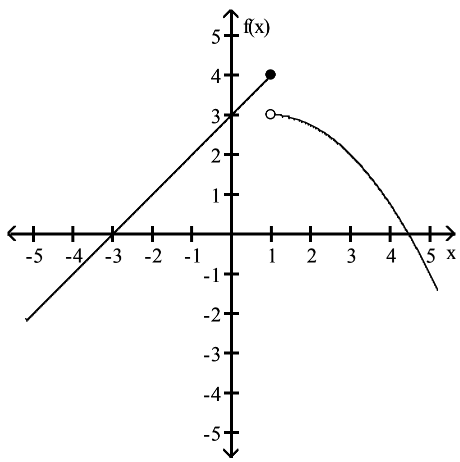
Exam

Name___________________________________

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

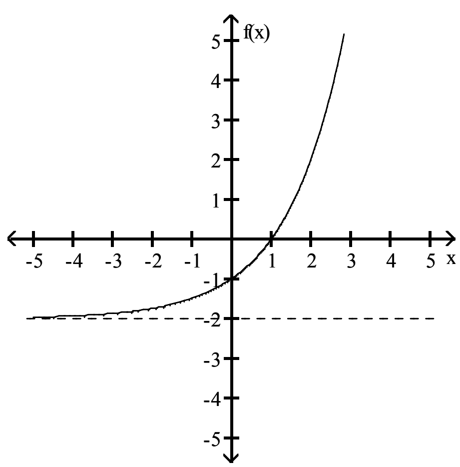
Decide whether the limit exists. If it exists, find its value.

1) $\lim_{x \to 1^+} f(x)$ 1) ________



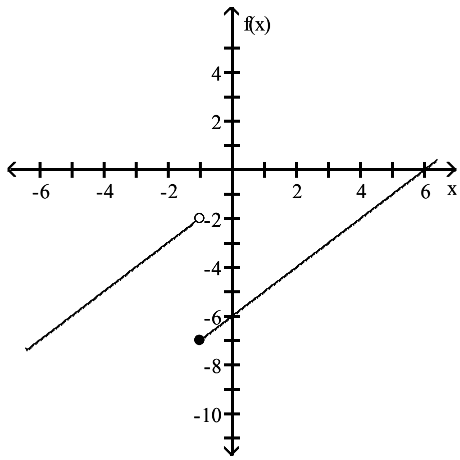
A) 4 B) 3 C) $3\frac{1}{2}$ D) Does not exist

2) $\lim_{x \to \infty} f(x)$ 2) ________



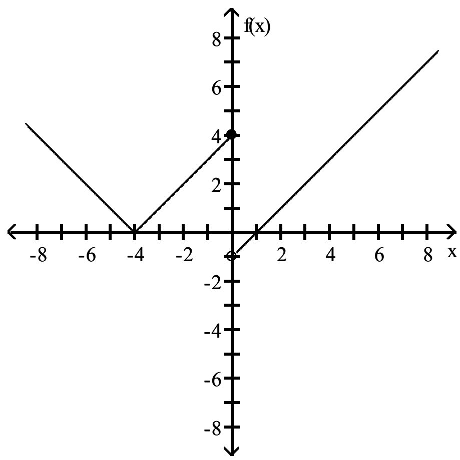
A) Does not exist B) ∞ C) -2 D) 0

3) $\lim_{x \to (-1)^-} f(x)$ and $\lim_{x \to (-1)^+} f(x)$ 3) ________



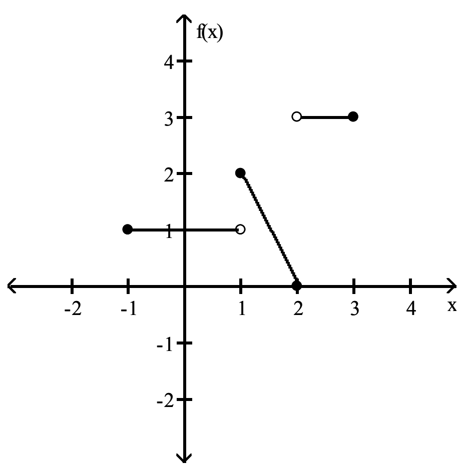
A) −5, −2 B) −7, −2 C) −7, −5 D) −2, −7

4) $\lim_{x \to 0^-} f(x)$ and $\lim_{x \to 0^+} f(x)$ 4) ________



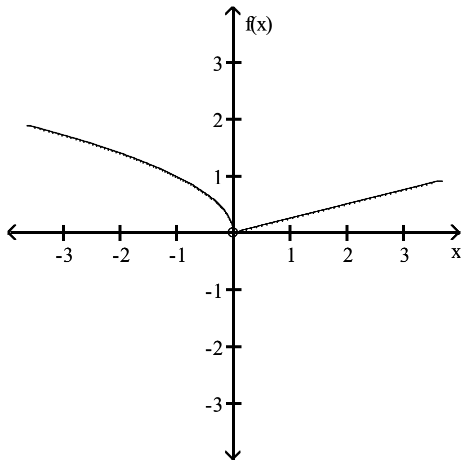
A) −1, 4 B) 4, −1 C) −4, −1 D) 4, 1

5) $\lim_{x \to 1} f(x)$ 5) ________



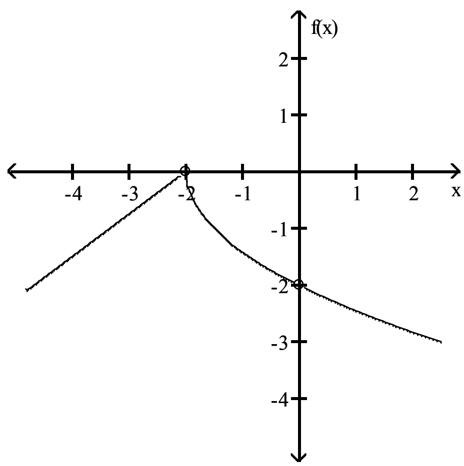
A) Does not exist B) 0 C) 1 D) 2

6) $\lim_{x \to 0} f(x)$ 6) ________



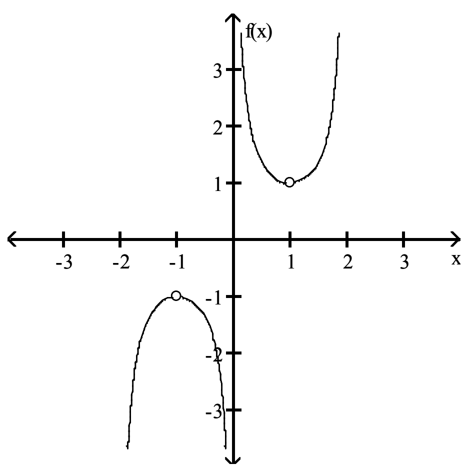
A) 1 B) Does not exist C) −1 D) 0

7) $\lim_{x \to 0} f(x)$ 7) ________



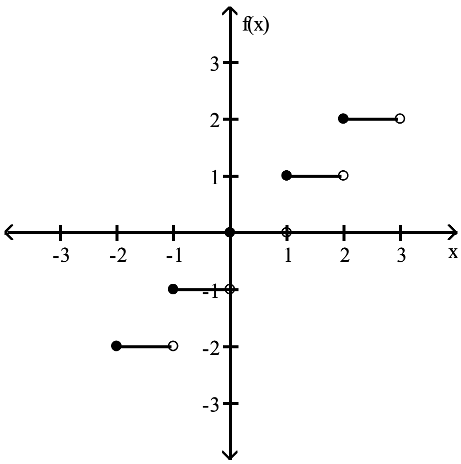
A) 0 B) −1 C) −2 D) Does not exist

8) $\lim_{x \to 1} f(x)$ 8) ________



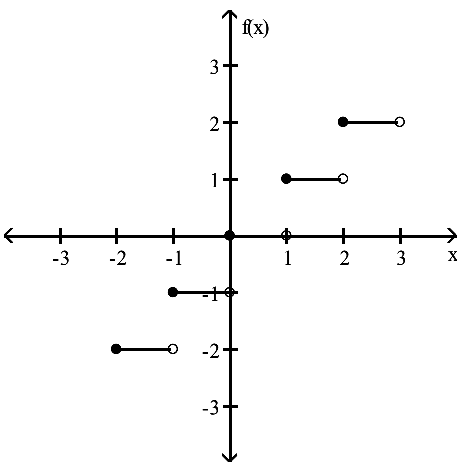
A) 1 B) −1 C) Does not exist D) 0

9) $\lim_{x \to -1} f(x)$ 9) ________



A) 0 B) −2 C) Does not exist D) −1

10) $\lim_{x \to -1/2} f(x)$ 10) ________



A) Does not exist B) 0 C) −1 D) −2

Complete the table and use the result to find the indicated limit.

11) If $f(x) = x^2 + 8x - 2$, find $\lim_{x \to 2} f(x)$. 11) _______

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)						

A)

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)	5.043	5.364	5.396	5.404	5.436	5.763

; limit = 5.40

B)

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)	5.043	5.364	5.396	5.404	5.436	5.763

; limit = ∞

C)

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)	16.810	17.880	17.988	18.012	18.120	19.210

; limit = 18.0

D)

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)	16.692	17.592	17.689	17.710	17.808	18.789

; limit = 17.70

12) If $f(x) = \frac{x^4 - 1}{x - 1}$, find $\lim_{x \to 1} f(x)$. 12) _______

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)						

A)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	4.595	5.046	5.095	5.105	5.154	5.677

; limit = 5.10

B)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	1.032	1.182	1.198	1.201	1.218	1.392

; limit = 1.210

C)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	1.032	1.182	1.198	1.201	1.218	1.392

; limit = ∞

D)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	3.439	3.940	3.994	4.006	4.060	4.641

; limit = 4.0

13) If $f(x) = \dfrac{x^3 - 6x + 8}{x - 2}$, find $\lim\limits_{x \to 0} f(x)$. 13) ________

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)						

A)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−1.22843	−1.20298	−1.20030	−1.19970	−1.19699	−1.16858

; limit = −1.20

B)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−2.18529	−2.10895	−2.10090	−2.99910	−2.09096	−2.00574

; limit = −2.10

C)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−1.22843	−1.20298	−1.20030	−1.19970	−1.19699	−1.16858

; limit = ∞

D)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−4.09476	−4.00995	−4.00100	−3.99900	−3.98995	−3.89526

; limit = −4.0

14) If $f(x) = \dfrac{x - 4}{\sqrt{x} - 2}$, find $\lim\limits_{x \to 4} f(x)$. 14) ________

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)						

A)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	5.07736	5.09775	5.09978	5.10022	5.10225	5.12236

; limit = 5.10

B)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	3.97484	3.99750	3.99975	4.00025	4.00250	4.02485

; limit = 4.0

C)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	1.19245	1.19925	1.19993	1.20007	1.20075	1.20745

; limit = 1.20

D)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	1.19245	1.19925	1.19993	1.20007	1.20075	1.20745

; limit = ∞

15) If $f(x) = x^2 - 5$, find $\lim_{x \to 0} f(x)$. 15) _______

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)						

A)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−1.4970	−1.4999	−1.5000	−1.5000	−1.4999	−1.4970

; limit = −15.0

B)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−4.9900	−4.9999	−5.0000	−5.0000	−4.9999	−4.9900

; limit = −5.0

C)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−2.9910	−2.9999	−3.0000	−3.0000	−2.9999	−2.9910

; limit = −3.0

D)

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)	−1.4970	−1.4999	−1.5000	−1.5000	−1.4999	−1.4970

; limit = ∞

16) If $f(x) = \frac{\sqrt{x + 1}}{x + 1}$, find $\lim_{x \to 1} f(x)$. 16) _______

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)						

A)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	0.72548	0.70888	0.70728	0.70693	0.70535	0.69007

; limit = 0.7071

B)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	0.21764	0.21266	0.21219	0.21208	0.21160	0.20702

; limit = 0.21213

C)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	0.21764	0.21266	0.21219	0.21208	0.21160	0.20702

; limit = ∞

D)

x	0.9	0.99	0.999	1.001	1.01	1.1
f(x)	2.15293	2.13799	2.13656	2.13624	2.13481	2.12106

; limit = 2.13640

17) If $f(x) = \sqrt{x} - 2$, find $\lim_{x \to 4} f(x)$. 17) _______

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)						

A)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	−0.02516	−0.00250	−0.00025	0.00025	0.00250	0.02485

; limit = 0

B)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	1.47736	1.49775	1.49977	1.50022	1.50225	1.52236

; limit = 1.50

C)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	3.9000	2.9000	1.9000	2.0000	3.0000	4.0000

; limit = ∞

D)

x	3.9	3.99	3.999	4.001	4.01	4.1
f(x)	3.9000	2.9000	1.9000	2.0000	3.0000	4.0000

; limit = 1.95

Give an appropriate answer.

18) Let $\lim_{x \to -4} f(x) = 6$ and $\lim_{x \to -4} g(x) = -5$. Find $\lim_{x \to -4} [f(x) - g(x)]$. 18) _______

A) 6 B) 11 C) 1 D) −4

19) Let $\lim_{x \to 4} f(x) = 3$ and $\lim_{x \to 4} g(x) = -2$. Find $\lim_{x \to 4} [f(x) \cdot g(x)]$. 19) _______

A) 4 B) 1 C) −2 D) −6

20) Let $\lim_{x \to -5} f(x) = 10$ and $\lim_{x \to -5} g(x) = -1$. Find $\lim_{x \to -5} \frac{f(x)}{g(x)}$. 20) _______

A) 11 B) − 10 C) $-\frac{1}{10}$ D) −5

21) Let $\lim_{x \to 1} f(x) = 1024$. Find $\lim_{x \to 1} \log_4 f(x)$. 21) _______

A) 625 B) 1 C) $\frac{5}{4}$ D) 5

22) Let $\lim_{x \to 2} f(x) = 225$. Find $\lim_{x \to 2} \sqrt{f(x)}$. 22) _______

A) 225 B) 2 C) 15 D) 3.8730

23) Let $\lim_{x \to -4} f(x) = 10$ and $\lim_{x \to -4} g(x) = 8$. Find $\lim_{x \to -4} [f(x) + g(x)]^2$. 23) _______

A) 2 B) 164 C) 324 D) 18

24) Let $\lim_{x \to 6} f(x) = 2$. Find $\lim_{x \to 6} (-4)^{f(x)}$. 24) _______

A) 16 B) 2 C) −4 D) 4096

25) Let $\lim_{x \to 10} f(x) = 64$. Find $\lim_{x \to 10} \sqrt[3]{f(x)}$. 25) _______

A) 3 B) 4 C) 10 D) 64

26) Let $\lim_{x \to 6} f(x) = 2$ and $\lim_{x \to 6} g(x) = 6$. Find $\lim_{x \to 6} \left[\frac{-8f(x) - 4g(x)}{5 + g(x)}\right]$. 26) _______

A) 6 B) $-\frac{36}{5}$ C) $\frac{8}{11}$ D) $-\frac{40}{11}$

27) Let $\lim_{x \to 9} f(x) = 3$ and $\lim_{x \to 9} g(x) = -1$. Find $\lim_{x \to 9} \left[\frac{[f(x)]^2}{6 + g(x)}\right]$. 27) _______

A) $\frac{9}{5}$ B) $\frac{3}{5}$ C) $\frac{9}{25}$ D) 9

Use the properties of limits to help decide whether the limit exists. If the limit exists, find its value.

