Calculus Early Transcendentals 3rd edition Briggs Test Bank

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Exam

Name___________________________________

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

Find the average velocity of an object which follows the position function s(t) over the given interval.

1) $s(t) = t^2 + 2t$, [2, 9] 1) ________

A) 13 B) $\frac{91}{9}$ C) $\frac{99}{7}$ D) 11

2) $s(t) = 4t^3 + 8t^2 - 5$, [−8, −2] 2) ________

A) 256 B) − 768 C) $-\frac{5}{6}$ D) $\frac{5}{2}$

3) $s(t) = \sqrt{2t}$, [2, 8] 3) ________

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

4) $s(t) = \frac{3}{t - 2}$, [4, 7] 4) ________

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

5) $s(t) = 4t^2$, $\left[0, \frac{7}{4}\right]$ 5) ________

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

6) $s(t) = -3t^2 - t$, [5, 6] 6) ________

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

7) $s(t) = \sin(3t)$, $\left[0, \frac{\pi}{6}\right]$ 7) ________

A) $-\frac{6}{\pi}$ B) $\frac{6}{\pi}$ C) $\frac{\pi}{6}$ D) $\frac{3}{\pi}$

8) $s(t) = 3 + \tan t$, $\left[-\frac{\pi}{4}, \frac{\pi}{4}\right]$ 8) ________

A) 0 B) $-\frac{4}{\pi}$ C) $\frac{4}{\pi}$ D) $-\frac{8}{5}$

Use the table to find the instantaneous velocity of y at the specified value of x.

9) x = 1. 9) ________

x	y
0	0
0.2	0.02
0.4	0.08
0.6	0.18
0.8	0.32
1.0	0.5
1.2	0.72
1.4	0.98

A) 1 B) 0.5 C) 2 D) 1.5

10) x = 1. 10) ________

x	y
0	0
0.2	0.01
0.4	0.04
0.6	0.09
0.8	0.16
1.0	0.25
1.2	0.36
1.4	0.49

A) 1 B) 0.5 C) 2 D) 1.5

11) x = 1. 11) ________

x	y
0	0
0.2	0.12
0.4	0.48
0.6	1.08
0.8	1.92
1.0	3
1.2	4.32
1.4	5.88

A) 2 B) 8 C) 6 D) 4

12) $x = 2$. 12) ________

x	y
0	10
0.5	38
1.0	58
1.5	70
2.0	74
2.5	70
3.0	58
3.5	38
4.0	10

A) -8 B) 0 C) 4 D) 8

13) $x = 1$. 13) ________

x	y
0.900	-0.05263
0.990	-0.00503
0.999	-0.0005
1.000	0.0000
1.001	0.0005
1.010	0.00498
1.100	0.04762

A) 0 B) -0.5 C) 0.5 D) 1

Find the slope of the curve for the given value of x.

14) $y = x^2 + 5x$, $x = 4$ 14) ________

A) slope is $-\frac{4}{25}$ B) slope is $\frac{1}{20}$ C) slope is 13 D) slope is -39

15) $y = x^2 + 11x - 15$, $x = 1$ 15) ________

A) slope is $-\frac{4}{25}$ B) slope is 13 C) slope is $\frac{1}{20}$ D) slope is -39

16) $y = x^3 - 8x$, $x = 1$ 16) ________

A) slope is -5 B) slope is 1 C) slope is -3 D) slope is 3

17) $y = x^3 - 2x^2 + 4$, $x = 3$ 17) ________

A) slope is 1 B) slope is 0 C) slope is -15 D) slope is 15

18) $y = 4 - x^3$, $x = -1$ 18) ________

A) slope is 3 B) slope is -1 C) slope is -3 D) slope is 0

Solve the problem.

19) Given $\lim_{x\to 0^-} f(x) = L_l$, $\lim_{x\to 0^+} f(x) = L_r$, and $L_l \neq L_r$, which of the following statements is true? 19) _______

I. $\lim_{x\to 0} f(x) = L_l$

II. $\lim_{x\to 0} f(x) = L_r$

III. $\lim_{x\to 0} f(x)$ does not exist.

A) II B) I C) III D) none

20) Given $\lim_{x\to 0^-} f(x) = L_l$, $\lim_{x\to 0^+} f(x) = L_r$, and $L_l = L_r$, which of the following statements is false? 20) _______

I. $\lim_{x\to 0} f(x) = L_l$

II. $\lim_{x\to 0} f(x) = L_r$

III. $\lim_{x\to 0} f(x)$ does not exist.

A) I B) III C) II D) none

21) If $\lim_{x\to 0} f(x) = L$, which of the following expressions are true? 21) _______

I. $\lim_{x\to 0^-} f(x)$ does not exist.

II. $\lim_{x\to 0^+} f(x)$ does not exist.

III. $\lim_{x\to 0^-} f(x) = L$

IV. $\lim_{x\to 0^+} f(x) = L$

A) II and III only B) I and IV only C) I and II only D) III and IV only

22) What conditions, when present, are sufficient to conclude that a function f(x) has a limit as x approaches some value of a? 22) _______

A) Either the limit of f(x) as $x \to a$ from the left exists or the limit of f(x) as $x \to a$ from the right exists

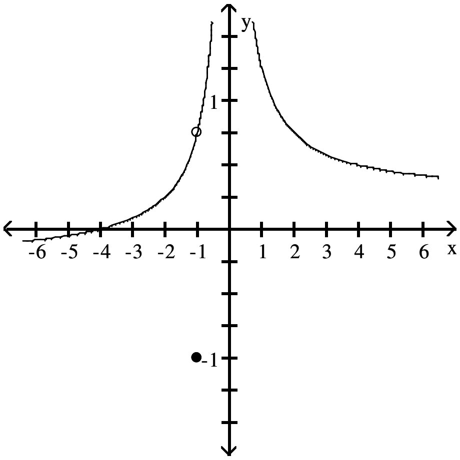
B) The limit of f(x) as $x \to a$ from the left exists, the limit of f(x) as $x \to a$ from the right exists, and these two limits are the same.

C) The limit of f(x) as $x \to a$ from the left exists, the limit of f(x) as $x \to a$ from the right exists, and at least one of these limits is the same as f(a).

D) f(a) exists, the limit of f(x) as $x \to a$ from the left exists, and the limit of f(x) as $x \to a$ from the right exists.

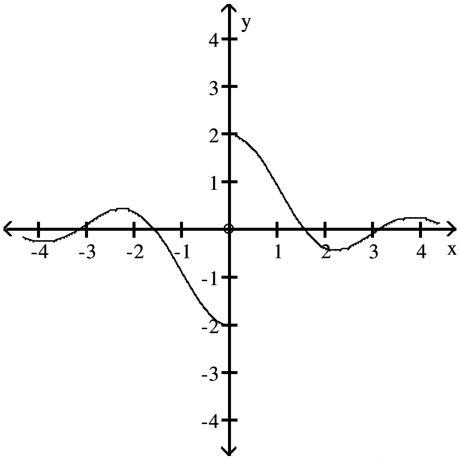
Use the graph to evaluate the limit.

23) $\lim_{x \to -1} f(x)$ 23) ________



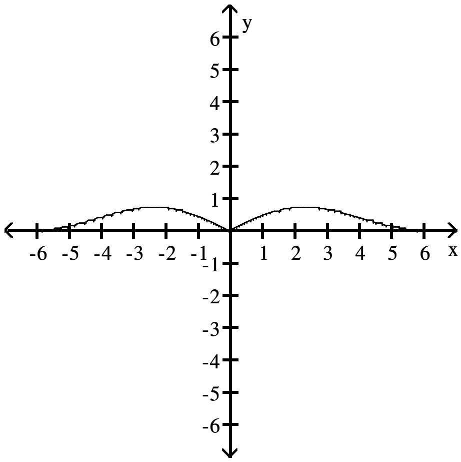
A) $\frac{3}{4}$ B) $-\frac{3}{4}$ C) -1 D) ∞

