 3 \times 10^8$
- D) $c_1 = 2.1 \times 10^{10}$

Answer: C

248) Snell's Law states that $\frac{I_1}{I_2} = \frac{\sin \theta_1}{\sin \theta_2}$. Use this law to find the requested value. If $c_1 = 4 \times 10^7$, $c_2 = 3.17 \times 10^7$

$$\frac{c_1}{c_2} = \frac{\sin \theta_1}{\sin \theta_2}$$

$\theta_1 = 42^\circ$, find θ_2 . Round your answer to the nearest degree.

- A) $\theta_2 = 35^\circ$
- B) $\theta_2 = 32^\circ$
- C) $\theta_2 = 31^\circ$
- D) $\theta_2 = 34^\circ$

Answer: B

249) Snell's Law states that $\frac{c_1}{c_2} = \frac{\sin \theta_1}{\sin \theta_2}$. Use this law to find the requested value. If $c_1 = 7 \times 10^6$, $c_2 = 5.54 \times 10^6$,

$\theta_2 = 36^\circ$, find θ_1 . Round your answer to the nearest degree.

- A) $\theta_1 = 49^\circ$
- B) $\theta_1 = 51^\circ$
- C) $\theta_1 = 48^\circ$
- D) $\theta_1 = 46^\circ$

Answer: C

250) From a boat on the lake, the angle of elevation to the top of a cliff is $26^\circ 29'$. If the base of the cliff is 1429 feet from the boat, how high is the cliff (to the nearest foot)?

- A) 722 ft
- B) 715 ft
- C) 712 ft
- D) 725 ft

Answer: C

251) From a boat on the river below a dam, the angle of elevation to the top of the dam is $21^\circ 31'$. If the dam is 437 feet above the level of the river, how far is the boat from the base of the dam (to the nearest foot)?

- A) 1108 ft
- B) 1088 ft
- C) 1098 ft
- D) 1078 ft

Answer: A

252) From a balloon 878 feet high, the angle of depression to the ranger headquarters is $67^\circ 34'$. How far is the headquarters from a point on the ground directly below the balloon (to the nearest foot)?

- A) 357 ft
- B) 362 ft
- C) 352 ft
- D) 367 ft

Answer: B

253) When sitting atop a tree and looking down at his pal Joey, the angle of depression of Mack's line of sight is $41^\circ 24'$. If Joey is known to be standing 20 feet from the base of the tree, how tall is the tree (to the nearest foot)?

- A) 20 ft
- B) 18 ft
- C) 24 ft
- D) 22 ft

Answer: B

254) The air speed of an airplane is 690 km/hr and its angle of climb is 2.07° . What is its ground speed (to the nearest km/hr)?

- A) 690 km/hr
- B) 685 km/hr
- C) 675 km/hr
- D) 680 km/hr

Answer: A

- 255) At an altitude of 3500 ft, the engine on a small plane fails. What angle of glide is needed to reach an airport runway that is 4 miles away by land? (Round your answer to the nearest tenth of a degree.)
- A) 88.9°
 - B) 10.4°
 - C) 9.4°
 - D) 89.9°

Answer: C

- 256) The chairlift at a ski resort has a vertical rise of 2400 feet. If the length of the ride is 1.2 miles, what is the average angle of inclination of the lift (to the nearest tenth of a degree)?
- A) 19.3°
 - B) 25.3°
 - C) 16.3°
 - D) 22.3°

Answer: D

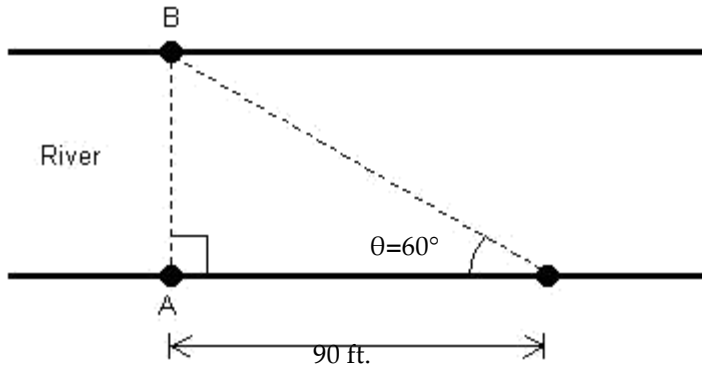
- 257) A 30-foot ladder is leaning against the side of a building. If the ladder makes an angle of $26^\circ 16'$ with the side of the building, how far is the bottom of the ladder from the base of the building? Round your answer to the hundredths place.
- A) 13.28 ft
 - B) 14.58 ft
 - C) 18.98 ft
 - D) 3.91 ft

Answer: A

- 258) A contractor needs to know the height of a building to estimate the cost of a job. From a point 89 feet away from the base of the building, the angle of elevation to the top of the building is found to be $45^\circ 36'$. Find the height of the building. Round your answer to the hundredths place.
- A) 93.78 ft
 - B) 90.88ft
 - C) 89.35 ft
 - D) 95.11 ft

Answer: B

259) A conservation officer needs to know the width of a river in order to set instruments correctly for a study of pollutants in the river. From point A, the conservation officer walks 90 feet downstream and sights point B on the opposite bank to determine that $\theta = 60^\circ$ (see figure). How wide is the river?



- A) 180 ft
- B) 78 ft
- C) 156 ft
- D) 52 ft

Answer: C

260) A weight attached to a spring is pulled down 3 inches below the equilibrium position. Assuming that the period of the system is $\frac{1}{5}$ second, determine a trigonometric model that gives the position of the weight at time t seconds.

- A) $y = 3 \cos \frac{1}{5} t$
- B) $y = 3 \cos 10\pi t$
- C) $y = -3 \cos 5\pi t$
- D) $y = -3 \cos 10\pi t$

Answer: D

261) A weight attached to a spring is pulled down 2 inches below the equilibrium position. Assuming that the frequency of the system is $\frac{5}{\pi}$ cycles per second, determine a trigonometric model that gives the position of the

weight at time t seconds. A)

- $y = 2 \cos 10t$
- B) $y = -2 \cos 10t$
- C) $y = 2 \cos 5t$
- D) $y = -2 \cos 5t$

Answer: B

262) Tides go up and down in a 14-hour period. The average depth of a certain river is 14 m and ranges from 11 to 17 m. The depth of the river can be approximated by a sine curve. Write an equation that gives the depth x hours after midnight given that high tide occurs at 7:00 am.

A) $d = 3 \sin \left[\frac{\pi x}{7} - \frac{\pi}{2} \right] + 14$

B) $d = 3 \sin \left[\frac{\pi x}{7} \right] + 14$

C) $d = 7 \sin \left[\frac{\pi x}{7} - \frac{\pi}{4} \right]$

D) $d = 3 \sin \left[\frac{\pi x}{14} - \frac{\pi}{2} \right] + 14$

Answer: A