28) $\lim_{x \to 9} \frac{x^2 - 81}{x - 9}$ 28) _______

A) 18 B) 9 C) 1 D) Does not exist

29) $\lim_{x \to -7} \frac{x^2 + 15x + 56}{x + 7}$ 29) _______

A) 15 B) Does not exist C) 1 D) 210

30) $\lim_{x \to 1} \frac{x^2 + 9x - 10}{x - 1}$ 30) _______

A) 0 B) 9 C) Does not exist D) 11

31) $\lim_{x \to 7} \frac{x^2 + 3x - 70}{x^2 - 49}$ 31) _______

A) $-\frac{3}{14}$ B) Does not exist C) $\frac{17}{14}$ D) 0

32) $\lim_{x \to 4} \frac{x^2 - 16}{x^2 - 5x + 4}$ 32) _______

A) $\frac{8}{3}$ B) 0 C) $\frac{4}{3}$ D) Does not exist

33) $\lim_{x \to 0} \frac{\frac{1}{x + 6} - \frac{1}{6}}{x}$ 33) _______

A) Does not exist B) $\frac{1}{36}$ C) $-\frac{1}{36}$ D) 0

34) $\lim_{x \to -3} \frac{x^2 - 9}{x + 3}$ 34) ________

A) 0 B) -3 C) -6 D) Does not exist

35) $\lim_{x \to -2} \frac{x^2 + 9x + 14}{x + 2}$ 35) ________

A) 9 B) 36 C) 5 D) Does not exist

36) $\lim_{x \to 9} \frac{\sqrt{x} - 3}{x - 9}$ 36) ________

A) $\frac{1}{6}$ B) $\frac{1}{3}$ C) 3 D) 0

37) $\lim_{h \to 0} \frac{(x + h)^3 - x^3}{h}$ 37) ________

A) Does not exist B) $3x^2$ C) $3x^2 + 3xh + h^2$ D) 0

38) $\lim_{x \to \infty} \frac{5x^2 + 6x - 3}{-4x^2 + 5}$ 38) ________

A) $-\frac{5}{3}$ B) ∞ C) 0 D) $-\frac{5}{4}$

39) $\lim_{x \to \infty} \frac{5x^3 + 2x}{-2x^4 + 3x^3 + 9}$ 39) ________

A) $-\frac{5}{2}$ B) 1 C) ∞ D) 0

40) $\lim_{x \to -\infty} \frac{x}{3x - 8}$ 40) ________

A) $-\frac{1}{3}$ B) 0 C) $\frac{1}{3}$ D) ∞

41) $\lim_{x \to \infty} \frac{3x + 1}{11x - 7}$ 41) ________

A) ∞ B) 0 C) $\frac{3}{11}$ D) $-\frac{1}{7}$

42) $\lim_{x \to \infty} \frac{5x + 1}{11x^2 - 7}$ 42) ________

A) 0 B) ∞ C) $-\frac{1}{7}$ D) $\frac{5}{11}$

43) $\lim_{x \to \infty} \frac{6x^5 - x + 4}{9x^2 - x - 6}$ 43) ________

A) $\frac{2}{3}$ B) ∞ C) $-\infty$ D) Does not exist

44) $\lim_{x \to \infty} \frac{5x^2 + 2x - 5x^4}{5x^2 - 2x + 1}$ 44) ________

A) Does not exist B) ∞ C) $-\infty$ D) 1

Use the properties of limits to help decide whether each limit exits. If a limit exists, find its value.

45) Let $f(x) = \begin{cases} x^2 + 1 & \text{if } x < 0 \\ 2 & \text{if } x \geq 0 \end{cases}$. Find $\lim_{x \to -4} f(x)$. 45) ________

A) Does not exist B) 1 C) 2 D) 17

46) Let $f(x) = \begin{cases} -2x + 3 & \text{if } x \leq 1 \\ -7x + 8 & \text{if } x > 1 \end{cases}$. Find $\lim_{x \to 1} f(x)$. 46) ________

A) 3 B) 8 C) Does not exist D) 1

47) Let $f(x) = \begin{cases} 3x + 1 & \text{if } x < 1 \\ 1 & \text{if } x = 1 \\ -7x + 9 & \text{if } x > 1 \end{cases}$. Find $\lim_{x \to 1} f(x)$. 47) ________

A) 4 B) 2 C) 0 D) Does not exist

Use a graphing utility to find the limit, if it exists.

48) $\lim_{x \to 1} \frac{x^4 - 4x^3 + 6x^2 - 7x + 4}{x - 1}$ 48) ________

A) 3 B) Does not exist. C) -3 D) -2

49) $\lim_{x \to \infty} \frac{(-2 + 2x^{2/3} + 2x^{4/3})^3}{x^4}$ 49) ________

A) Does not exist. B) 2 C) 8 D) 2.5

50) $\lim_{x \to 8} \frac{x^2 - 64}{x - 8}$ 50) ________

A) Does not exist B) 16 C) 1 D) 8

51) $\lim_{x \to 6} \frac{x^2 + 2x - 48}{x^2 - 36}$ 51) ________

A) 0 B) Does not exist C) $-\frac{1}{6}$ D) $\frac{7}{6}$

52) $\lim_{x \to 2} \frac{x^2 - 4}{x^2 - 6x + 8}$ 52) ________

A) Does not exist B) -1 C) -2 D) 0

53) $\lim_{t \to \infty} \frac{\sqrt{25t^2 - 125}}{t - 5}$ 53) ________

A) Does not exist B) 5 C) 25 D) 125

54) $\lim_{x \to 3} \frac{x^4 - 22x - 15}{x^2 - 9}$ 54) ________

A) Does not exist B) 9 C) ∞ D) 14.333

55) $\lim_{x \to -\infty} \frac{\sqrt{49x^2 + 1}}{3x}$ 55) ________

A) 0 B) Does not exist C) −2.333 D) 2.333

56) $\lim_{x \to -\infty} \frac{\sqrt{49x^2 + 6x + 8}}{2x}$ 56) ________

A) −3.5 B) ∞ C) 3.5 D) Does not exist

Solve the problem.

57) A company training program determines that, on average, a new employee can do P(s) pieces of work per day after s days of on−the−job training, where $P(s) = \frac{82 + 44s}{s + 6}$. Find $\lim_{s \to 1} P(s)$. 57) ________

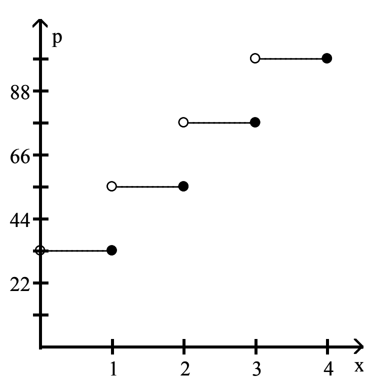
A) 126 B) Does not exist C) 18 D) 21

58) The cost of manufacturing a particular videotape is $c(x) = 9000 + 9x$, where x is the number of tapes produced. The average cost per tape, denoted by $\overline{c}(x)$, is found by dividing c(x) by x. Find $\lim_{x \to 1000} \overline{c}(x)$. 58) ________

A) 18 B) Does not exist C) 25 D) 11

59) Given is a graph of a portion of the postage function, which depicts the cost (in cents) of mailing a letter, p, versus the weight (in ounces) of the letter, x. Find each limit, if it exists: 59) ________

$\lim_{x \to 3^-} p(x)$, $\lim_{x \to 3^+} p(x)$, $\lim_{x \to 3} p(x)$



A) 99; 77; does not exist B) 77; 77; 77
C) 77; 99; does not exist D) 77; 99; 77

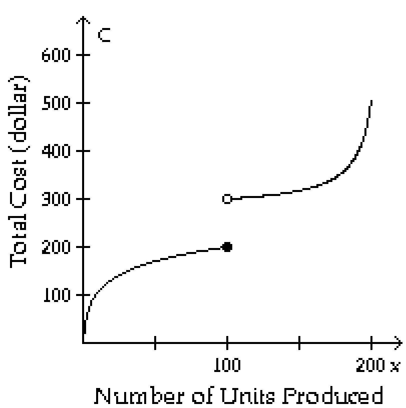
60) Suppose that the cost, p, of shipping a 3-pound parcel depends on the distance shipped, x, according to the function p(x) depicted in the graph. Find each limit, if it exists: 60) _______

$\lim_{x \to 100} p(x)$, $\lim_{x \to 500} p(x)$, $\lim_{x \to 1500} p(x)$

A) 5; 5; 15
B) 5; does not exist; 15
C) 5; does not exist; does not exist
D) 5; 10; 15

61) Suppose the the cost, C, of producing x units of a product can be illustrated by the given graph. Find each limit, if it exists: 61) _______

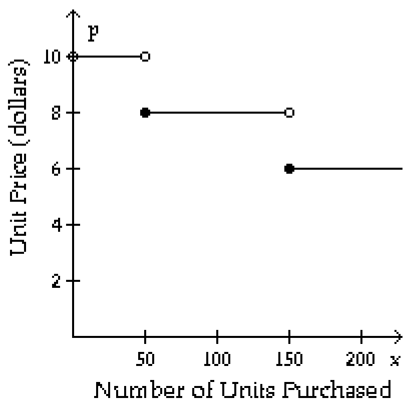
$\lim_{x \to 100^-} p(x)$, $\lim_{x \to 100^+} p(x)$, $\lim_{x \to 100} p(x)$



A) 200; does not exist; does not exist
B) 200; 200; 200
C) 200; 300; does not exist
D) 200; 300; 200

62) Suppose that the unit price, p, for x units of a product can be illustrated by the given graph. Find each limit, if it exists: 62) ________

$\lim_{x \to 50^-} p(x)$, $\lim_{x \to 50^+} p(x)$, $\lim_{x \to 50} p(x)$, $\lim_{x \to 75} p(x)$



A) 8; 8; 8; 8
B) 8; 8; does not exist; 8
C) 10; 8; 8; 8
D) 10; 8; does not exist; 8

63) The blood alcohol level h hours after consumption of 2 ounces of pure ethanol is given by $C(h) = \frac{0.55h}{h^3 - h^2 + 5}$. Find the blood alcohol level as h approaches infinity. 63) ________

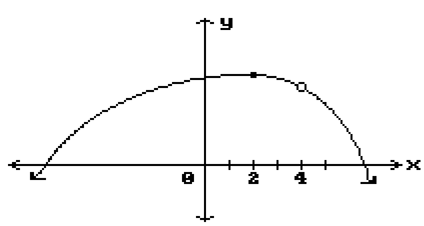
A) .55
B) 0
C) .11
D) ∞

64) The current value of an annuity per period is given by $P = \frac{R}{i} - \frac{R}{i(1 + i)^n}$, where n is the number of periods, i is the interest rate, and R is the amount of the periodic payment. Find the limit of the current value equation as n approaches infinity to derive an expression for the current value for an annuity that makes payments in perpetuity. 64) ________

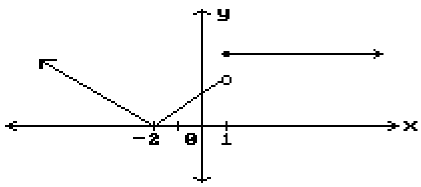
A) $P = \frac{R}{i} - R$
B) $P = \frac{R}{i}$
C) $P = 0$
D) $P = \infty$

Find all points where the function is discontinuous.

65) 65) ________

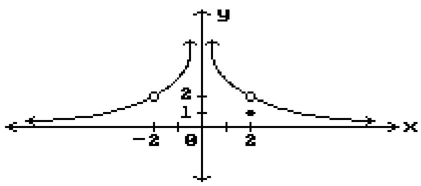


A) None
B) x = 4
C) x = 2
D) x = 4, x = 2

66) 

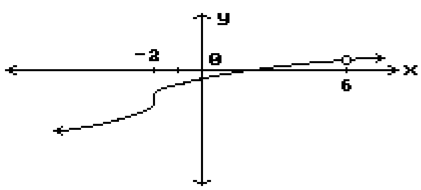
A) x = −2, x = 1 B) None C) x = −2 D) x = 1

66) _______

67) 

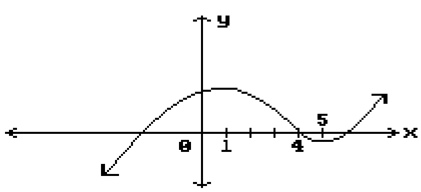
A) x = 2
B) x = −2, x = 0
C) x = 0, x = 2
D) x = −2, x = 0, x = 2

67) _______

68) 

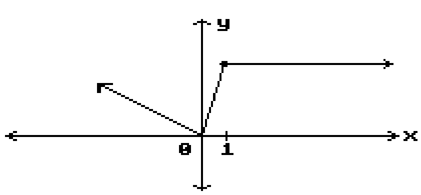
A) x = −2 B) x = 6 C) None D) x = −2, x = 6

68) _______

69) 

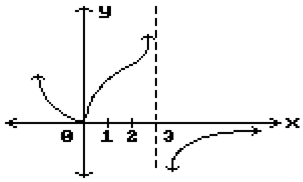
A) x = 4
B) None
C) x = 1, x = 5
D) x = 1, x = 4, x = 5

69) _______

70) 

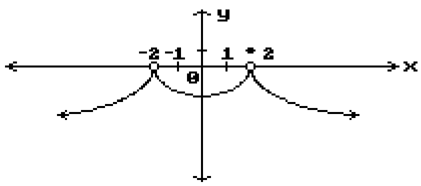
A) x = 0 B) None C) x = 1 D) x = 0, x = 1

70) _______

71) 

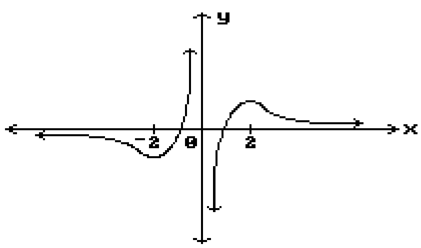
A) x = 0, x = 3 B) x = 0 C) x = 3 D) None

71) ________

72) 

A) x = 2 B) x = −2, x = 2 C) None D) x = −2

72) ________

73) 

A) x = −2, x = 0, x = 2
B) None
C) x = 0
D) x = −2, x = 2

73) ________

Find all values x = a where the function is discontinuous.

74) $f(x) = \dfrac{-3x}{(7x - 2)(2 - 4x)}$

A) $a = \frac{2}{7}, -\frac{1}{2}$ B) $a = 0, \frac{2}{7}, \frac{1}{2}$ C) $a = \frac{2}{7}, \frac{1}{2}$ D) Nowhere

74) ________

75) $f(x) = \dfrac{|x^2 - 100|}{x - 4}$

A) a = −10, 10, 4 B) a = 10, 4 C) Nowhere D) a = 4

75) ________

76) $f(x) = \dfrac{x^2 - 36}{x + 6}$

A) a = −6 B) a = 5 C) a = −36 D) a = 6

76) ________

77) $g(x) = \begin{cases} 0 & \text{if } x < 0 \\ x^2 - 2x & \text{if } 0 \le x \le 2 \\ 2 & \text{if } x > 2 \end{cases}$

A) a = 0, 2 B) Nowhere C) a = 0 D) a = 2

77) ________

78) $q(x) = x^2 + 9x - 7$

A) a = 9 B) Nowhere C) a = 0 D) a = 7

78) ________

79) $k(x) = e^{\sqrt{x+2}}$ 79) ________

A) $a > -2$ B) Nowhere C) $a > 2$ D) $a < -2$

80) $f(x) = \ln\left|\dfrac{x-8}{x+3}\right|$ 80) ________

A) $a = 8, -3$ B) Nowhere C) $a = -3$ D) $a = -8, 3$

81) $f(x) = \begin{cases} 5 & \text{if } x < 5 \\ x + 6 & \text{if } 5 \le x \le 10 \\ 16 & \text{if } x > 10 \end{cases}$ 81) ________

A) $a = 5$ B) $a = 10$ C) $a = -5$ D) Nowhere

82) $f(x) = \begin{cases} 9 & \text{if } x < 4 \\ x^2 - 7 & \text{if } 4 \le x \le 10 \\ 9 & \text{if } x > 10 \end{cases}$ 82) ________

A) Nowhere B) $a = 10$ C) $a = 4$ D) $a = 7$

83) $f(x) = \begin{cases} 3x - 8 & \text{if } x < 0 \\ x^2 + 2x - 8 & \text{if } x \ge 0 \end{cases}$ 83) ________

A) $a = 0$ B) Nowhere C) $a = 2$ D) $a = -8$

Give an appropriate response.