24) $\lim_{x \to 0} f(x)$ 24) ________



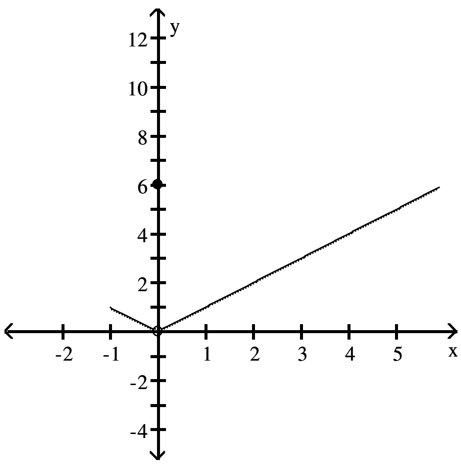
A) 2 B) does not exist C) -2 D) 0

25) $\lim_{x \to 0} f(x)$ 25) _______



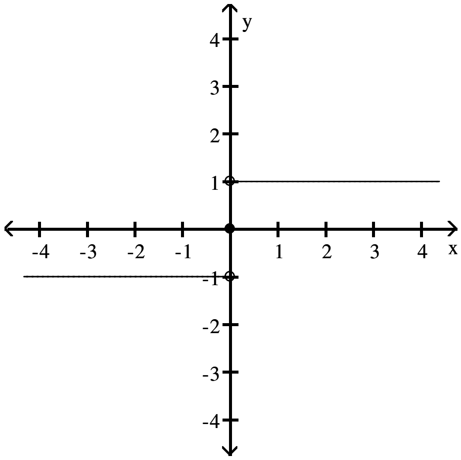
A) 0 B) –1 C) 1 D) does not exist

26) $\lim_{x \to 0} f(x)$ 26) _______



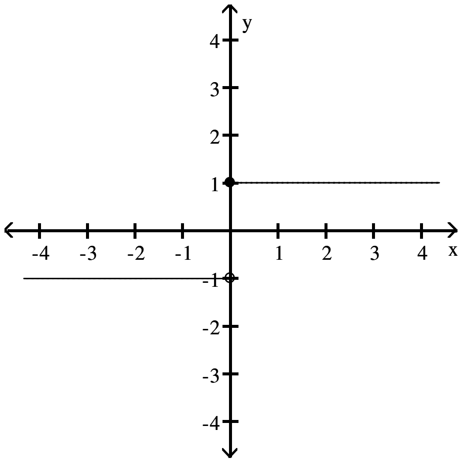
A) 0 B) –1 C) 6 D) does not exist

27) $\lim_{x \to 0} f(x)$ 27) _______



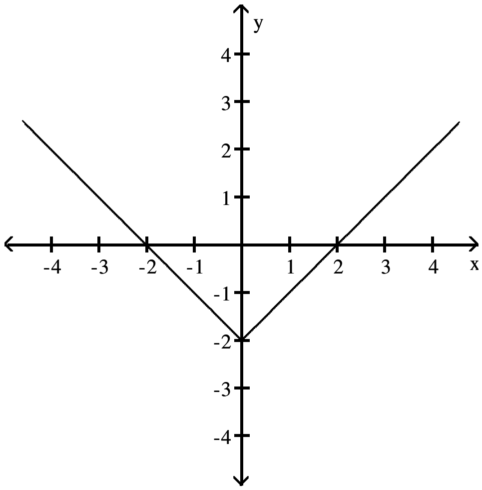
A) –1 B) 1 C) ∞ D) does not exist

28) $\lim_{x \to 0} f(x)$ 28) _______



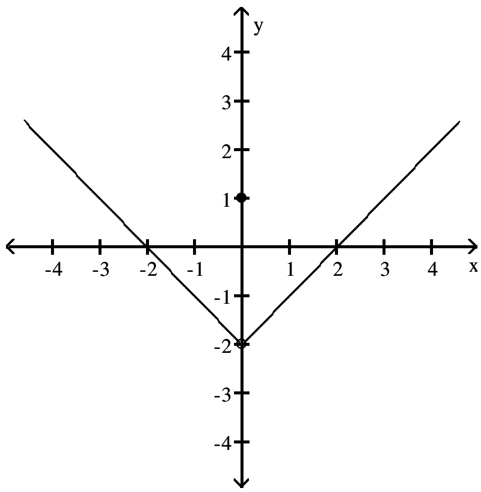
A) does not exist B) –1 C) 1 D) ∞

29) $\lim_{x \to 0} f(x)$ 29) _______



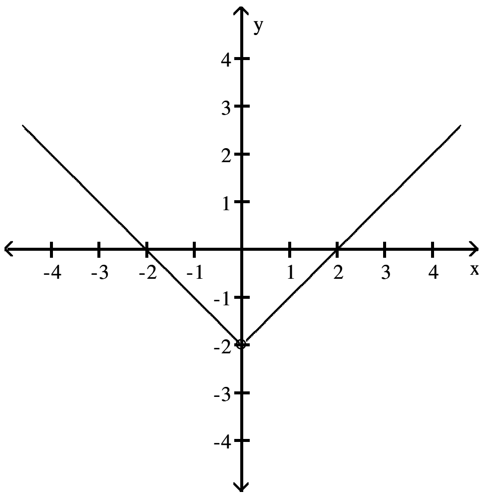
A) 0 B) does not exist C) −2 D) 2

30) $\lim_{x \to 0} f(x)$ 30) _______



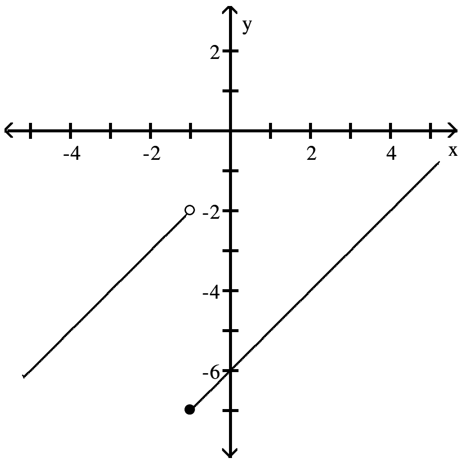
A) 1 B) −2 C) does not exist D) 0

31) $\lim_{x \to 0} f(x)$ 31) _______



A) –2 B) –1 C) does not exist D) 2

32) Find $\lim_{x \to (-1)^-} f(x)$ and $\lim_{x \to (-1)^+} f(x)$ 32) _______



A) –5; –2 B) –7; –2 C) –2; –7 D) –7; –5

Use the table of values of f to estimate the limit.

33) Let $f(x) = x^2 + 8x - 2$, find $\lim\limits_{x \to 2} f(x)$. 33) _______

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)	16.692	17.592	17.689	17.710	17.808	18.789

; limit = 17.70

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)	5.043	5.364	5.396	5.404	5.436	5.763

; limit = 5.40

D)

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

34) Let $f(x) = \dfrac{x - 4}{\sqrt{x} - 2}$, find $\lim\limits_{x \to 4} f(x)$. 34) _______

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)	1.19245	1.19925	1.19993	1.20007	1.20075	1.20745

; limit = 1.20

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)	5.07736	5.09775	5.09978	5.10022	5.10225	5.12236

; limit = 5.10

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 = ∞

35) Let $f(x) = x^2 - 5$, find $\lim\limits_{x \to 0} f(x)$. 35) _______

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 = ∞

B)

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

C)

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

D)

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

36) Let $f(x) = \dfrac{x - 5}{x^2 - 7x + 10}$, find $\lim\limits_{x \to 5} f(x)$. 36) _______

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)						

A)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	−0.3448	−0.3344	−0.3334	−0.3332	−0.3322	−0.3226

; limit = −0.3333

B)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	0.4448	0.4344	0.4334	0.4332	0.4322	0.4226

; limit = 0.4333

C)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	0.2448	0.2344	0.2334	0.2332	0.2322	0.2226

; limit = 0.2333

D)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	0.3448	0.3344	0.3334	0.3332	0.3322	0.3226

; limit = 0.3333

37) Let $f(x) = \dfrac{x^2 - 2x - 3}{x^2 + 2x - 15}$, find $\lim\limits_{x \to 3} f(x)$. 37) ________

x	2.9	2.99	2.999	3.001	3.01	3.1
f(x)						

A)

x	2.9	2.99	2.999	3.001	3.01	3.1
f(x)	−1.1053	−1.0101	−1.0010	−0.9990	−0.9900	−0.9048

; limit = −1

B)

x	2.9	2.99	2.999	3.001	3.01	3.1
f(x)	0.4937	0.4994	0.4999	0.5001	0.5006	0.5062

; limit = 0.5

C)

x	2.9	2.99	2.999	3.001	3.01	3.1
f(x)	0.5937	0.5994	0.5999	0.6001	0.6006	0.6062

; limit = 0.6

D)

x	2.9	2.99	2.999	3.001	3.01	3.1
f(x)	0.3937	0.3994	0.3999	0.4001	0.4006	0.4062

; limit = 0.4

38) Let $f(x) = \dfrac{\sin(4x)}{x}$, find $\lim\limits_{x \to 0} f(x)$. 38) ________

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(x)		3.99893342			3.99893342	

A) limit = 0
B) limit = 3.5
C) limit does not exist
D) limit = 4

39) Let $f(\theta) = \dfrac{\cos(5\theta)}{\theta}$, find $\lim\limits_{\theta \to 0} f(\theta)$. 39) ________

x	−0.1	−0.01	−0.001	0.001	0.01	0.1
f(θ)	−8.7758256					8.7758256

A) limit = 8.7758256
B) limit = 0
C) limit does not exist
D) limit = 5

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

Provide an appropriate response.

40) It can be shown that the inequalities $1 - \dfrac{x^2}{6} < \dfrac{x \sin(x)}{2 - 2\cos(x)} < 1$ hold for all values of x close to zero. What, if anything, does this tell you about $\dfrac{x \sin(x)}{2 - 2\cos(x)}$? Explain. 40) ________________

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

41) Write the formal notation for the principle "the limit of a quotient is the quotient of the limits" and include a statement of any restrictions on the principle. 41) _______

A) $\lim\limits_{x \to a} \dfrac{g(x)}{f(x)} = \dfrac{g(a)}{f(a)}$, provided that $f(a) \neq 0$.

B) If $\lim\limits_{x \to a} g(x) = M$ and $\lim\limits_{x \to a} f(x) = L$, then $\lim\limits_{x \to a} \dfrac{g(x)}{f(x)} = \dfrac{\lim\limits_{x \to a} g(x)}{\lim\limits_{x \to a} f(x)} = \dfrac{M}{L}$, provided that $f(a) \neq 0$.

C) $\lim\limits_{x \to a} \dfrac{g(x)}{f(x)} = \dfrac{g(a)}{f(a)}$.

D) If $\lim\limits_{x \to a} g(x) = M$ and $\lim\limits_{x \to a} f(x) = L$, then $\lim\limits_{x \to a} \dfrac{g(x)}{f(x)} = \dfrac{\lim\limits_{x \to a} g(x)}{\lim\limits_{x \to a} f(x)} = \dfrac{M}{L}$, provided that $L \neq 0$.

42) Provide a short sentence that summarizes the general limit principle given by the formal notation $\lim\limits_{x \to a} [f(x) \pm g(x)] = \lim\limits_{x \to a} f(x) \pm \lim\limits_{x \to a} g(x) = L \pm M$, given that $\lim\limits_{x \to a} f(x) = L$ and $\lim\limits_{x \to a} g(x) = M$. 42) _______

A) The sum or the difference of two functions is continuous.
B) The limit of a sum or a difference is the sum or the difference of the functions.
C) The sum or the difference of two functions is the sum of two limits.
D) The limit of a sum or a difference is the sum or the difference of the limits.

43) The statement "the limit of a constant times a function is the constant times the limit" follows from a combination of two fundamental limit principles. What are they? 43) _______

A) The limit of a product is the product of the limits, and the limit of a quotient is the quotient of the limits.
B) The limit of a product is the product of the limits, and a constant is continuous.
C) The limit of a function is a constant times a limit, and the limit of a constant is the constant.
D) The limit of a constant is the constant, and the limit of a product is the product of the limits.

Find the limit.

44) $\lim\limits_{x \to 17} \sqrt{5}$ 44) _______

A) $\sqrt{5}$ B) 17 C) $\sqrt{17}$ D) 5

45) $\lim\limits_{x \to 2} (7x - 4)$ 45) _______

A) –18 B) 18 C) 10 D) –10

46) $\lim\limits_{x \to -5} (10 - 4x)$ 46) _______

A) 30 B) –10 C) –30 D) 10

Give an appropriate answer.

47) Let $\lim_{x \to 5} f(x) = -3$ and $\lim_{x \to 5} g(x) = -6$. Find $\lim_{x \to 5} [f(x) - g(x)]$. 47) _______

A) -9 B) 5 C) 3 D) -3

48) Let $\lim_{x \to -9} f(x) = -7$ and $\lim_{x \to -9} g(x) = -8$. Find $\lim_{x \to -9} [f(x) \cdot g(x)]$. 48) _______

A) -8 B) 56 C) -15 D) -9

49) Let $\lim_{x \to -3} f(x) = -6$ and $\lim_{x \to -3} g(x) = 4$. Find $\lim_{x \to -3} \frac{f(x)}{g(x)}$. 49) _______

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

50) Let $\lim_{x \to -1} f(x) = 16$. Find $\lim_{x \to -1} \sqrt{f(x)}$. 50) _______

A) 4 B) 2.0000 C) -1 D) 16

51) Let $\lim_{x \to 3} f(x) = 3$ and $\lim_{x \to 3} g(x) = -5$. Find $\lim_{x \to 3} [f(x) + g(x)]^2$. 51) _______

A) 34 B) 8 C) 4 D) -2

52) Let $\lim_{x \to 10} f(x) = 1024$. Find $\lim_{x \to 10} \sqrt[5]{f(x)}$. 52) _______

A) 10 B) 4 C) 1024 D) 5

53) Let $\lim_{x \to -8} f(x) = 5$ and $\lim_{x \to -8} g(x) = -1$. Find $\lim_{x \to -8} \left[\frac{-3f(x) - 2g(x)}{10 + g(x)}\right]$. 53) _______

A) $-\frac{17}{9}$ B) -8 C) $-\frac{13}{9}$ D) $-\frac{7}{2}$

Find the limit.

54) $\lim_{x \to 2} (x^3 + 5x^2 - 7x + 1)$ 54) _______

A) 29 B) 0 C) 15 D) does not exist

55) $\lim_{x \to -2} (3x^5 - 3x^4 - 4x^3 + x^2 + 5)$ 55) _______

A) -7 B) -167 C) 41 D) -103

56) $\lim_{x \to -1} \frac{x}{3x + 2}$ 56) _______

A) 0 B) does not exist C) $-\frac{1}{5}$ D) 1

57) $\lim\limits_{x \to 0} \dfrac{x^3 - 6x + 8}{x - 2}$ 57) _______

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

58) $\lim\limits_{x \to 1} \dfrac{3x^2 + 7x - 2}{3x^2 - 4x - 2}$ 58) _______

A) 0 B) $-\dfrac{7}{4}$ C) $-\dfrac{8}{3}$ D) Does not exist

59) $\lim\limits_{x \to -1} (x + 3)^2(x - 3)^3$ 59) _______

A) -1024 B) 32 C) 128 D) -256

60) $\lim\limits_{x \to 7} \sqrt{x^2 + 10x + 25}$ 60) _______

A) does not exist B) 12 C) ± 12 D) 144

61) $\lim\limits_{x \to 5} \sqrt{9x + 91}$ 61) _______

A) $-2\sqrt{34}$ B) 136 C) $2\sqrt{34}$ D) -136

62) $\lim\limits_{h \to 0} \dfrac{2}{\sqrt{3h + 4} + 2}$ 62) _______

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

63) $\lim\limits_{x \to 0} \dfrac{\sqrt{1 + x} - 1}{x}$ 63) _______

A) 0 B) 1/2 C) 1/4 D) Does not exist

Determine the limit by sketching an appropriate graph.

64) $\lim\limits_{x \to 5^-} f(x)$, where $f(x) = \begin{cases} -3x - 5 & \text{for } x < 5 \\ 5x - 4 & \text{for } x \ge 5 \end{cases}$ 64) _______

A) -3 B) -4 C) 21 D) -20

65) $\lim\limits_{x \to 5^+} f(x)$, where $f(x) = \begin{cases} -5x - 5 & \text{for } x < 5 \\ 3x - 4 & \text{for } x \ge 5 \end{cases}$ 65) _______

A) -3 B) 11 C) -30 D) -4

66) $\lim\limits_{x \to -1^+} f(x)$, where $f(x) = \begin{cases} x^2 + 3 & \text{for } x \ne -1 \\ 0 & \text{for } x = -1 \end{cases}$ 66) _______

A) -2 B) 4 C) 0 D) 1

67) $\lim\limits_{x \to 4^-} f(x)$, where $f(x) = \begin{cases} \sqrt{1 - x^2} & 0 \le x < 1 \\ 1 & 1 \le x < 4 \\ 4 & x = 4 \end{cases}$ 67) _______

A) Does not exist B) 1 C) 0 D) 4

68) $\lim\limits_{x \to -1^+} f(x)$, where $f(x) = \begin{cases} x & -1 \le x < 0, \text{ or } 0 < x \le 3 \\ 1 & x = 0 \\ 0 & x < -1 \text{ or } x > 3 \end{cases}$ 68) _______

A) -0 B) 7 C) -1 D) Does not exist

Find the limit, if it exists.