84) Find the limit of f(x) as x approaches 3 from the right. 84) ________

$f(x) = \begin{cases} -2 & \text{if } x < 3 \\ x + 2 & \text{if } 3 \le x \le 5 \\ 7 & \text{if } x > 5 \end{cases}$

A) -2 B) 5
C) 7 D) The limit does not exist.

85) Find the limit of f(x) as x approaches 2 from the left. 85) ________

$f(x) = \begin{cases} 1 & \text{if } x < 2 \\ x + 2 & \text{if } 2 \le x \le 4 \\ 6 & \text{if } x > 4 \end{cases}$

A) 4 B) 1
C) 6 D) The limit does not exist.

Find the value of the constant k that makes the function continuous.

86) $h(x) = \begin{cases} x^2 & \text{if } x \le 3 \\ x + k & \text{if } x > 3 \end{cases}$ 86) ________

A) $k = 3$ B) $k = 6$ C) $k = -3$ D) $k = 12$

87) $g(x) = \begin{cases} x^2 - 7 & \text{if } x < 6 \\ 5kx & \text{if } x \ge 6 \end{cases}$ 87) ________

A) $k = \dfrac{6}{5}$ B) $k = \dfrac{29}{30}$ C) $k = 29$ D) $k = 13$

88) $f(x) = \begin{cases} x^2 + x + k & \text{if } x < 2 \\ x^3 & \text{if } x \geq 2 \end{cases}$ 88) _______

A) $k = 2$ B) $k = 14$ C) $k = 6$ D) $k = 8$

89) $h(x) = \begin{cases} \dfrac{7x^2 + 25x - 12}{x + 4} & \text{if } x \neq -4 \\ 3x + k & \text{if } x = -4 \end{cases}$ 89) _______

A) $k = -19$ B) $k = 52$ C) $k = 0$ D) $k = 4$

Use a graphing utility to find the discontinuities of the given rational function.

90) $f(x) = \dfrac{x^2 + 4x + 4}{x^3 + 2x^2 + x - 18}$ 90) _______

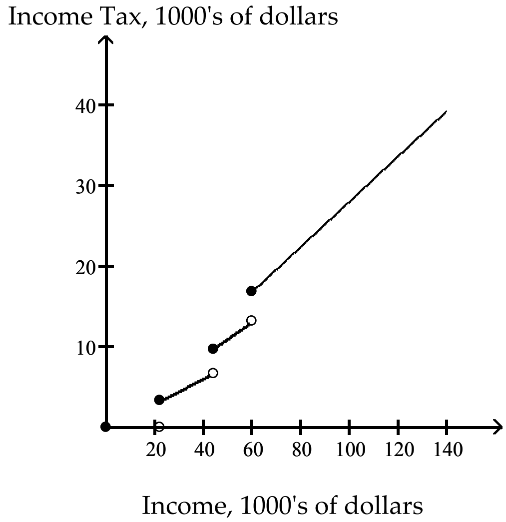
A) -2
B) 4
C) 2
D) The function is continuous for all values of x.

91) $f(x) = \dfrac{x + 1}{x^3 + 2x^2 + 10x - 13}$ 91) _______

A) 3
B) 1
C) -1
D) The function is continuous for all values of x.

Solve the problem.

92) The graph below shows the amount of income tax that a single person must pay on his or her income when claiming the standard deduction. Identify the income levels where discontinuities occur and explain the meaning of the discontinuities. 92) _______



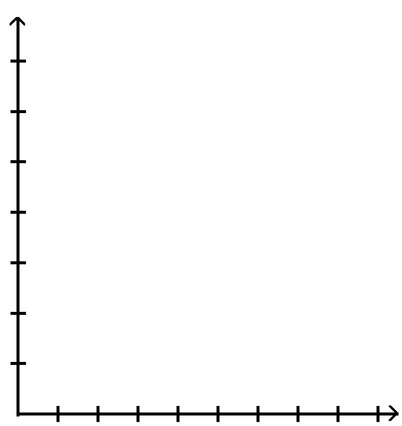
A) Discontinuities at x = $44,000 and x = $60,000. Discontinuities represent boundaries between tax brackets.

B) Discontinuities at x = $22,000, x = $44,000, and x = $60,000. Discontinuities represent tax cheating on the part of high-income earners.

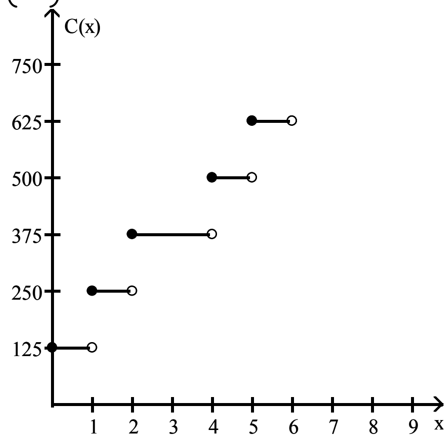
C) Discontinuities at x = $22,000, x = $44,000, and x = $60,000. Discontinuities represent boundaries between tax brackets.

D) Discontinuities at x = $44,000 and x = $60,000. Discontinuities represent tax shelters.

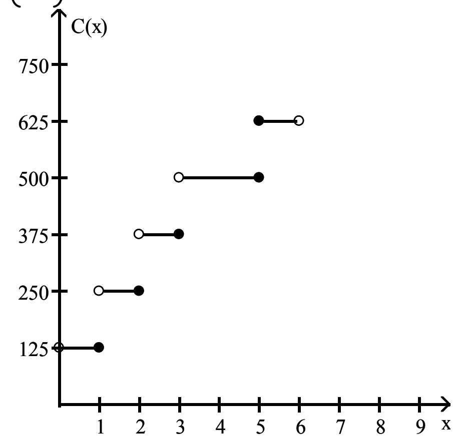
93) In order to boost business, a ski resort in Vermont is offering rooms for $125 per night with every fourth night free. Let C(x) represent the total cost of renting a room for x days. Sketch a graph of C(x) on the interval (0, 6] and determine the cost for staying $4\frac{1}{2}$ days. 93) _______



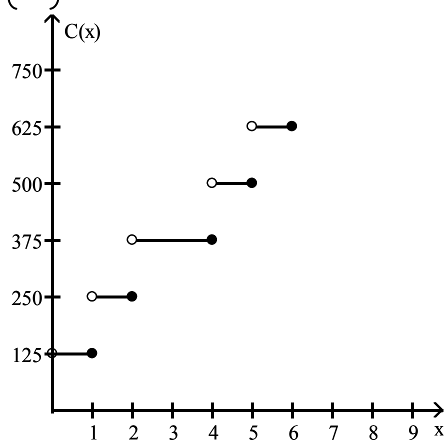
A) $C\left(4\frac{1}{2}\right) = \$375$



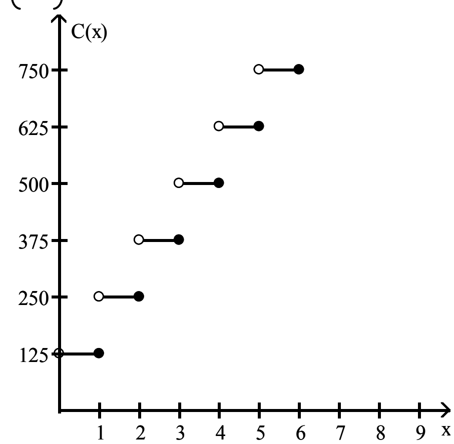
B) $C\left(4\frac{1}{2}\right) = \$500$



C) $C\left(4\frac{1}{2}\right) = \$500$



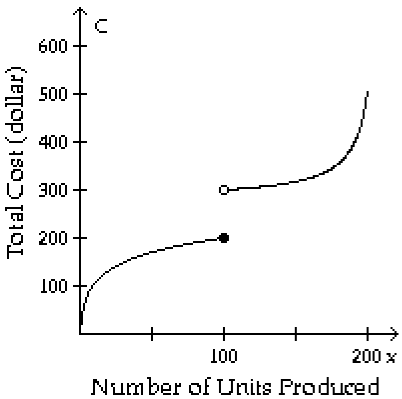
D) $C\left(4\frac{1}{2}\right) = \$625$



94) Suppose that the cost, p, of shipping a 3–pound parcel depends on the distance shipped, x, according to the function p(x) depicted in the graph. Is p continuous at $x = 50$? at $x = 500$? at $x = 1500$? at $x = 3000$? 94) _______

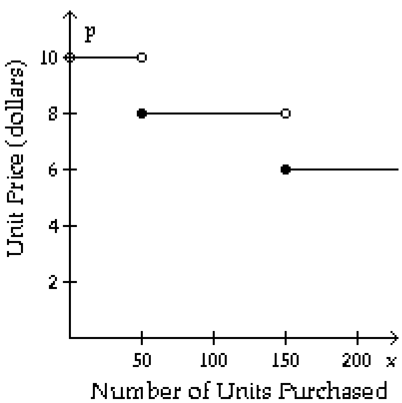
A) Yes; no; yes; no
B) Yes; yes; yes; no
C) Yes; no; no; no
D) No; no; yes; no

95) Suppose that the cost, C, of producing x units of a product can be illustrated by the given graph. Is C(x) continuous at x = 50? x = 100? x = 150? 95) _______



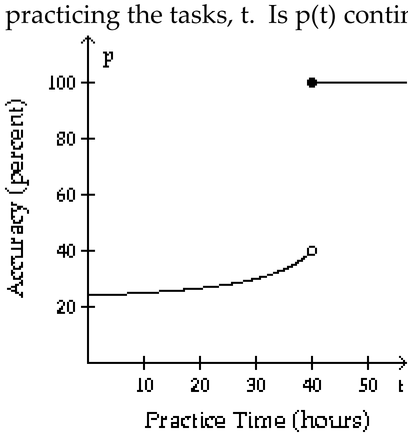
A) Yes; no; yes B) Yes; no; no C) No; no; no D) Yes; yes; yes

96) Suppose that the unit price, p, for x units of a product can be illustrated by the given graph. Is p(x) continuous at x = 50? x = 100? x = 150? 96) _______



A) No; no; no B) No; yes; yes C) Yes; no; yes D) No; yes; no

97) Consider the learning curve defined in the graph. Depicted is the accuracy, p, expressed as a percentage, in performing a series of short tasks versus the accumulated amount of time spent practicing the tasks, t. Is p(t) continuous at t = 25? at t = 40? at t = 45? 97) _______



A) Yes; no; yes B) Yes; yes; yes C) No; no; no D) Yes; no; no

Find the average rate of change for the function over the given interval.

98) $y = x^2 + 1x$ between $x = 3$ and $x = 6$ 98) _______

A) 10 B) 7 C) 5 D) 14

99) $y = 5x^3 - 8x^2 + 1$ between $x = -3$ and $x = 2$ 99) _______

A) $\frac{215}{2}$ B) 43 C) $\frac{9}{2}$ D) $\frac{9}{5}$

100) $y = \sqrt{2x}$ between $x = 2$ and $x = 8$ 100) ______

A) 7 B) $\frac{1}{3}$ C) $-\frac{3}{10}$ D) 2

101) $y = \frac{3}{x - 2}$ between $x = 4$ and $x = 7$ 101) ______

A) $-\frac{3}{10}$ B) $\frac{1}{3}$ C) 2 D) 7

102) $y = 4x^2$ between $x = 0$ to $x = \frac{7}{4}$ 102) ______

A) $-\frac{3}{10}$ B) 2 C) $\frac{1}{3}$ D) 7

103) $y = -3x^2 - x$ between $x = 5$ and $x = 6$ 103) ______

A) $-\frac{1}{6}$ B) -34 C) -2 D) $\frac{1}{2}$

104) $y = x^3 + x^2 - 8x - 7$ between $x = 0$ and $x = 2$ 104) ______

A) -2 B) -28 C) $-\frac{1}{6}$ D) $\frac{1}{2}$

105) $y = \sqrt{2x - 1}$ between $x = 1$ and $x = 5$ 105) ______

A) -28 B) $\frac{1}{2}$ C) -2 D) $-\frac{1}{6}$

106) $y = \frac{3}{x + 2}$ between $x = 1$ and $x = 4$ 106) ______

A) $-\frac{1}{6}$ B) -28 C) -2 D) $\frac{1}{2}$

107) $y = 5x + 7$ between $x = -1$ and $x = 0$ 107) ______

A) -28 B) $-\frac{1}{6}$ C) $\frac{1}{2}$ D) 5

Suppose the position of an object moving in a straight line is given by the specified function. Find the instantaneous velocity at time t.

108) $s(t) = t^2 + 6t + 3$, $t = 4$ 108) ______

A) 32 B) 14 C) 11 D) 43

109) $s(t) = t^2 + 4t + 3$, $t = 1$ 109) ______

A) 9 B) 5 C) 6 D) 8

110) $s(t) = 5t^2 - 7t - 3$, $t = 4$ 110) ______

A) 33 B) 49 C) 30 D) 13

111) $s(t) = t^3 + 5t + 9$, $t = 2$ 111) ______

A) 26 B) 17 C) 9 D) 11

112) $s(t) = t^3 + 4t + 5$, $t = 1$ 112) ______

A) 10 B) 7 C) 6 D) 12

Find the instantaneous rate of change for the function at the given value.

113) $F(x) = x^2 + 9x$ at $x = -1$ 113) ______

A) −2 B) 7 C) 8 D) −8

114) $f(x) = 5x + 9$ at $x = 2$ 114) ______

A) 0 B) 9 C) 5 D) 10

115) $s(t) = t^2 + 5t$ at $t = 4$ 115) ______

A) 9 B) 3 C) 21 D) 13

116) $g(t) = 5t^2 + t$ at $t = -4$ 116) ______

A) −14 B) 6 C) −41 D) −39

117) $F(x) = 2x^2 + x - 3$ at $x = 4$ 117) ______

A) 19 B) 15 C) 17 D) 5

118) $g(x) = x^2 + 11x - 15$ at $x = 1$ 118) ______

A) −9 B) 11 C) 26 D) 13

119) $s(t) = 3t^2 + 5t - 7$ at $t = -2$ 119) ______

A) 1 B) −17 C) −1 D) −7

120) $g(t) = 3t^2 + 6$ at $t = 4$ 120) ______

A) 8 B) 12 C) 24 D) −24

Use the formula for instantaneous rate of change, approximating the limit by using smaller and smaller values of h, to find the instantaneous rate of change for the function at the given value.

121) Use a graphing utility to approximate the instantaneous rate of change of $f(x) = x^{1/x}$ at $x = 3$. 121) ______

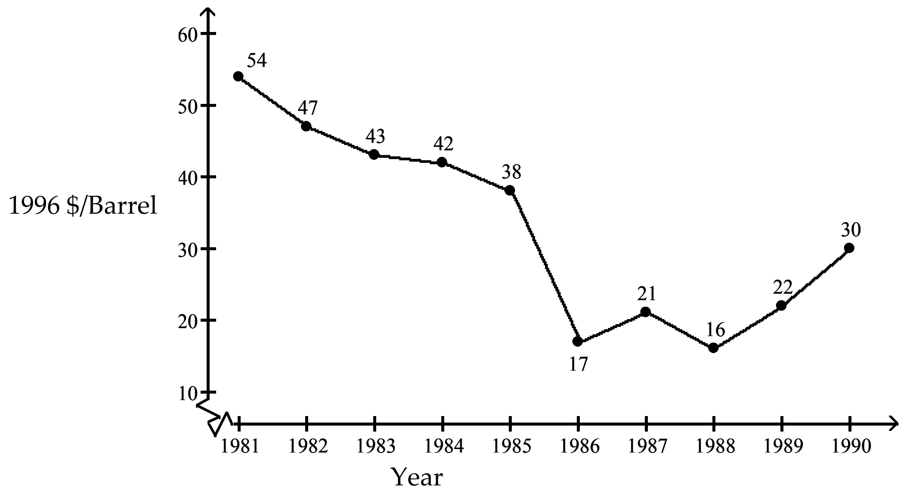
A) −0.0899 B) −0.0316 C) −0.0158 D) 0.1667

122) Use a graphing utility to approximate the instantaneous rate of change of $f(x) = x^{-\ln x}$ at $x = 2$. 122) ______

A) .2158 B) 0.6185 C) −0.4287 D) −0.6548

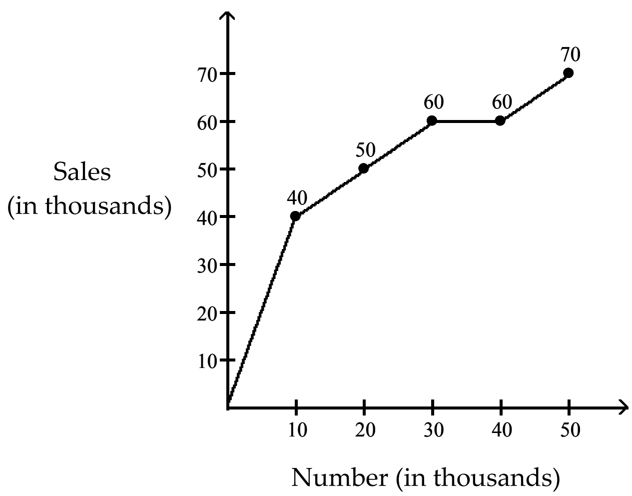
Solve the problem.

123) The graph shows the average cost of a barrel of crude oil for the years 1981 to 1990 in constant 1996 dollars. Find the approximate average change in price from 1981 to 1986. 123) ______



A) About −$7/year B) About −$4/year
C) About −$15/year D) About −$37/year

124) The graph shows the total sales in thousands of dollars from the distribution of x thousand catalogs. Find the average rate of change of sales with respect to the number of catalogs distributed from 10 to 50. 124) ______



A) 1 B) $\frac{3}{4}$ C) $\frac{1}{4}$ D) 2

125) Suppose that the total profit in hundreds of dollars from selling x items is given by $P(x) = -x^2 + 10x - 21$. Find the marginal profit at $x = 3$. 125) ______

A) $600 per item B) $0 per item C) −$600 per item D) $400 per item

126) The total cost to produce x handcrafted wagons is $C(x) = 90 + 4x - x^2 + 5x^3$. Find the rate of change of cost with respect to the number of wagons produced (the marginal cost) when $x = 6$. 126) ______

A) $622 per wagon
B) $1068 per wagon
C) $532 per wagon
D) $1158 per wagon

127) Suppose that the revenue from selling x radios is $R(x) = 65x - \frac{x^2}{10}$ dollars. Use the function $R'(x)$ to estimate the increase in revenue that will result from increasing production from 105 radios to 106 radios per week. 127) ______

A) $86.00
B) $44.00
C) $43.80
D) $54.50

128) Suppose that the dollar cost of producing x radios is $C(x) = 800 + 40x - 0.2x^2$. Find the marginal cost when 35 radios are produced. 128) ______

A) $26
B) $54
C) –$1955
D) $1955

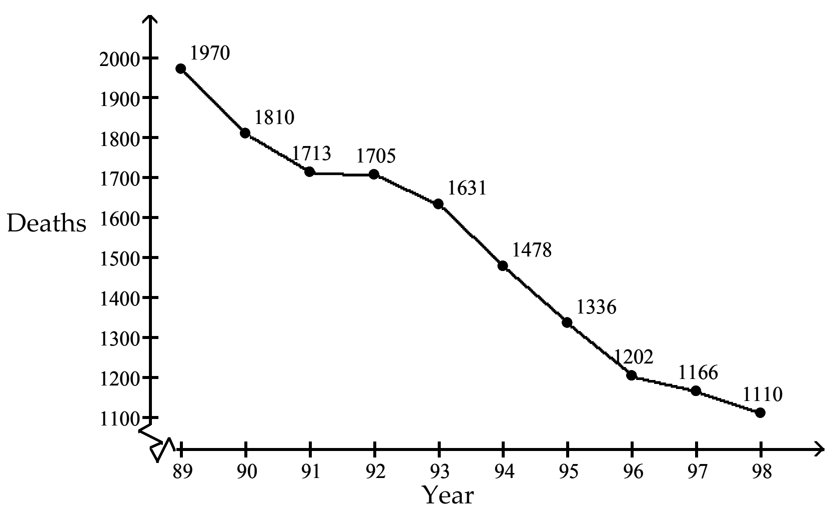
129) Suppose that the dollar cost of producing x radios is $c(x) = 600 + 30x - 0.2x^2$. Find the average cost per radio of producing the first 40 radios. 129) ______

A) $1480.00
B) $37.00
C) $1430.00
D) $880.00

130) A particular strain of influenza is known to spread according to the function $p(t) = \frac{1}{4}(t^2 + t)$, where t is the number of days after the first appearance of the strain and p(t) is the percentage of the population that is infected. Find the instantaneous rate of change of p with respect to t at $t = 3$. 130) ______

A) 3% per day
B) 2% per day
C) $\frac{3}{2}$% per day
D) $\frac{7}{4}$% per day

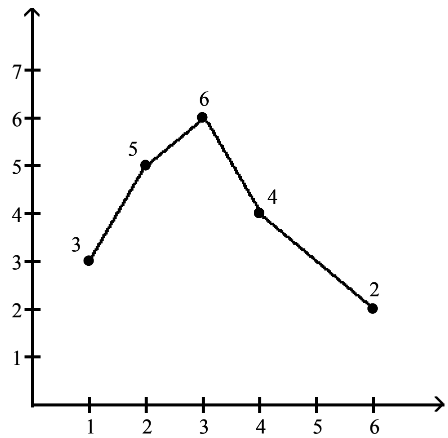
131) The graph below shows the number of tuberculosis deaths in the United States from 1989 to 1998. 131) ______



Estimate the average rate of change in tuberculosis deaths from 1996 to 1998.

A) About –50 deaths per year
B) About –20 deaths per year
C) About –90 deaths per year
D) About –0.5 deaths per year

132) The graph shows the population in millions of bacteria t minutes after a bactericide is introduced into a culture. Find the average rate of change of population with respect to time for the time from 1 to 4 minutes. 132) ______



A) $\frac{1}{4}$ B) 4 C) $\frac{1}{3}$ D) 3

133) The number of gallons of water in a swimming pool t minutes after the pool has started to drain is $Q(t) = 50(20 - x)^2$. How fast is the water running out at the end of 12 minutes? 133) ______

A) 400 gal/min B) 1600 gal/min C) 800 gal/min D) 3200 gal/min

134) The size of a population of mice after t months is $P = 100(1 + 0.2t + 0.02t^2)$. Find the growth rate at t = 17 months. 134) ______

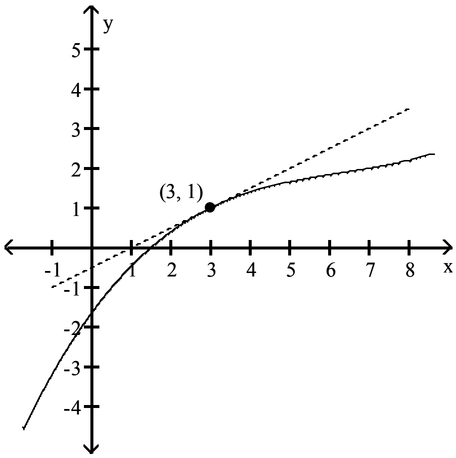
A) 88 mice/month B) 176 mice/month
C) 188 mice/month D) 44 mice/month

135) A ball is thrown vertically upward from the ground at a velocity of 65 feet per second. Its distance from the ground after t seconds is given by $s(t) = -16t^2 + 65t$. How fast is the ball moving 2 seconds after being thrown? 135) ______

A) 66 ft per sec B) 1 ft per sec C) −5 ft per sec D) 33 ft per sec

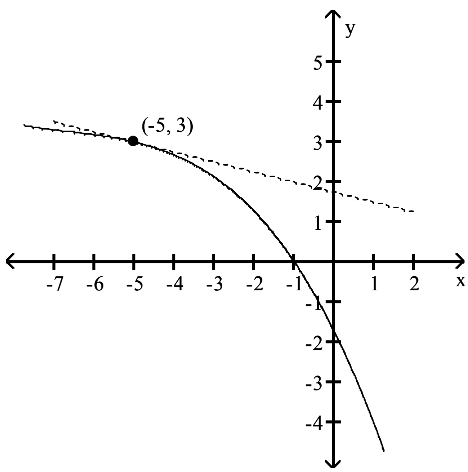
Estimate the slope of the tangent line to the curve at the given point.

136) 136) ______



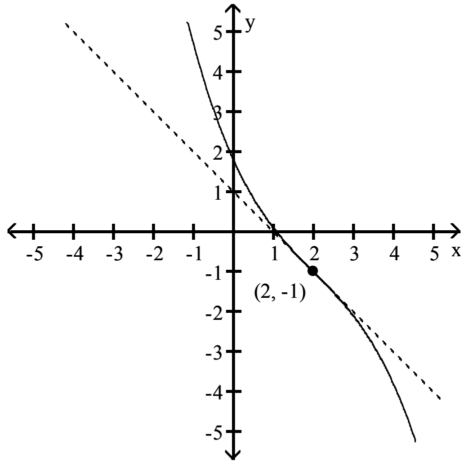
A) −1 B) 2 C) $\frac{1}{2}$ D) 1

137) 137) ______



A) $-\frac{1}{2}$ B) $-\frac{1}{4}$ C) $\frac{1}{4}$ D) −4

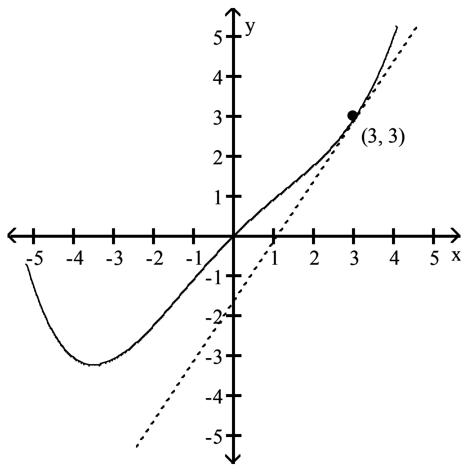
138)



A) $-\frac{3}{2}$ B) $-\frac{1}{2}$ C) -1 D) 1

138) ______

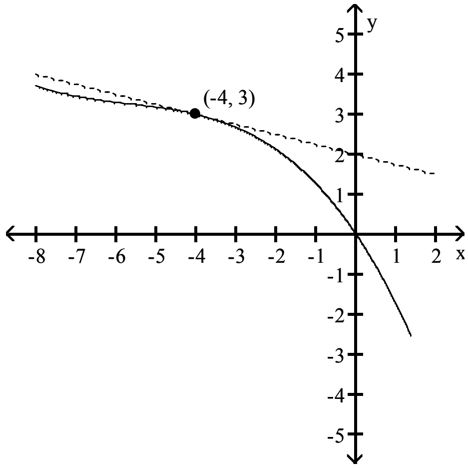
139)



A) $\frac{3}{2}$ B) $\frac{1}{2}$ C) 3 D) $\frac{2}{3}$

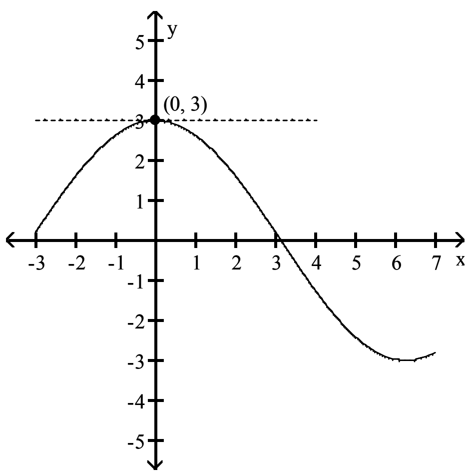
139) ______

140) 140) ______



A) $-\frac{1}{2}$ B) $-\frac{1}{4}$ C) $\frac{1}{4}$ D) -4

141) 141) ______



A) 1 B) undefined C) 3 D) 0

Find f'(x) at the given value of x.

142) $f(x) = 10x^2 + 8x$; Find $f'(9)$. 142) ______

A) 188 B) 220 C) -243 D) 252

143) $f(x) = \frac{-10}{x}$; Find $f'(4)$. 143) ______

A) $\frac{5}{8}$ B) $\frac{5}{2}$ C) $\frac{2}{5}$ D) $\frac{8}{5}$

144) $f(x) = \sqrt{x}$; Find $f'(16)$. 144) ______

A) 16 B) 4 C) $\frac{1}{4}$ D) $\frac{1}{8}$

145) $f(x) = \frac{-1}{x + 6}$; Find $f'(-4)$. 145) ______

A) $\frac{3}{4}$ B) $-\frac{3}{4}$ C) $\frac{1}{4}$ D) $-\frac{1}{4}$

146) $f(x) = \sqrt{x + 5}$; Find $f'(11)$. 146) ______

A) $\frac{1}{8}$ B) $\frac{5}{8}$ C) $\frac{\sqrt{3}}{8}$ D) $\frac{5\sqrt{3}}{8}$

147) $f(x) = \frac{48}{x}$; Find $f'(2)$. 147) ______

A) -24 B) 24 C) -12 D) 48

148) $f(x) = x^2 - 9x - 1$; Find $f'(-5)$. 148) ______

A) -20 B) -10 C) 69 D) -19

149) $f(x) = x^3 + 3$; Find $f'(2)$. 149) ______

A) 15 B) -12 C) 12 D) 13

150) $f(x) = -7x^2 + 2x + 6$; Find $f'(3)$. 150) ______

A) -40 B) -34 C) 44 D) -36

151) $f(x) = 7\sqrt{x}$; Find $f'(5)$. 151) ______

A) Does not exist B) 70 C) $\frac{7}{2\sqrt{5}}$ D) $\frac{7\sqrt{5}}{2}$

Find the equation of the secant line through the points where x has the given values.

152) $f(x) = x^2 + 3x$; $x = 3, x = 4$ 152) ______

A) $y = 10x$ B) $y = 10x - 12$ C) $y = 12x - 10$ D) $y = 10x + 12$

153) $f(x) = 4 - x^2$; $x = -4, x = 0$ 153) ______

A) $y = 4x + 4$ B) $y = -4x - 4$ C) $y = 4$ D) $y = 4x - 4$

154) $f(x) = \frac{8}{x}$; $x = 6, x = 10$ 154) ______

A) $y = -\frac{8}{x^2}$ B) $y = -\frac{2}{15}x$ C) $y = \frac{2}{15}x - \frac{32}{15}$ D) $y = -\frac{2}{15}x + \frac{32}{15}$

155) $f(x) = 6\sqrt{x}$; $x = 25, x = 4$ 155) ______

A) $y = \frac{6}{7}x - \frac{60}{7}$ B) $y = -\frac{6}{7}x + \frac{60}{7}$ C) $y = \frac{6}{2\sqrt{x}}$ D) $y = \frac{6}{7}x + \frac{60}{7}$

Find the equation of the tangent line to the curve when x has the given value.