69) $\lim\limits_{x \to 0} \dfrac{x^3 + 12x^2 - 5x}{5x}$ 69) _______

A) Does not exist B) 0 C) 5 D) -1

70) $\lim\limits_{x \to 1} \dfrac{x^4 - 1}{x - 1}$ 70) _______

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

71) $\lim\limits_{x \to 9} \dfrac{x^2 - 81}{x - 9}$ 71) _______

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

72) $\lim\limits_{x \to -7} \dfrac{x^2 + 11x + 28}{x + 7}$ 72) _______

A) Does not exist B) 154 C) 11 D) -3

73) $\lim\limits_{x \to 2} \dfrac{x^2 + 4x - 12}{x - 2}$ 73) _______

A) 4 B) 0 C) Does not exist D) 8

74) $\lim\limits_{x \to 3} \dfrac{x^2 + 5x - 24}{x^2 - 9}$ 74) _______

A) 0 B) $\dfrac{11}{6}$ C) $-\dfrac{5}{6}$ D) Does not exist

75) $\lim\limits_{x \to 1} \dfrac{x^2 - 1}{x^2 - 5x + 4}$ 75) _______

A) Does not exist B) $-\dfrac{2}{3}$ C) 0 D) $-\dfrac{1}{3}$

76) $\lim_{x \to 5} \dfrac{x^2 - 11x + 30}{x^2 - 7x + 10}$ 76) _______

A) $-\dfrac{1}{3}$ B) $\dfrac{1}{3}$ C) $\dfrac{11}{3}$ D) Does not exist

77) $\lim_{h \to 0} \dfrac{(x + h)^3 - x^3}{h}$ 77) _______

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

78) $\lim_{x \to 10} \dfrac{|10 - x|}{10 - x}$ 78) _______

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

Provide an appropriate response.

79) It can be shown that the inequalities $-x \le x \cos\left(\dfrac{1}{x}\right) \le x$ hold for all values of $x \ge 0$. 79) _______

Find $\lim_{x \to 0} x \cos\left(\dfrac{1}{x}\right)$ if it exists.

A) 1 B) 0 C) does not exist D) 0.0007

80) The inequality $1 - \dfrac{x^2}{2} < \dfrac{\sin x}{x} < 1$ holds when x is measured in radians and $|x| < 1$. 80) _______

Find $\lim_{x \to 0} \dfrac{\sin x}{x}$ if it exists.

A) does not exist B) 0.0007 C) 0 D) 1

81) If $x^3 \le f(x) \le x$ for x in $[-1,1]$, find $\lim_{x \to 0} f(x)$ if it exists. 81) _______

A) does not exist B) 0 C) 1 D) -1

Compute the values of f(x) and use them to determine the indicated limit.

82) If $f(x) = x^2 + 8x - 2$, find $\lim\limits_{x \to 2} f(x)$. 82) _______

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 = ∞

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 = 5.40

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

83) If $f(x) = \dfrac{x^4 - 1}{x - 1}$, find $\lim\limits_{x \to 1} f(x)$. 83) _______

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)	1.032	1.182	1.198	1.201	1.218	1.392

; limit = ∞

B)

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

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 = 1.210

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

84) If $f(x) = \dfrac{x^3 - 6x + 8}{x - 2}$, find $\lim\limits_{x \to 0} f(x)$. 84) ________

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)	−2.18529	−2.10895	−2.10090	−2.99910	−2.09096	−2.00574

; limit = −2.10

B)

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

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)	−1.22843	−1.20298	−1.20030	−1.19970	−1.19699	−1.16858

; limit = −1.20

85) If $f(x) = \dfrac{x - 4}{\sqrt{x} - 2}$, find $\lim\limits_{x \to 4} f(x)$. 85) ________

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)	1.19245	1.19925	1.19993	1.20007	1.20075	1.20745

; limit = 1.20

B)

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 = ∞

C)

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

D)

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

86) If $f(x) = x^2 - 5$, find $\lim_{x \to 0} f(x)$. 86) _______

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)	−4.9900	−4.9999	−5.0000	−5.0000	−4.9999	−4.9900

; limit = −5.0

B)

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 = ∞

C)

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

D)

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

87) If $f(x) = \frac{\sqrt{x + 1}}{x + 1}$, find $\lim_{x \to 1} f(x)$. 87) _______

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)	2.15293	2.13799	2.13656	2.13624	2.13481	2.12106

; limit = 2.13640

B)

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

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)	0.21764	0.21266	0.21219	0.21208	0.21160	0.20702

; limit = 0.21213

88) If $f(x) = \sqrt{x} - 2$, find $\lim\limits_{x \to 4} f(x)$. 88) _______

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)	1.47736	1.49775	1.49977	1.50022	1.50225	1.52236

; limit = 1.50

B)

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

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 = 1.95

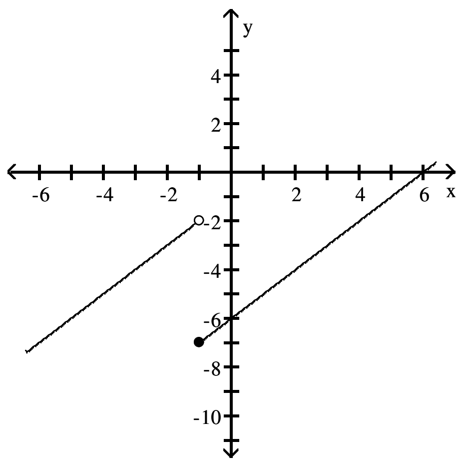
D)

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 = ∞

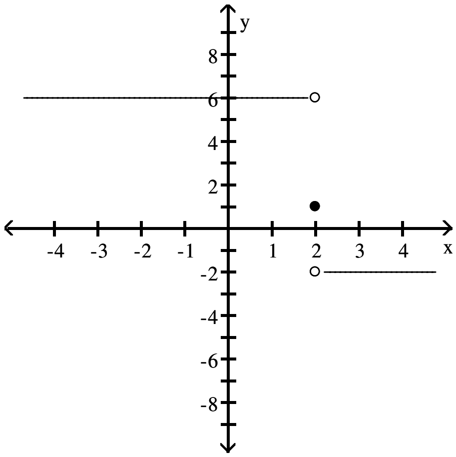
For the function f whose graph is given, determine the limit.

89) Find $\lim\limits_{x \to -1^-} f(x)$ and $\lim\limits_{x \to -1^+} f(x)$. 89) _______



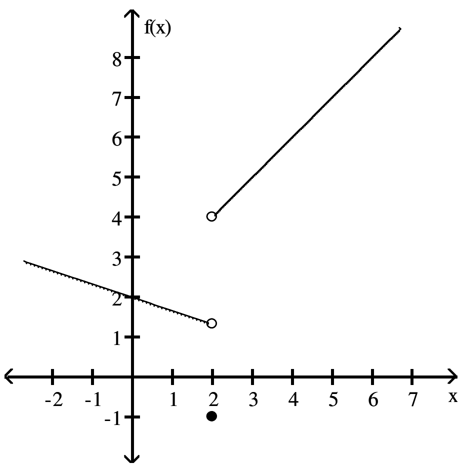
A) −5; −2 B) −2; −7 C) −7; −5 D) −7; −2

90) Find $\lim_{x \to 2^-} f(x)$ and $\lim_{x \to 2^+} f(x)$. 90) _______



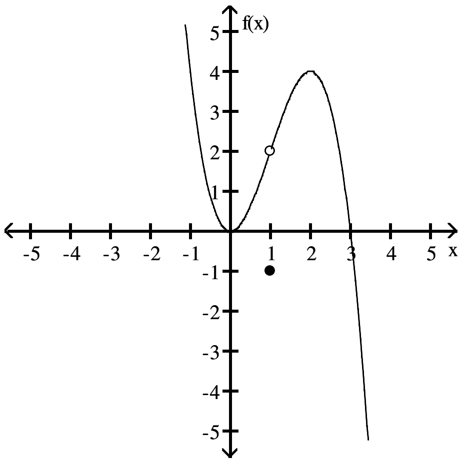
A) $-2; 6$
B) $1; 1$
C) $6; -2$
D) does not exist; does not exist