156) $f(x) = -7 - x^2$; $x = 9$ 156) ______

A) $y = 18x - 74$ B) $y = -2x$ C) $y = 9x + 74$ D) $y = -18x + 74$

157) $f(x) = \frac{7}{x + 1}$; $x = 4$ 157) ______

A) $y = -\frac{14}{25}x + \frac{63}{25}$ B) $y = -\frac{7}{25}x + \frac{7}{25}$ C) $y = \frac{7}{25}x + \frac{7}{25}$ D) $y = -\frac{7}{25}x + \frac{63}{25}$

158) $f(x) = \frac{x^2}{4}$; $x = -4$ 158) ______

A) $y = -2x - 4$ B) $y = -2x + 4$ C) $y = -8x - 4$ D) $y = -2x - 8$

159) $f(x) = \frac{x^3}{2}$; $x = 2$ 159) ______

A) $y = 2x - 8$ B) $y = 6x - 8$ C) $y = 2x + 8$ D) $y = 8x + 6$

160) $f(x) = \frac{x^3}{2}$; $x = -6$ 160) ______

A) $y = 216x + 18$ B) $y = 54x + 216$ C) $y = 216x + 54$ D) $y = 18x + 216$

161) $f(x) = \frac{64}{x}$; $x = 2$ 161) ______

A) $y = -16x + 32$ B) $y = -32x + 96$ C) $y = -16x$ D) $y = -16x + 64$

162) $f(x) = \frac{27}{x}$; $x = 3$ 162) ______

A) $y = -3x + 18$ B) $y = -6x + 27$ C) $y = -3x + 9$ D) $y = -3x$

163) $f(x) = x^2 - 3$; $x = 2$ 163) ______

A) $y = 2x - 7$ B) $y = 4x - 11$ C) $y = 4x - 14$ D) $y = 4x - 7$

164) $f(x) = x^2 + 2$; $x = -3$ 164) ______

A) $y = -3x - 7$ B) $y = -6x - 7$ C) $y = -6x - 16$ D) $y = -6x - 14$

165) $f(x) = x^2 - x$; $x = -4$ 165) ______

A) $y = -9x - 12$ B) $y = -9x + 12$ C) $y = -9x + 16$ D) $y = -9x - 16$

Use a graphing calculator to find f'(x) when x has the given value.

166) $f(x) = -7x^2 + 4x$; $x = 17$ 166) ______

A) -115 B) -234 C) -242 D) -248

167) $f(x) = 6\sqrt{x}$; $x = 100$ 167) ______

A) $-\frac{6}{5}$ B) $\frac{3}{10}$ C) $\frac{3}{50}$ D) Undefined

168) $f(x) = \frac{3}{x}$; $x = -4$ 168) ______

A) $\frac{3}{16}$ B) $\frac{-3}{16}$ C) $\frac{-5}{16}$ D) -16

169) $f(x) = \sqrt{x + 1}$; $x = 8$ 169) ______

A) $\frac{7}{6}$ B) $-\frac{1}{6}$ C) $-\frac{7}{6}$ D) $\frac{1}{6}$

170) $f(x) = 2x^2 - 3x$; $x = 13$ 170) ______

A) 49 B) 1211.1667 C) $52x - 3$ D) 55

171) $f(x) = 4e^x$; $x = -3$ 171) ______

A) 0.1991 B) −32.6194 C) 4.0498 D) −12

172) $f(x) = 6 \ln|x|$; $x = 5$ 172) ______

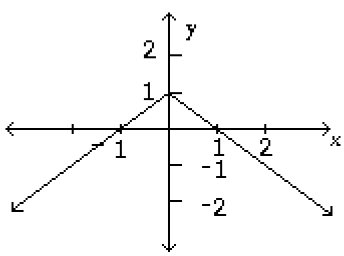
A) 1.2 B) 0.8333 C) 7.2 D) 0

173) $f(x) = -\frac{5}{x}$; $x = 7$ 173) ______

A) 0.102 B) 245 C) −0.7143 D) 9.8

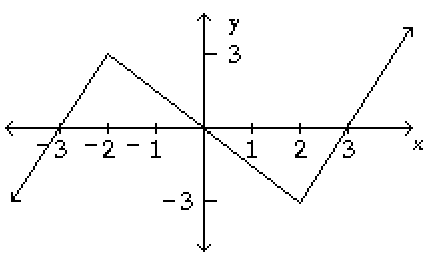
Find the x-values where the function does not have a derivative.

174) 174) ______



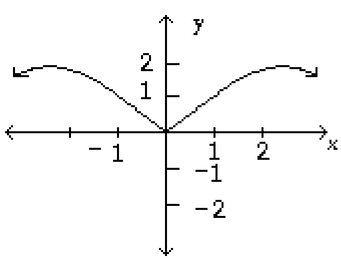
A) $x = -1$ B) $x = 0$ C) $x = 1$ D) $x = 2$

175) 175) ______

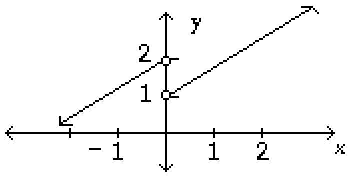


A) $x = -3, x = 3$ B) $x = -3, x = 0, x = 3$
C) $x = -2, x = 0, x = 2$ D) $x = -2, x = 2$

176) 176) ______

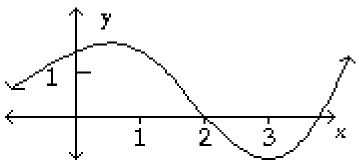


A) $x = 0$ B) $x = 2$
C) $x = -2, x = 0, x = 2$ D) $x = -2, x = 2$

177) 

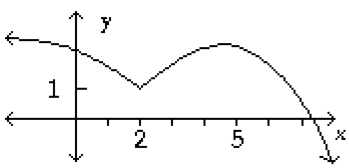
A) x = 2
B) x = 0, x = 1, x = 2
C) x = 1
D) x = 0

177) ______

178) 

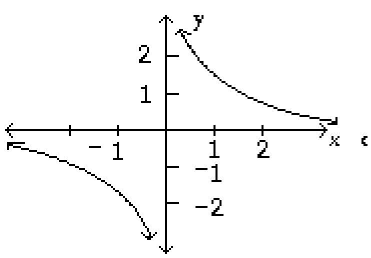
A) x = 2
B) x = 1, x = 3
C) x = 1, x = 2, x = 3
D) Exists at all points

178) ______

179) 

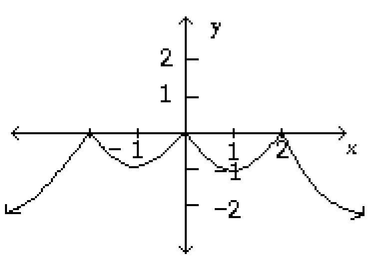
A) x = 2
B) x = 2, x = 5
C) x = 5
D) Exists at all points

179) ______

180) 

A) x = −1, x = 1
B) x = −1, x = 0, x = 1
C) x = 0
D) Exists at all points

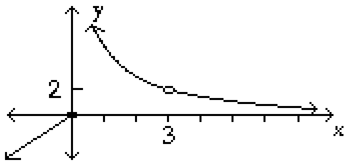
180) ______

181) 

A) x = 0
B) x = −2, x = 2
C) x = −2, x = 0, x = 2
D) Exists at all points

181) ______

182) 182) ______



A) $x = 0, x = 3$
B) $x = 3$
C) $x = 0$
D) Exists at all points

Use a graphing calculator to find f'(x) when x has the given value.

183) $f(x) = x^{x/2}$; $x = 3$ 183) ______

A) 0.2938
B) 1.6932
C) 5.4524
D) −0.2019

184) $f(x) = x^{6/x}$; $x = 3$ 184) ______

A) −0.2357
B) −0.5917
C) −0.16441
D) 0.1122

Solve the problem.

185) Suppose the demand for a certain item is given by $D(p) = -4p^2 + 4p + 6$, where p represents the price of the item. Find D'(p), the rate of change of demand with respect to price. 185) ______

A) $D'(p) = -8p + 4$
B) $D'(p) = -8p^2 + 4$
C) $D'(p) = -4p^2 + 4$
D) $D'(p) = -4p + 4$

186) Suppose the demand for a certain item is given by $D(p) = -3p^2 + 7p + 3$, where p represents the price of the item. Find D'(7). 186) ______

A) −35
B) −32
C) 7
D) 10

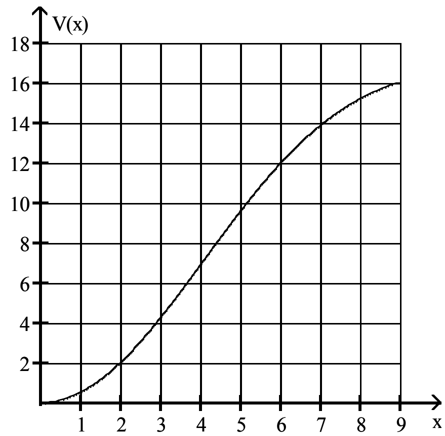
187) The profit from the expenditure of x thousand dollars on advertising is given by $P(x) = 1040 + 25x - 3x^2$. Find the marginal profit when the expenditure is $x = 9$. 187) ______

A) 1040 thousand dollars
B) 225 thousand dollars
C) 171 thousand dollars
D) −29 thousand dollars

188) The revenue generated by the sale of x bicycles is given by $R(x) = 10.00x - x^2/200$. Find the marginal revenue when $x = 700$ units. 188) ______

A) $10.00
B) $70.00
C) $17.00
D) $3.00

189) The graph shows the amount of potential energy $V(x)$ (in arbitrary energy units) stored in a large rubber band that is stretched a distance of x inches beyond its relaxed length. 189) ______



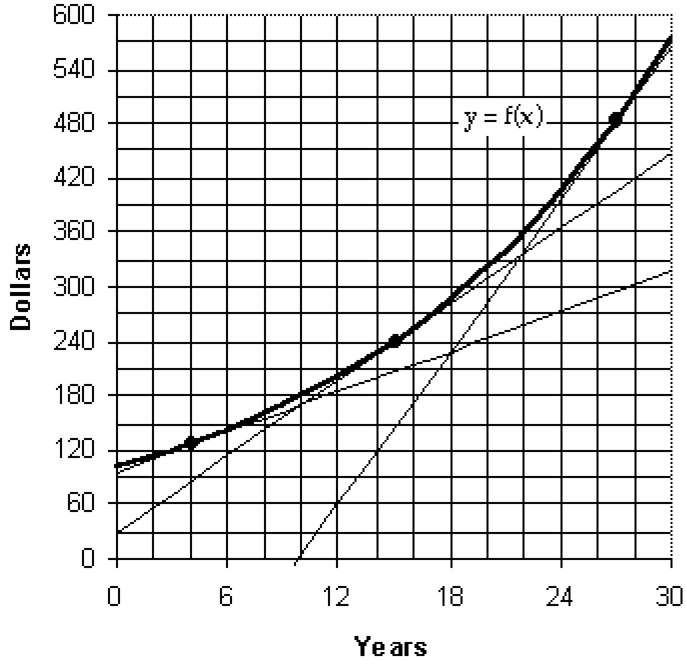
The magnitude of the force required to hold the rubber band at the position $x = a$ is the derivative of the potential energy with respect to x, evaluated at the point $x = a$. Estimate the force required to hold the band at a stretched position $x = 8$. (Hint: the force in this problem has units of "energy units per inch".)

A) 2.9 energy units per inch
B) 2.2 energy units per inch
C) 1.1 energy units per inch
D) –1.1 energy units per inch

190) The force F (in N) exerted by a cam on a lever is given by $F = x^4 - 13x^3 + 45x^2 - 67x + 30$, where x ($1 \le x \le 5$) is the distance (in cm) from the center of rotation of the cam to the edge of the cam in contact with the lever. Find the instantaneous rate of change of F with respect to x when $x = 4$ cm. 190) ______

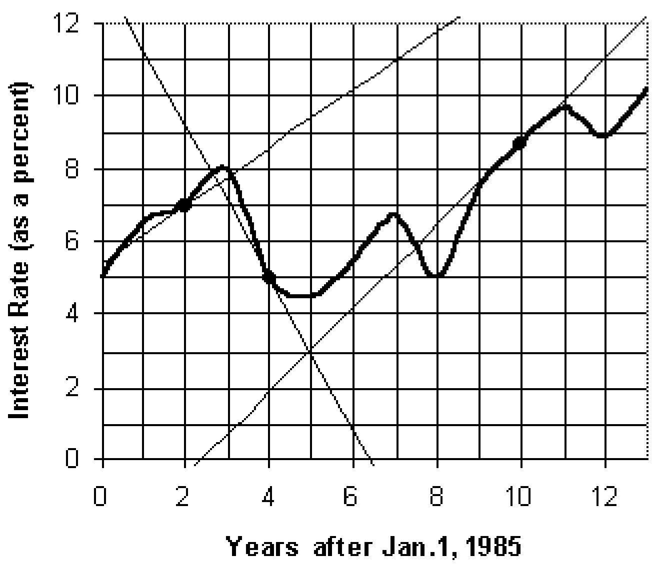
A) –31 N/cm
B) –94 N/cm
C) –139 N/cm
D) –75 N/cm

191) One hundred dollars is deposited in a savings account at 6% interest compounded continuously. The function defined by f(x) shown in the figure gives the balance in the account after t years. At what rate (in dollars per year) is the balance growing after 27 years? 191) ______



A) ≈ \$7/year B) ≈ \$8/year C) ≈ \$14/year D) ≈ \$28/year

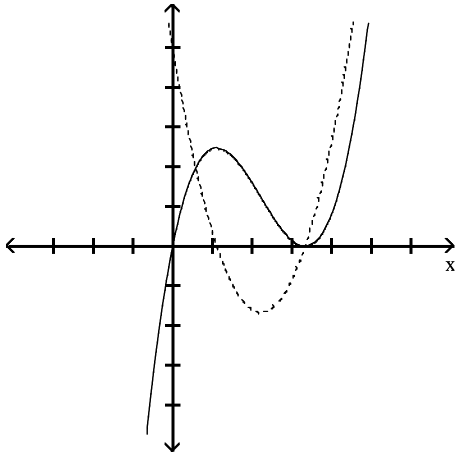
192) Refer to the figure, where f(t) is the interest rate (as a percent) on a 6–month certificate of deposit t years after January 1, 1985. The straight lines are tangent to the graph of $y = f(t)$ at $t = 2$, $t = 4$, and $t = 10$. How fast was the interest rate changing on January 1, 1995? 192) ______



A) ≈ –2%/year B) ≈ 2%/year C) ≈ 0%/year D) ≈ 1%/year

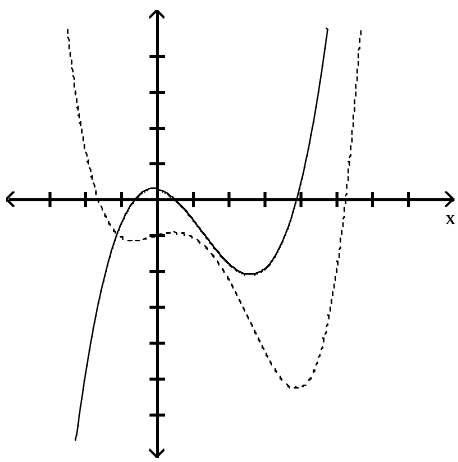
The graphs of a function f(x) and its derivative f'(x) are shown below. Decide which is the graph of f(x) and which is the graph of f'(x).