91) Find $\lim_{x \to 2^-} f(x)$. 91) _______



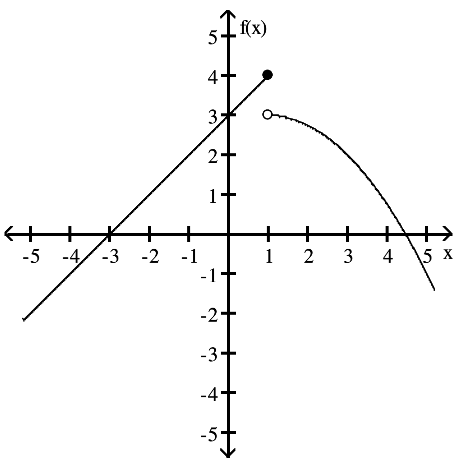
A) 2.3
B) 1.3
C) 4
D) -1

92) Find $\lim_{x \to 1^-} f(x)$. 92) _______



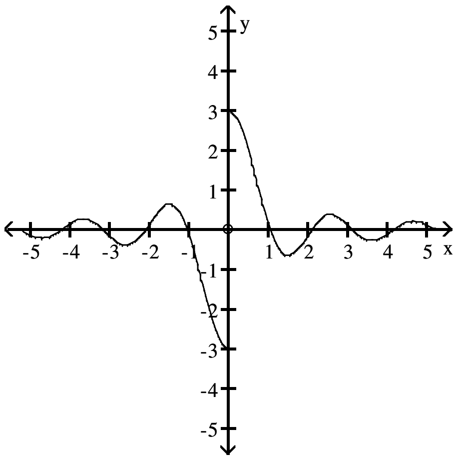
A) 2
B) does not exist
C) $\frac{1}{2}$
D) -1

93) Find $\lim_{x \to 1^+} f(x)$. 93) _______



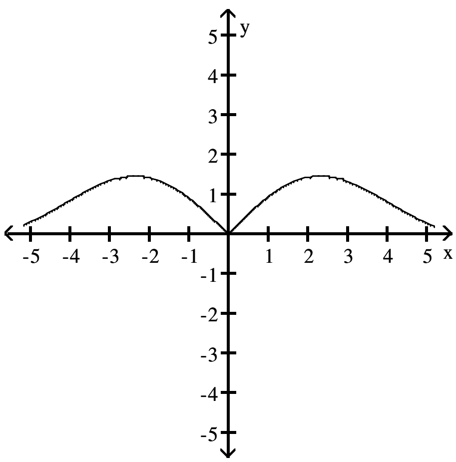
A) does not exist
B) $3\frac{1}{2}$
C) 3
D) 4

94) Find $\lim_{x \to 0} f(x)$. 94) _______



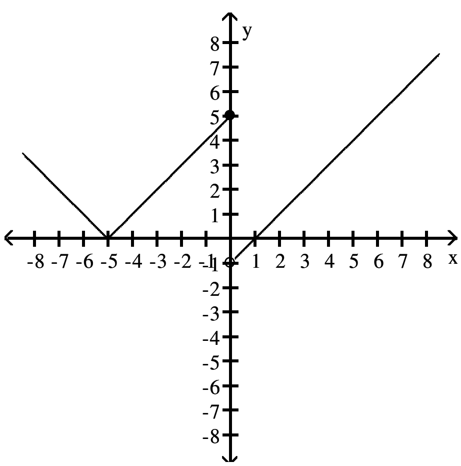
A) –3 B) 0 C) 3 D) does not exist

95) Find $\lim_{x \to 0} f(x)$. 95) _______



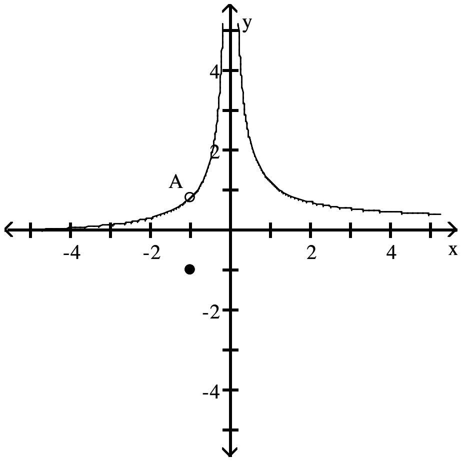
A) –2 B) 0 C) does not exist D) 2

96) Find $\lim_{x \to 0} f(x)$. 96) _______



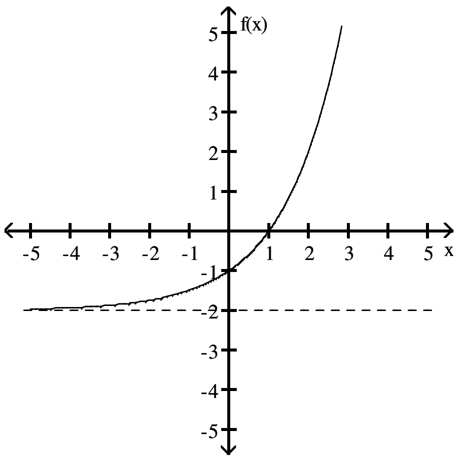
A) 0 B) does not exist C) 5 D) –5

97) Find $\lim_{x \to -1} f(x)$. 97) _______



A) does not exist B) -1 C) $\frac{4}{5}$ D) $-\frac{4}{5}$

98) Find $\lim_{x \to -\infty} f(x)$. 98) _______



A) does not exist B) $-\infty$ C) -2 D) 0

Find the limit.

99) $\lim_{x \to -2} \frac{1}{x+2}$ 99) _______

A) ∞ B) Does not exist C) $-\infty$ D) 1/2

100) $\lim_{x \to -6^+} \frac{1}{x+6}$ 100) ______

A) $-\infty$ B) 0 C) -1 D) ∞

101) $\lim_{x \to 8^+} \frac{1}{(x-8)^2}$ 101) ______

A) ∞ B) -1 C) 0 D) $-\infty$

102) $\lim_{x \to -5^-} \frac{4}{x^2 - 25}$ 102) ______

A) $-\infty$ B) ∞ C) 0 D) -1

103) $\lim_{x \to 3^+} \frac{5}{x^2 - 9}$ 103) ______

A) $-\infty$ B) 0 C) ∞ D) 1

104) $\lim_{x \to (\pi/2)^+} \tan x$ 104) ______

A) 1 B) 0 C) ∞ D) $-\infty$

105) $\lim_{x \to (-\pi/2)^-} \sec x$ 105) ______

A) ∞ B) $-\infty$ C) 1 D) 0

106) $\lim_{x \to 0^+} (1 + \csc x)$ 106) ______

A) ∞ B) 1 C) 0 D) Does not exist

107) $\lim_{x \to 0} (1 - \cot x)$ 107) ______

A) ∞ B) $-\infty$ C) 0 D) Does not exist

108) $\lim_{x \to -3^+} \frac{x^2 - 7x + 12}{x^3 - 9x}$ 108) ______

A) Does not exist B) 0 C) $-\infty$ D) ∞

109) $\lim_{x \to 4^+} \frac{x^2 - 6x + 8}{x^3 - 4x}$ 109) ______

A) $-\infty$ B) ∞ C) Does not exist D) 0

Find all vertical asymptotes of the given function.