193) 193) ______



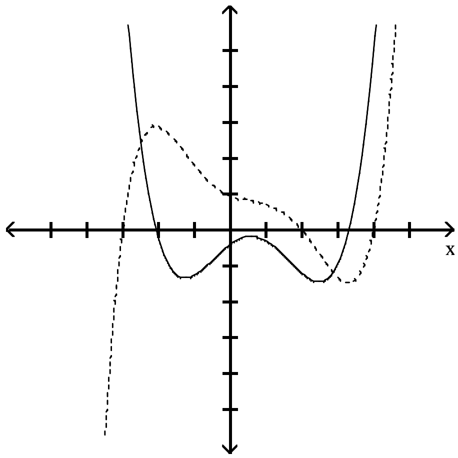
A) f(x) is the dashed line; f'(x) is the solid line.
B) Neither graph could be the derivative of the other.
C) f(x) is the solid line; f'(x) is the dashed line.
D) Either graph could be the derivative of the other.

194) 194) ______



A) Neither graph could be the derivative of the other.
B) Either graph could be the derivative of the other.
C) f(x) is the solid line; f'(x) is the dashed line.
D) f(x) is the dashed line; f'(x) is the solid line.

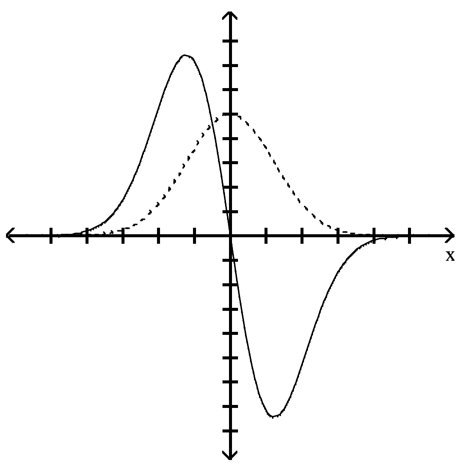
195)



A) f(x) is the dashed line; f'(x) is the solid line.
B) Either graph could be the derivative of the other.
C) Neither graph could be the derivative of the other.
D) f(x) is the solid line; f'(x) is the dashed line.

195) ______

196)

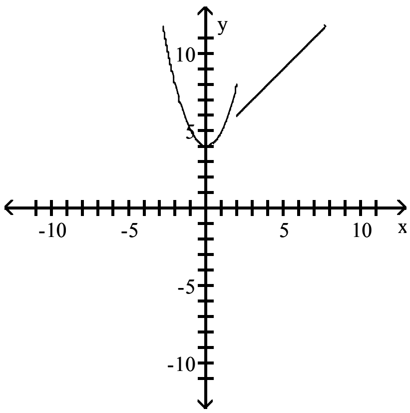


A) f(x) is the dashed line; f'(x) is the solid line.
B) Neither graph could be the derivative of the other.
C) f(x) is the solid line; f'(x) is the dashed line.
D) Either graph could be the derivative of the other.

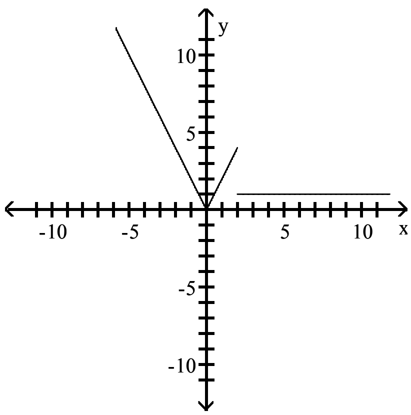
196) ______

Sketch the derivative of the graph.

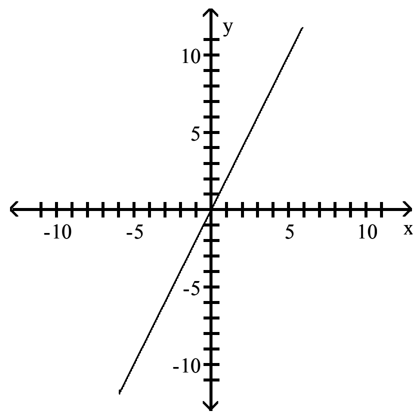
197) 197) ______



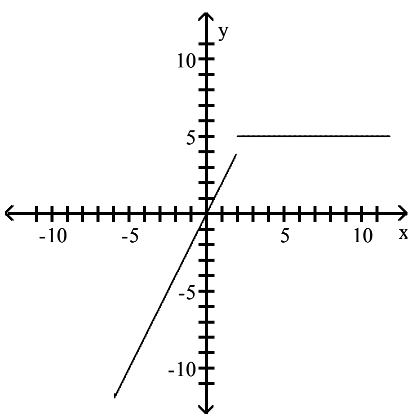
A)



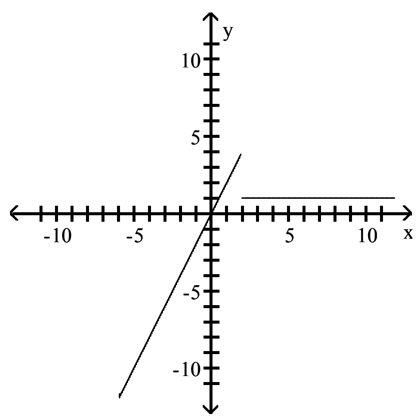
B)



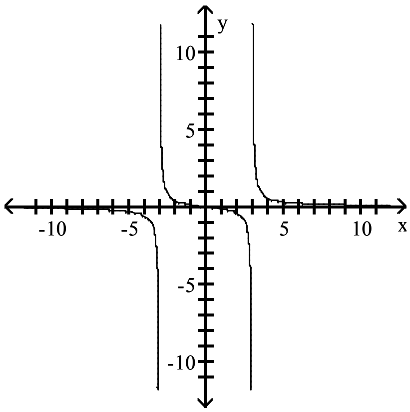
C)



D)



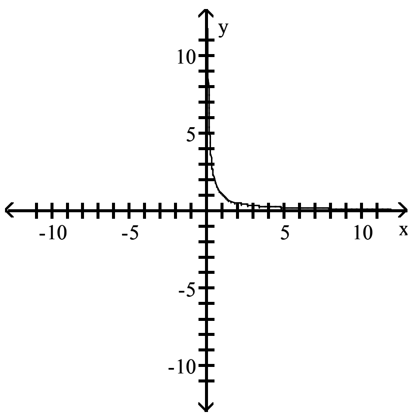
198)



y
10
5
-10
-5
5
10
x
-5
-10

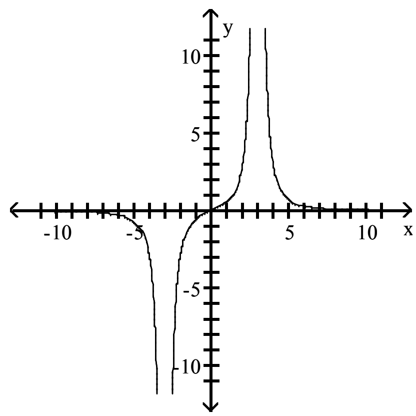
198) ______

A)



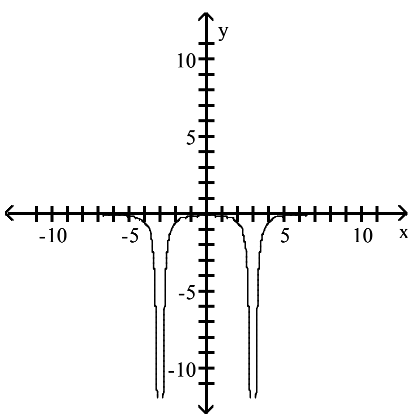
y
10
5
-10
-5
5
10
x
-5
-10

B)



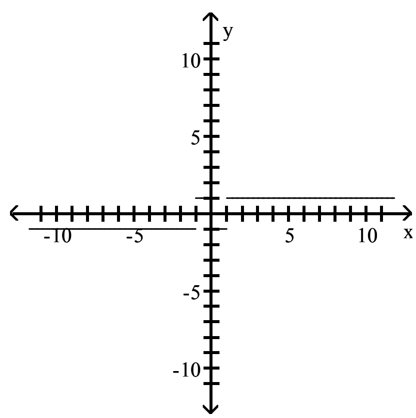
y
10
5
-10
-5
5
10
x
-5
-10

C)



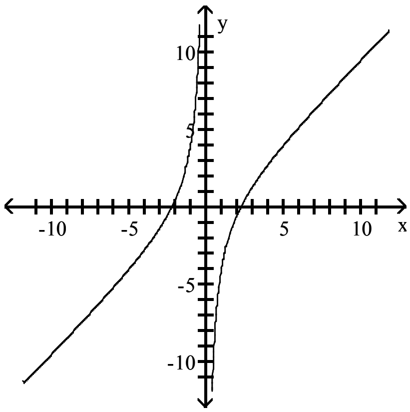
y
10
5
-10
-5
5
10
x
-5
-10

D)



y
10
5
-10
-5
5
10
x
-5
-10

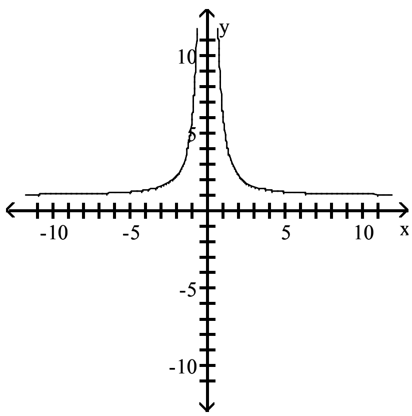
199)



y
10
5
-5
-10
-10
-5
5
10
x

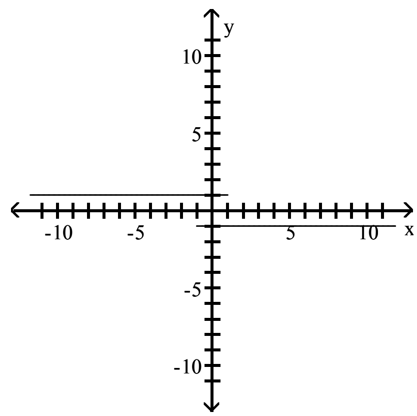
199) ______

A)



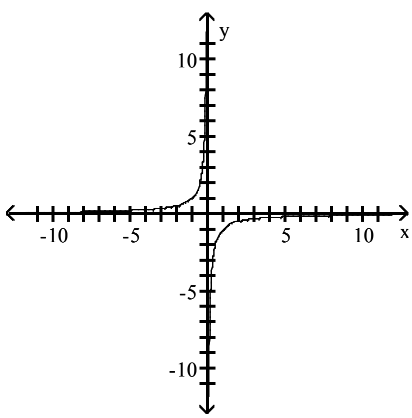
y
10
5
-5
-10
-10
-5
5
10
x

B)



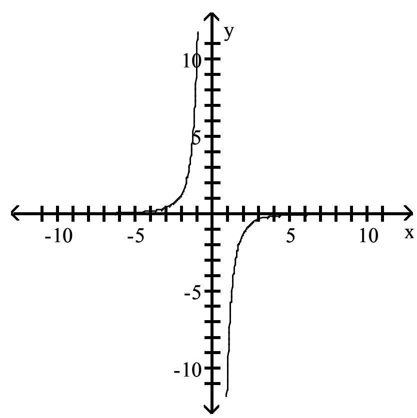
y
10
5
-5
-10
-10
-5
5
10
x

C)



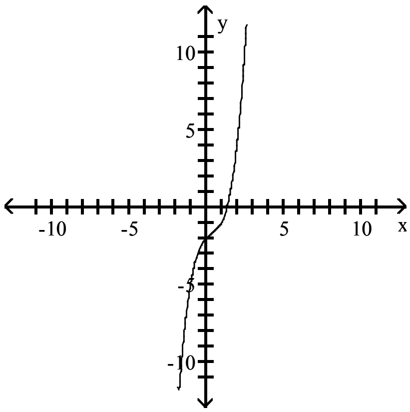
y
10
5
-5
-10
-10
-5
5
10
x

D)



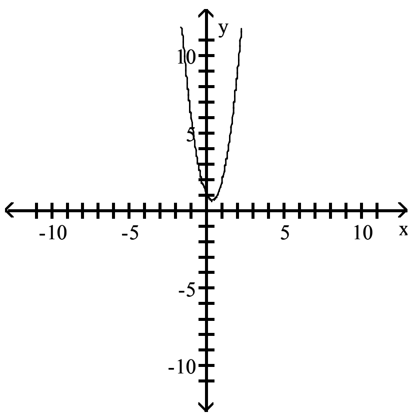
y
10
5
-5
-10
-10
-5
5
10
x

200)

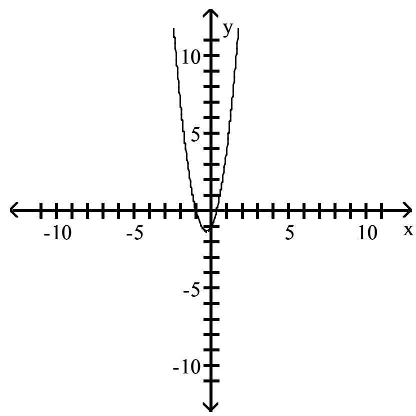


200) ______

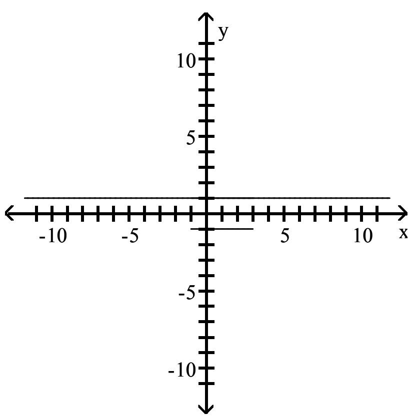
A)



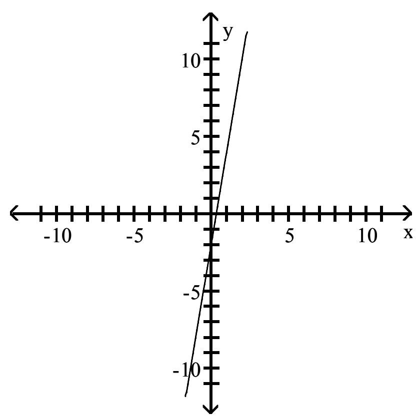
B)

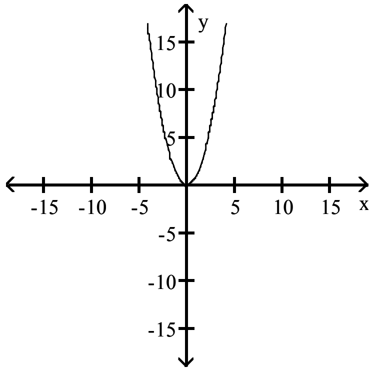


C)



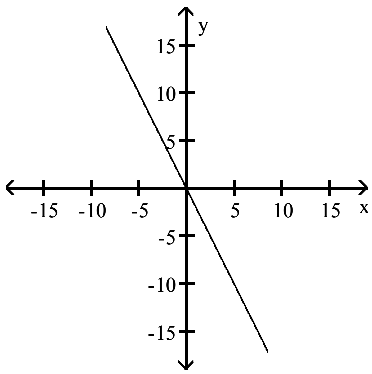
D)



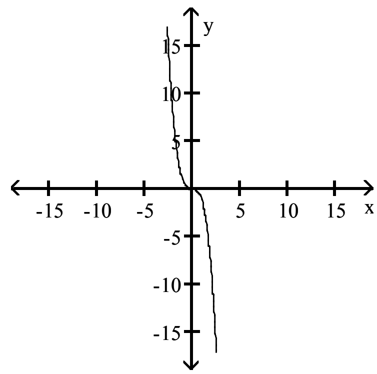
201) 