110) $h(x) = \frac{3x}{x - 4}$ 110) ______

A) $x = 3$ B) none C) $x = 4$ D) $x = -4$

111) $f(x) = \frac{x + 2}{x^2 - 36}$ 111) ______

A) $x = 0, x = 36$ B) $x = 36, x = -2$
C) $x = -6, x = 6, x = -2$ D) $x = -6, x = 6$

112) $f(x) = \frac{x + 3}{x^2 + 36}$ 112) ______

A) $x = -6, x = 6, x = -3$
B) $x = -6, x = -3$
C) none
D) $x = -6, x = 6$

113) $f(x) = \frac{x + 11}{x^2 + 4x}$ 113) ______

A) $x = -4, x = -11$
B) $x = 0, x = -4$
C) $x = -2, x = 2$
D) $x = 0, x = -2, x = 2$

114) $f(x) = \frac{x - 1}{x^3 + 36x}$ 114) ______

A) $x = -6, x = 6$
B) $x = 0, x = -6, x = 6$
C) $x = 0$
D) $x = 0, x = -36$

115) $R(x) = \frac{-3x^2}{x^2 + 4x - 60}$ 115) ______

A) $x = -10, x = 6, x = -3$
B) $x = 10, x = -6$
C) $x = -10, x = 6$
D) $x = -60$

116) $R(x) = \frac{x - 1}{x^3 + 2x^2 - 48x}$ 116) ______

A) $x = -8, x = 6$
B) $x = -6, x = 0, x = 8$
C) $x = -8, x = 0, x = 6$
D) $x = -6, x = -30, x = 8$

117) $f(x) = \frac{-2x(x + 2)}{5x^2 - 4x - 9}$ 117) ______

A) $x = -\frac{5}{9}, x = 1$
B) $x = \frac{9}{5}, x = -1$
C) $x = \frac{5}{9}, x = -1$
D) $x = -\frac{9}{5}, x = 1$

118) $f(x) = \frac{x - 3}{9x - x^3}$ 118) ______

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

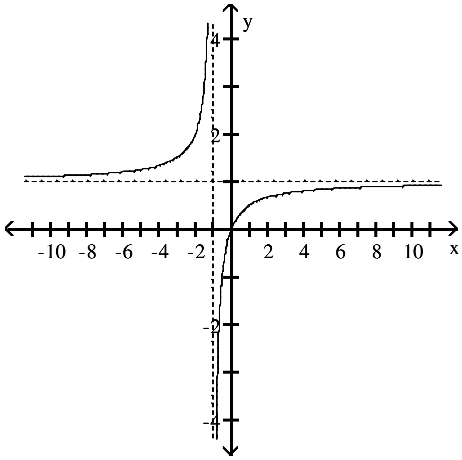
119) $f(x) = \frac{-x^2 + 16}{x^2 + 5x + 4}$ 119) ______

A) $x = -1, x = 4$
B) $x = -1, x = -4$
C) $x = 1, x = -4$
D) $x = -1$

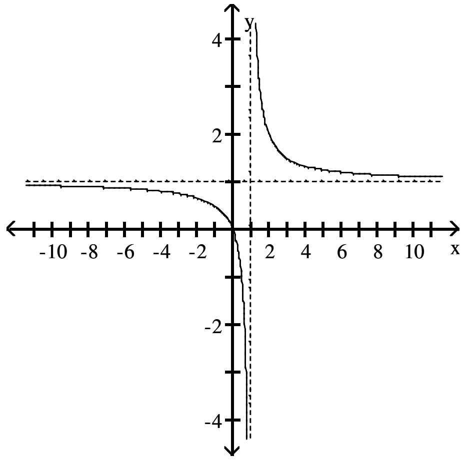
Choose the graph that represents the given function without using a graphing utility.

120) $f(x) = \dfrac{x}{x - 1}$ 120) ______

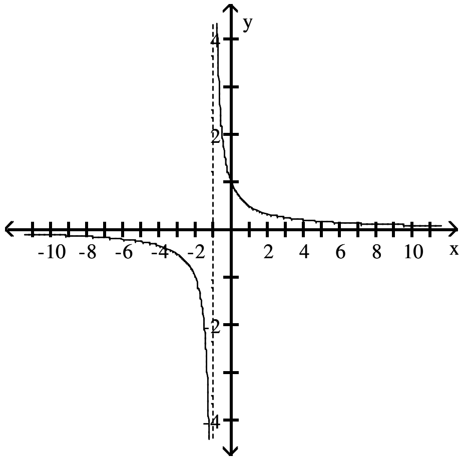
A)



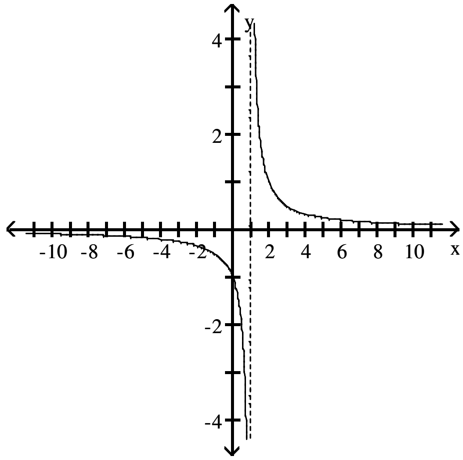
B)



C)



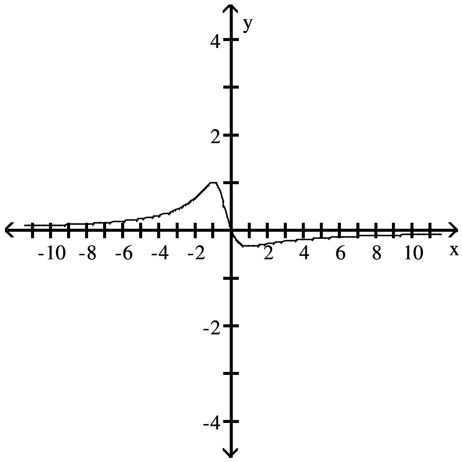
D)



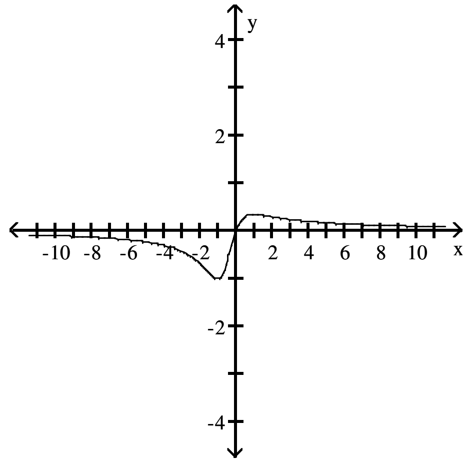
121) $f(x) = \dfrac{x}{x^2 + x + 1}$

121) ______

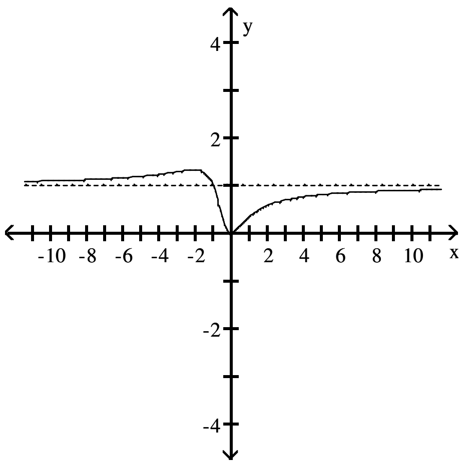
A)



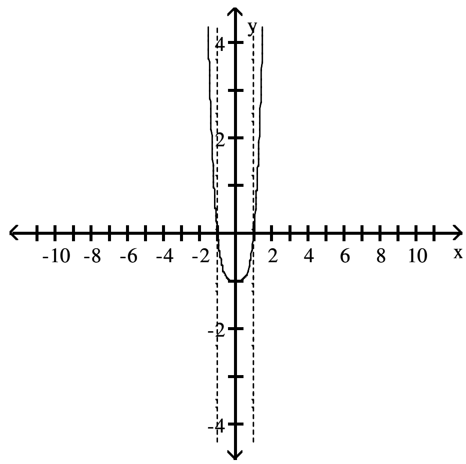
B)



C)

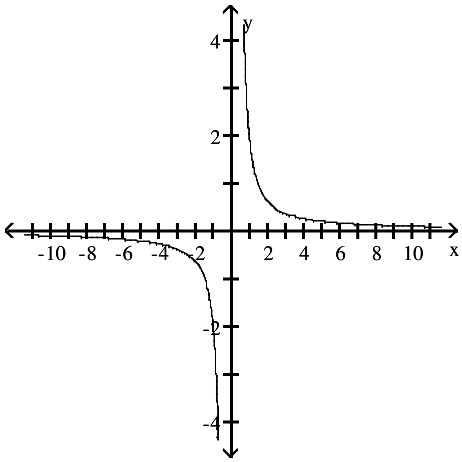


D)

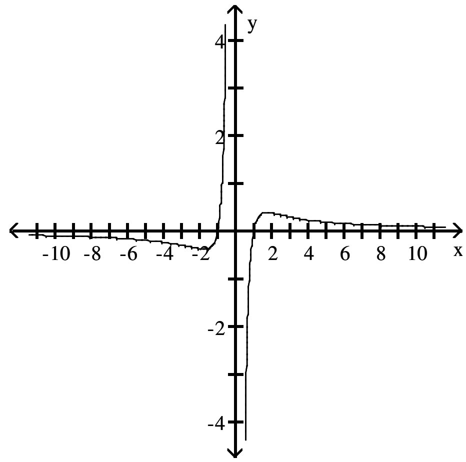


122) $f(x) = \dfrac{x^2 - 1}{x^3}$ 122) ______

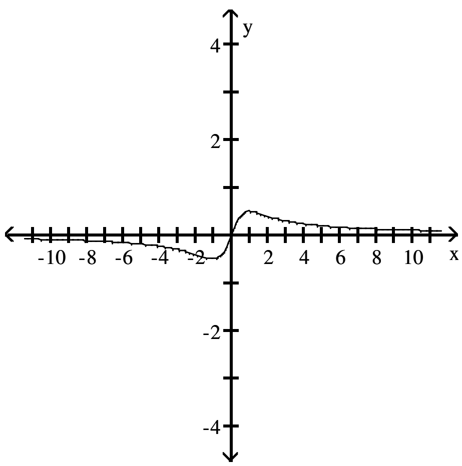
A)



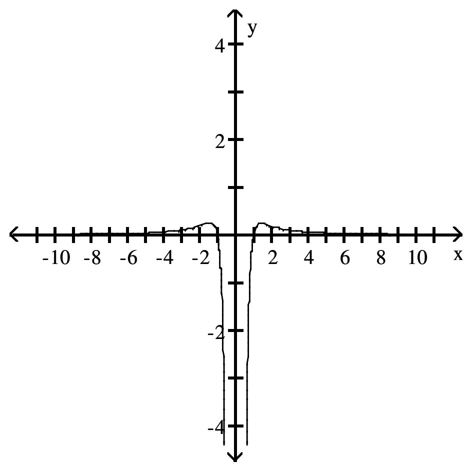
B)



C)

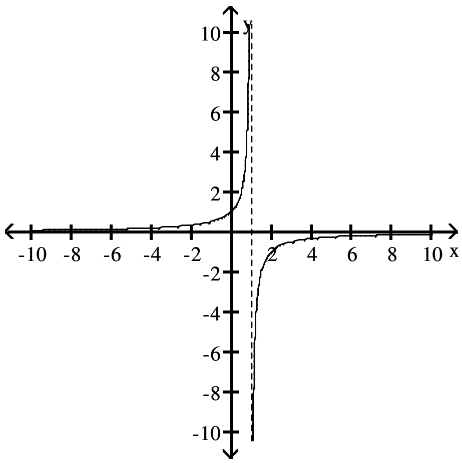


D)

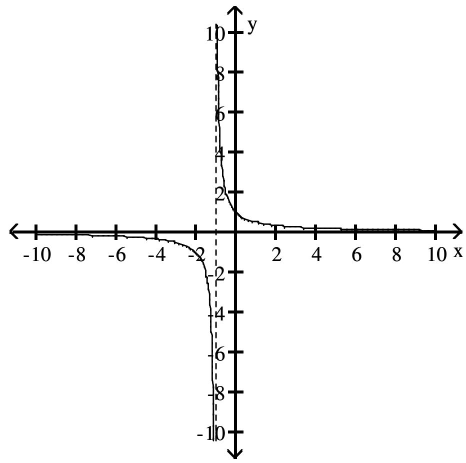


123) $f(x) = \frac{1}{x + 1}$ 123) ______

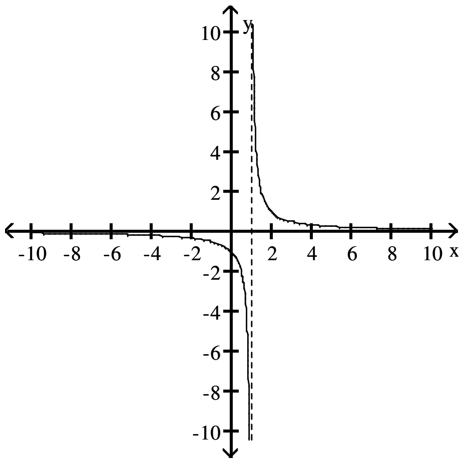
A)



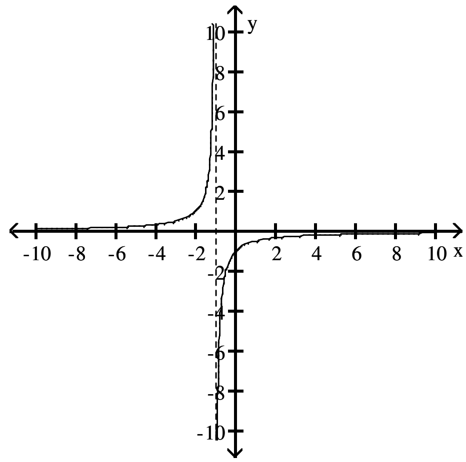
B)



C)

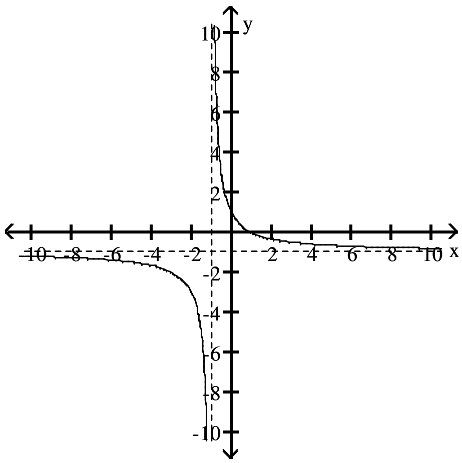


D)

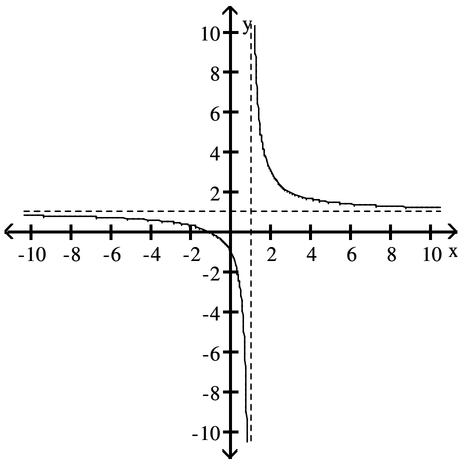


124) $f(x) = \dfrac{x - 1}{x + 1}$ 124) ______

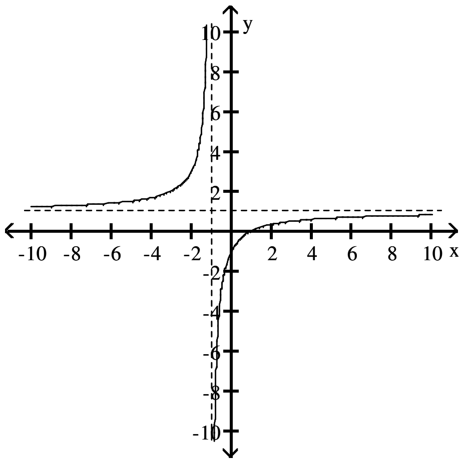
A)



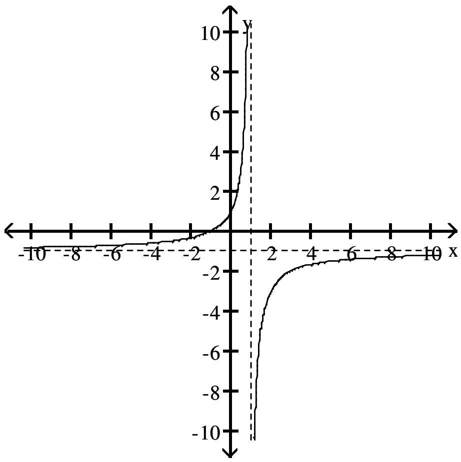
B)



C)