201) ______

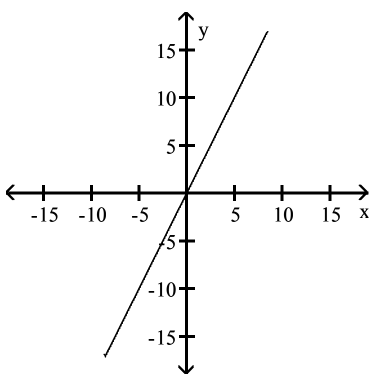
A)



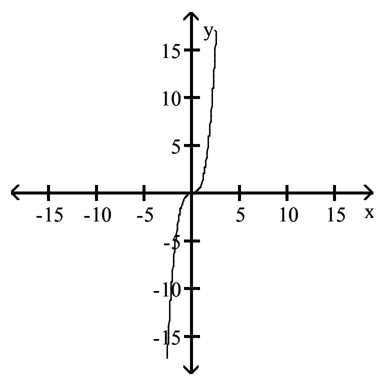
B)



C)

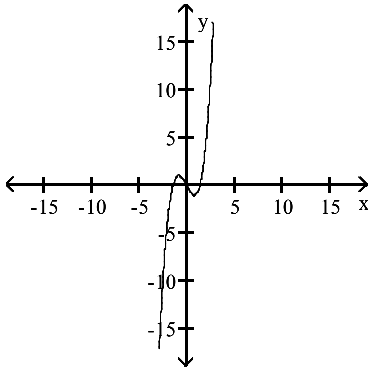


D)



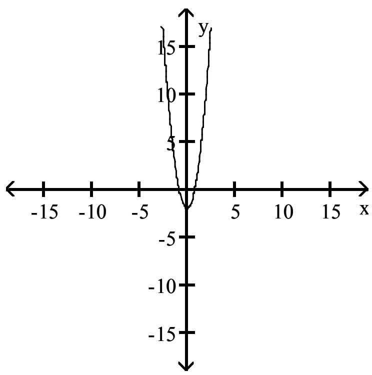
202)

202) ______



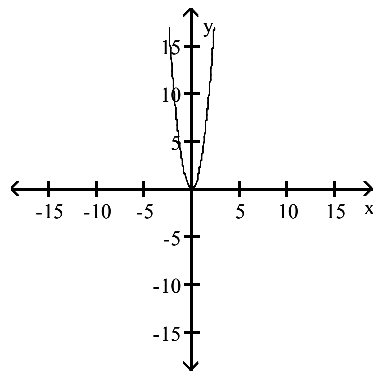
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

A)



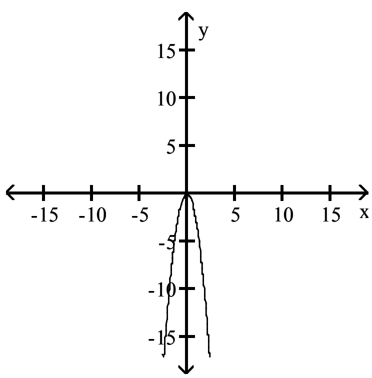
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

B)



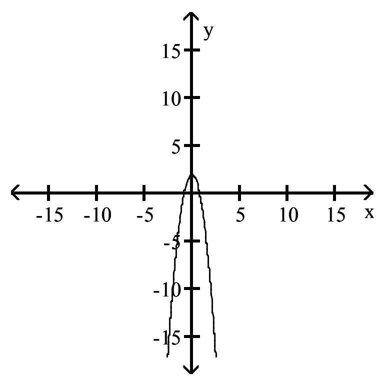
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

C)



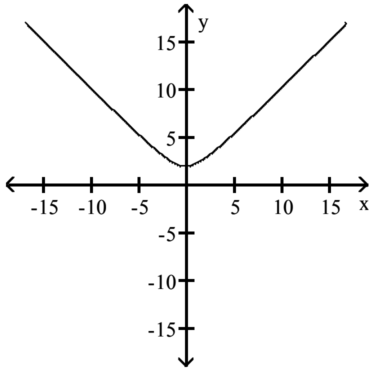
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

D)



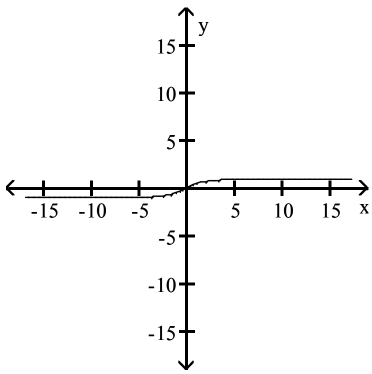
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

203)

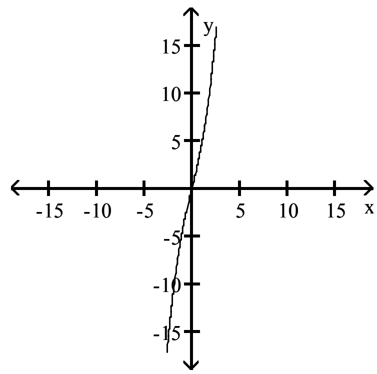

y
15
10
5
-5
-10
-15
-15 -10 -5 5 10 15 x

203) ______

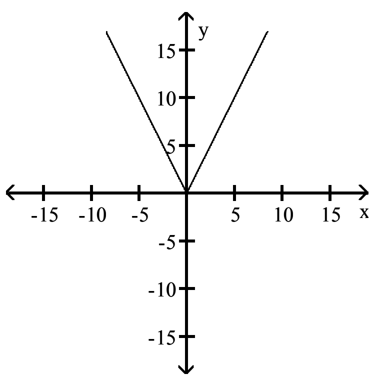
A)


y
15
10
5
-5
-10
-15
-15 -10 -5 5 10 15 x

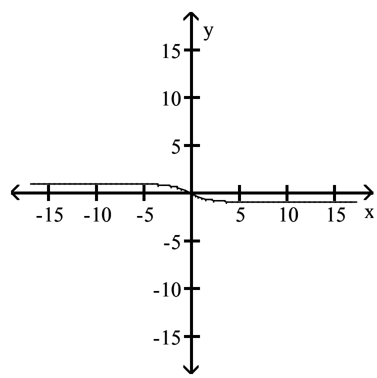
B)


y
15
10
5
-5
-10
-15
-15 -10 -5 5 10 15 x

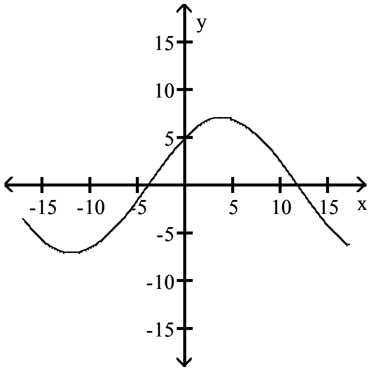
C)


y
15
10
5
-5
-10
-15
-15 -10 -5 5 10 15 x

D)

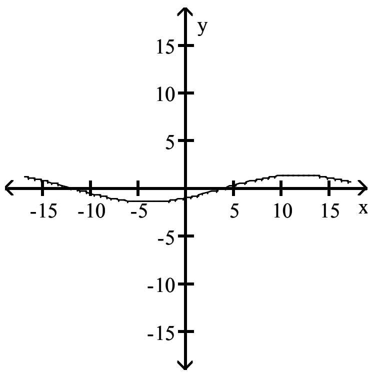

y
15
10
5
-5
-10
-15
-15 -10 -5 5 10 15 x

204) 204) ______



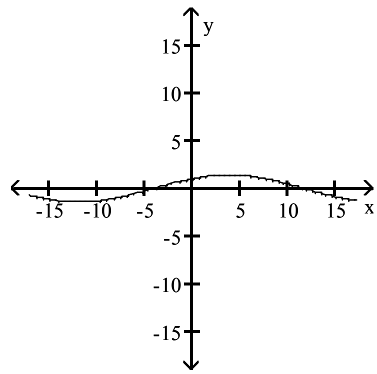
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

A)



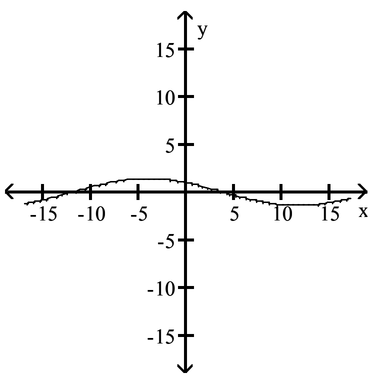
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

B)



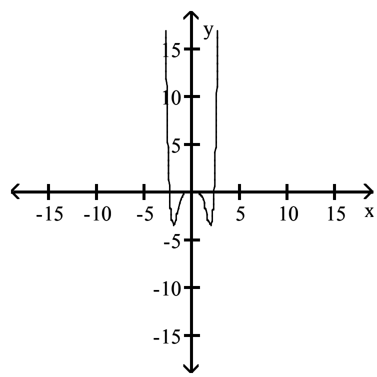
y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

C)

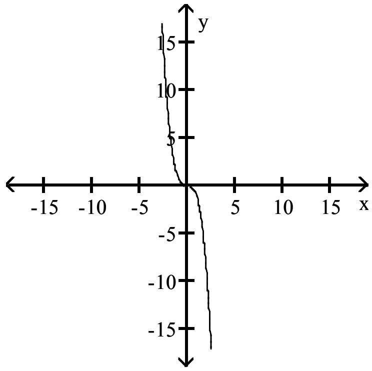


y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

D)

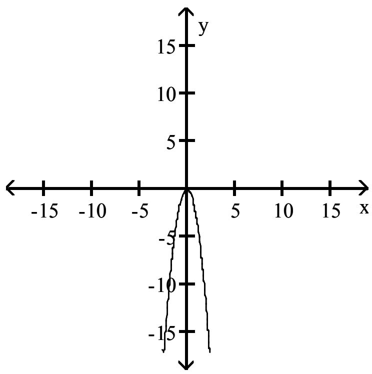


y
15
10
5
-15 -10 -5 5 10 15 x
-5
-10
-15

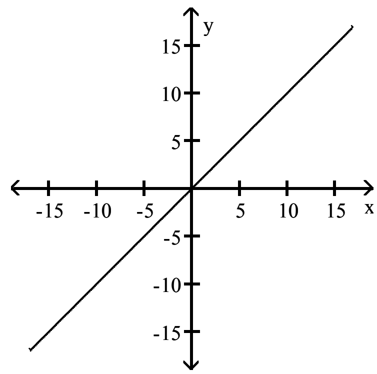
205) 

205) ______

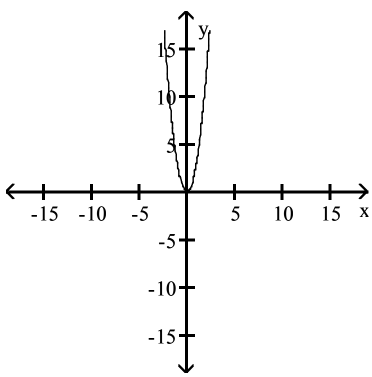
A)



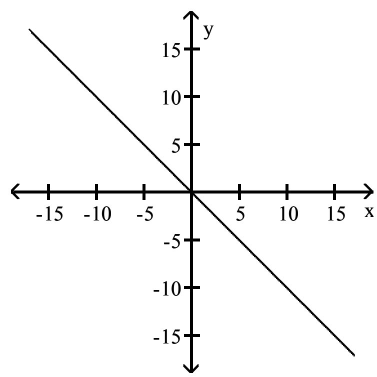
B)



C)

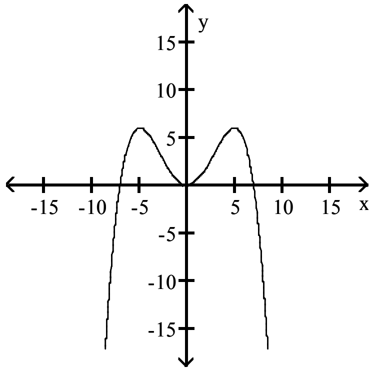


D)

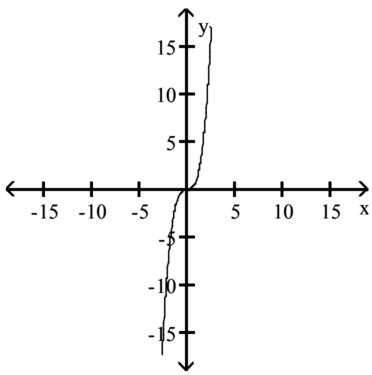


206)

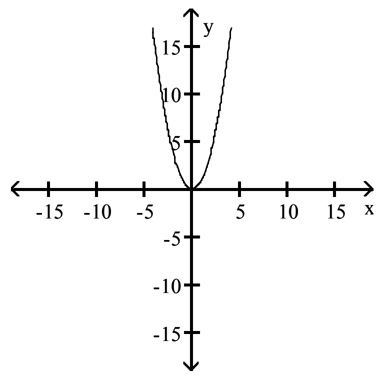
206) ______



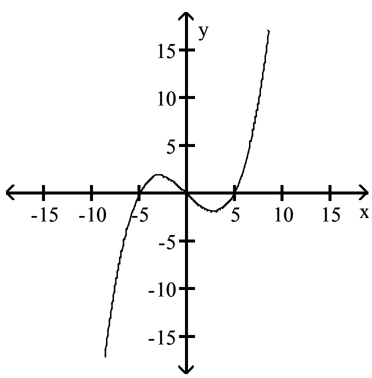
A)



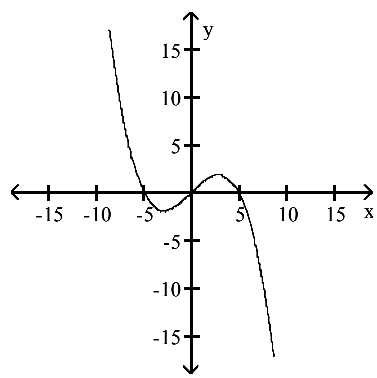
B)



C)



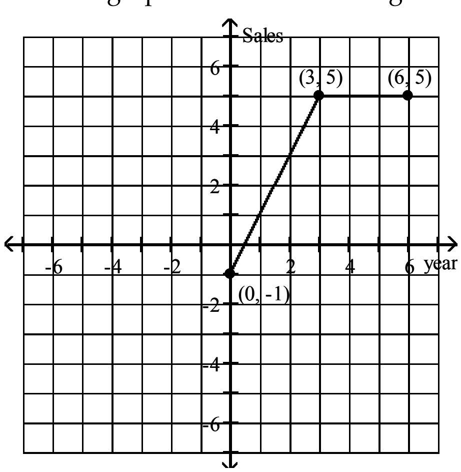
D)



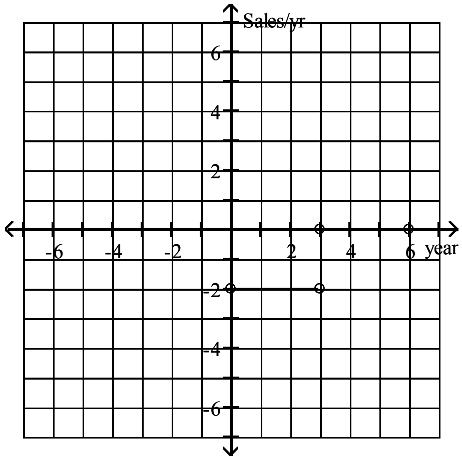
Solve the problem.

207) The graph shows annual sales (in thousands of dollars) of a new video game at a particular store. Sketch a graph of the rate of change of sales as a function of time.

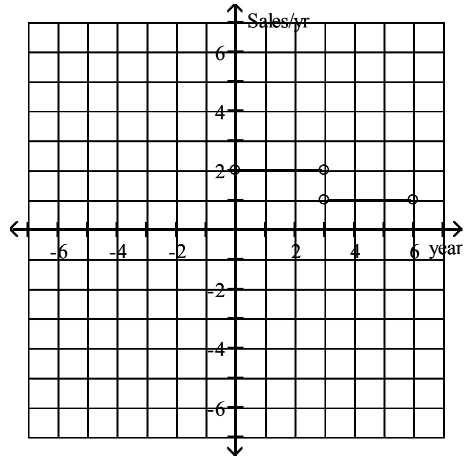
207) ______



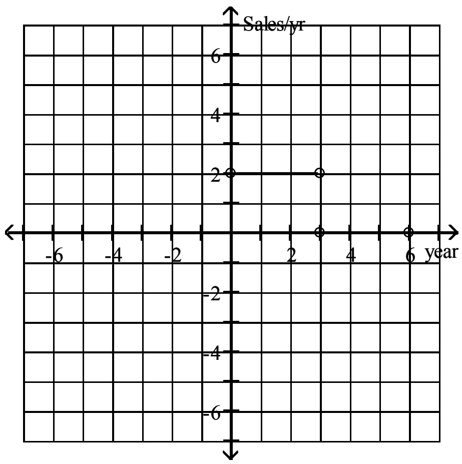
A)



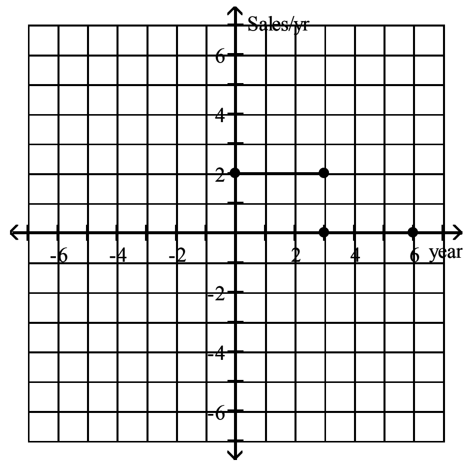
B)



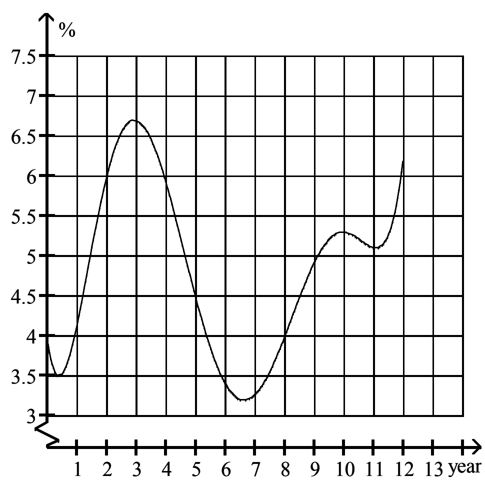
C)



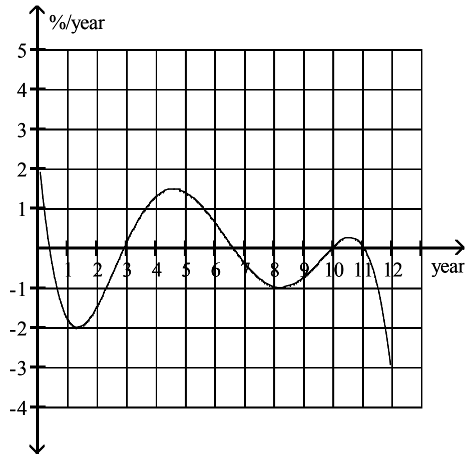
D)



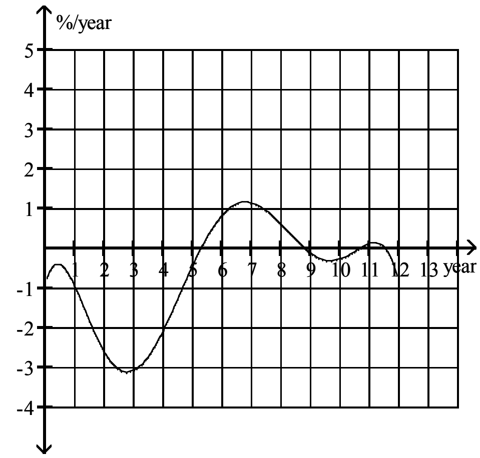
208) The graph shows the yearly average interest rates for 30–year mortgages for years since 1998 (Year 0 corresponds to 1998). Sketch a graph of the rate of change of interest rates with respect to time. 208) ______



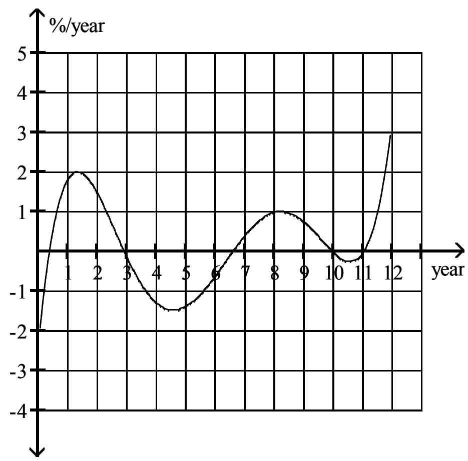
A)



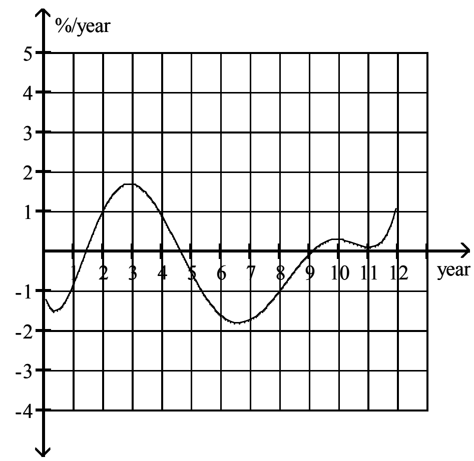
B)



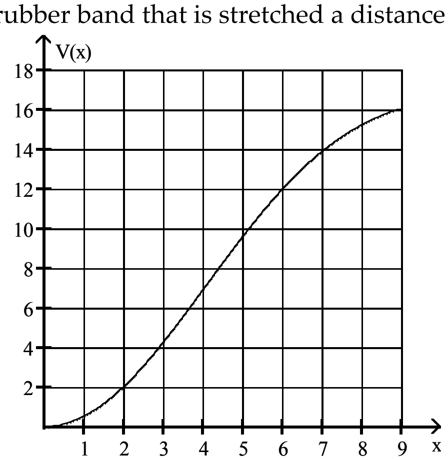
C)



D)

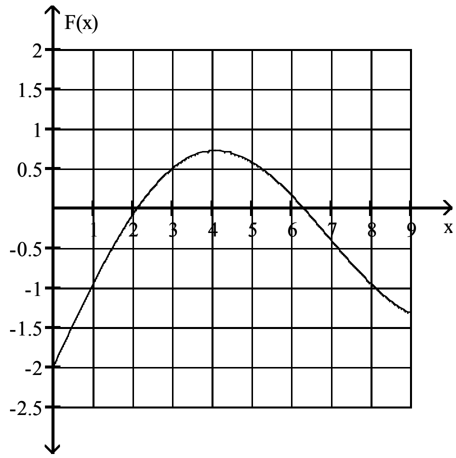


209) The graph shows the amount of potential energy V(x) (in arbitrary energy units) stored in a large rubber band that is stretched a distance of x inches beyond its normal length. 209) ______

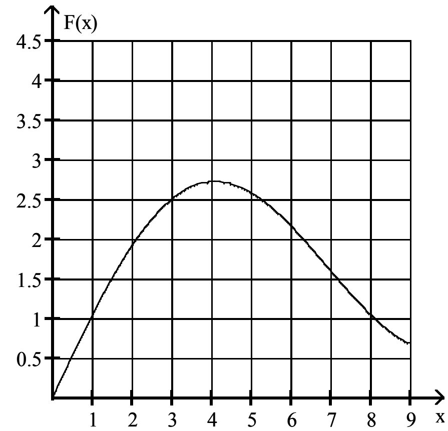


The magnitude of the force required to hold the rubber band at the position x = a is the derivative of the potential energy with respect to x, evaluated at the point x = a. Sketch a graph of the magnitude of the force versus x.

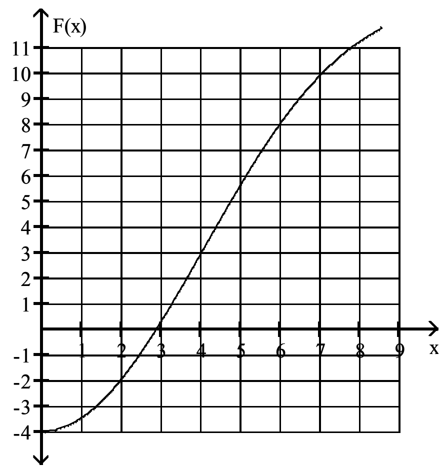
A)



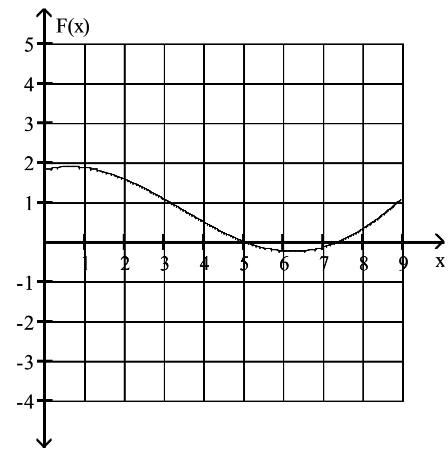
B)



C)



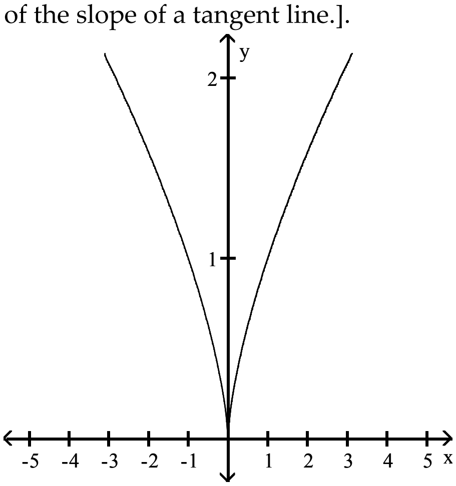
D)



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

Provide an appropriate response.

210) The graph of the function $y = f(x) = x^{2/3}$ is shown below. The "V"–shaped graph comes to a sharp point at $x = 0$. Without doing any calculations, decide whether the function has a tangent at $x = 0$. Give reasons for your answer. [Hint: consider the signs of the tangent lines on either side of $x = 0$ and what implication this has in terms of the limit definition of the slope of a tangent line.]. 210) _______________



211) Is there any difference between the problems "find the derivative of f(x) at x = a" and "find the slope of the line tangent to f(x) at x = a"? Explain. 211) ______________

212) Explain how the intermediate value theorem can be used to show that there is a zero for $x^3 - 0.6x^2 - 7.8x + 9$ between 5 and −3. 212) ______________

213) A colleague asserts that a calculation of the average rate of change of y with respect to x from x = a to x = b will always be only an approximation to the instantaneous rate of change at x = x. Do you agree with this assertion? Explain your answer using graphs or examples. 213) ______________

214) Does the curve $y = \sqrt{x}$ ever have a negative slope? If so, where? Give reasons for your answer. 214) ______________

215) Does the curve $y = x^3 + 4x - 10$ have a tangent whose slope is −2? If so, find an equation for the line and the point of tangency. If not, why not? 215) ______________

216) Can a tangent line to a graph intersect the graph at more than one point? If not, why not. If so, give an example. 216) ______________

217) If functions f(x) and g(x) are continuous for $0 \le x \le 6$, could $\frac{f(x)}{g(x)}$ possibly be discontinuous at a point of [0, 6]? Provide an example. 217) ______________

1) B
2) B
3) D
4) B
5) A
6) D
7) C
8) A
9) C
10) C
11) C
12) D
13) D
14) B
15) B
16) A
17) A
18) B
19) D
20) B
21) D
22) C
23) C
24) A
25) B
26) D
27) A
28) A
29) C
30) D
31) C
32) A
33) C
34) C
35) C
36) A
37) B
38) D
39) D
40) C
41) C
42) A
43) B
44) C
45) D
46) D
47) D
48) C
49) C
50) B

51) D
52) C
53) B
54) D
55) C
56) A
57) C
58) A
59) C
60) B
61) C
62) D
63) B
64) B
65) B
66) D
67) D
68) B
69) B
70) B
71) C
72) B
73) C
74) C
75) D
76) A
77) D
78) B
79) D
80) A
81) A
82) B
83) B
84) B
85) B
86) B
87) B
88) A
89) A
90) C
91) B
92) C
93) C
94) A
95) A
96) D
97) A
98) A
99) B
100) B

101) A
102) D
103) B
104) A
105) B
106) A
107) D
108) B
109) C
110) A
111) B
112) B
113) B
114) C
115) D
116) D
117) C
118) D
119) D
120) C
121) C
122) C
123) A
124) B
125) D
126) C
127) B
128) A
129) B
130) D
131) A
132) C
133) C
134) A
135) B
136) C
137) B
138) C
139) A
140) B
141) D
142) A
143) A
144) D
145) C
146) A
147) C
148) D
149) C
150) A

151) C
152) B
153) A
154) D
155) D
156) D
157) D
158) A
159) B
160) B
161) D
162) A
163) D
164) B
165) D
166) B
167) B
168) B
169) D
170) A
171) A
172) A
173) A
174) B
175) D
176) A
177) D
178) D
179) A
180) C
181) C
182) A
183) C
184) B
185) A
186) A
187) D
188) D
189) C
190) D
191) D
192) D
193) C
194) D
195) A
196) A
197) D
198) C
199) A
200) A

Answer Key
Testname: UNTITLED3

201) C
202) A
203) A
204) C
205) A
206) D
207) C
208) C
209) B
210) The function does not have a tangent at $x = 0$. The tangents to the left of $x = 0$ all have negative slopes, whereas those to the right of $x = 0$ all have positive slopes. Thus, the limit of the slope as x approaches 0 from the left cannot equal the limit of the slope as x approaches 0 from the right and therefore, according to the definition of the slope of the tangent line, no tangent line exists.
211) There is no difference at all. The two quantities are defined exactly the same, namely:

slope of tangent at a = $\lim\limits_{x \to a} \dfrac{f(x) - f(a)}{x - a} = f'(x)$.

212) Answers will vary. $f(5) > 0$ and $f(-3) < 0$. Since the function is a polynomial function it is continuous on the interval between 5 and -3. Thus the function must contain a point between 5 and -3 such that $f(x) = 0$.
213) No. If $y = f(x)$ is a line, then the average and instantaneous rates of change are identical.
214) The curve $y = \sqrt{x}$ never has a negative slope. The derivative of the curve is $y' = \dfrac{1}{2\sqrt{x}}$, which is never negative. A curve only has a negative slope where its derivative is negative. Since the derivative of $y = \sqrt{x}$ is never negative, the curve never has a negative slope.
215) The curve has no tangent whose slope is -2. The derivative of the curve, $y' = 3x^2 + 4$, is always positive and thus never equals -2.
216) Yes, a tangent line to a graph can intersect the graph at more than one point. For example, the graph $y = x^3 - 2x^2$ has a horizontal tangent at $x = 0$. It intersects the graph at both (0, 0) and (2, 0).
217) Yes, if $f(x) = 1$ and $g(x) = x - 3$, then $h(x) = \dfrac{1}{x - 3}$ is discontinuous at $x = 3$.