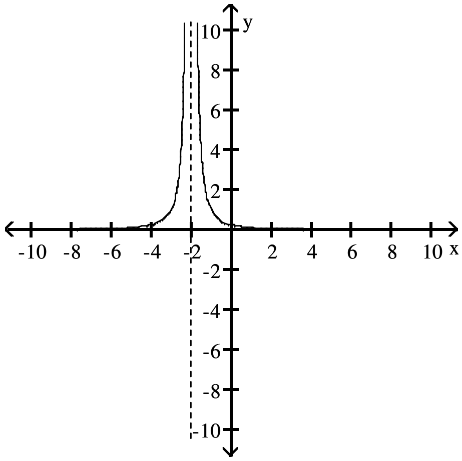


D)

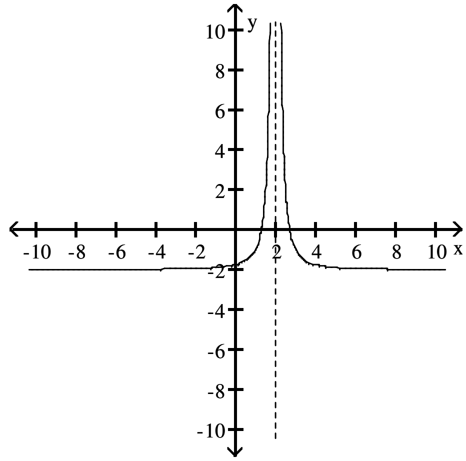


125) $f(x) = \dfrac{1}{(x + 2)^2}$ 125) ______

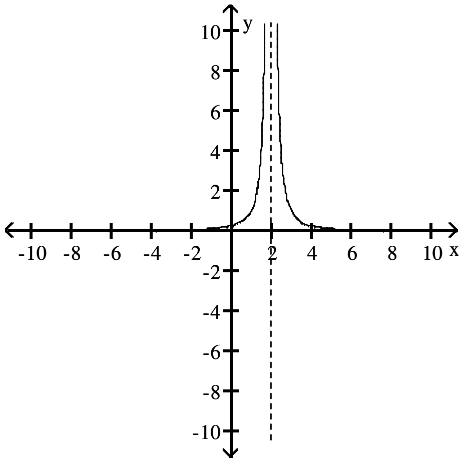
A)



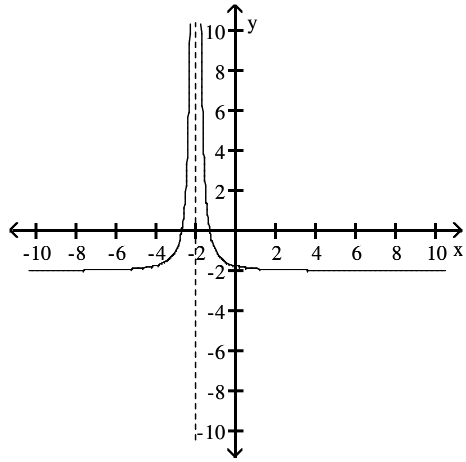
B)



C)

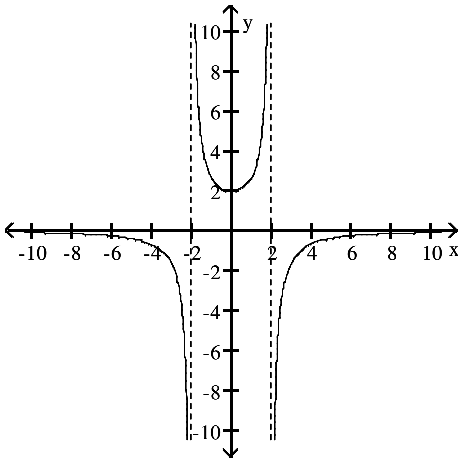


D)

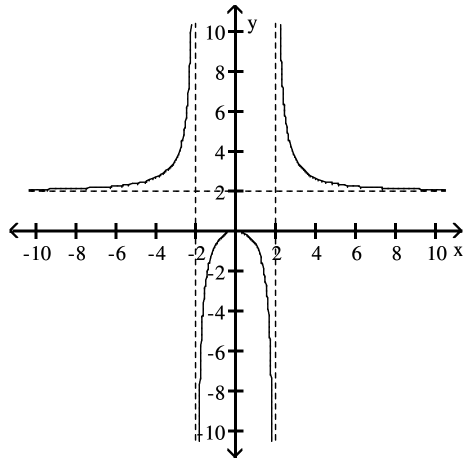


126) $f(x) = \dfrac{2x^2}{4 - x^2}$ 126) ______

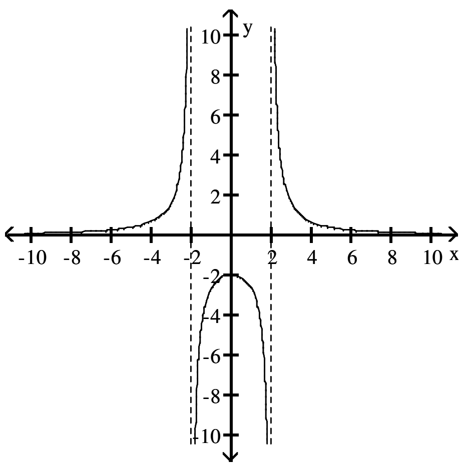
A)



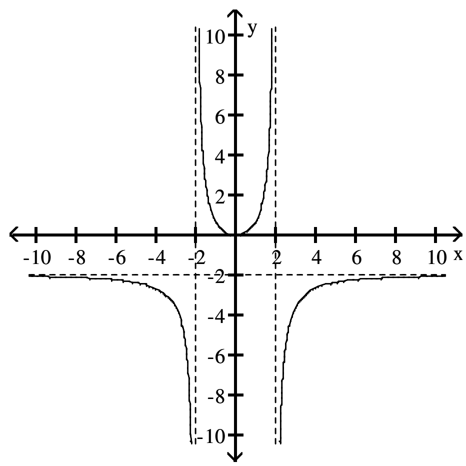
B)



C)



D)



Determine the limit at infinity.

127) $\lim\limits_{x \to \infty} \dfrac{8}{x} - 8$ 127) ______

A) –8 B) 8 C) –16 D) 0

128) $\lim\limits_{x \to -\infty} \dfrac{4}{9 - (5/x^2)}$ 128) ______

A) $-\infty$ B) 4 C) 1 D) $\dfrac{4}{9}$

129) $\lim\limits_{x \to -\infty} \dfrac{-6 + (3/x)}{5 - (1/x^2)}$ 129) ______

A) $-\infty$ B) $-\dfrac{6}{5}$ C) ∞ D) $\dfrac{6}{5}$

130) $\lim\limits_{x\to\infty} \dfrac{x^2 - 5x + 13}{x^3 - 3x^2 + 4}$ 130) ______

A) $\dfrac{13}{4}$ B) ∞ C) 1 D) 0

131) $\lim\limits_{x\to-\infty} \dfrac{-15x^2 - 8x + 13}{-5x^2 + 3x + 2}$ 131) ______

A) 1 B) $\dfrac{13}{2}$ C) 3 D) ∞

132) $\lim\limits_{x\to\infty} \dfrac{3x + 1}{14x - 7}$ 132) ______

A) $\dfrac{3}{14}$ B) $-\dfrac{1}{7}$ C) ∞ D) 0

133) $\lim\limits_{x\to\infty} \dfrac{7x^3 - 2x^2 + 3x}{-x^3 - 2x + 7}$ 133) ______

A) $\dfrac{3}{2}$ B) 7 C) ∞ D) -7

134) $\lim\limits_{x\to-\infty} \dfrac{4x^3 + 3x^2}{x - 7x^2}$ 134) ______

A) ∞ B) 4 C) $-\dfrac{3}{7}$ D) $-\infty$

135) $\lim\limits_{x\to-\infty} \dfrac{\cos 5x}{x}$ 135) ______

A) $-\infty$ B) 1 C) 0 D) 5

136) $\lim\limits_{x\to\infty} \left(8 - \dfrac{3}{x} + \dfrac{1}{x^2}\right)$ 136) ______

A) 6 B) 0 C) 8 D) ∞

Describe the end behavior.

137) $\ln x$ on $(0,\infty)$ 137) ______

A) $\lim\limits_{x\to 0^+} \ln x = -\infty$ and $\lim\limits_{x\to\infty} \ln x = 0$

B) $\lim\limits_{x\to 0^+} \ln x = -\infty$ and $\lim\limits_{x\to\infty} \ln x = \infty$

C) $\lim\limits_{x\to 0^+} \ln x = 1$ and $\lim\limits_{x\to\infty} \ln x = \infty$

D) $\lim\limits_{x\to 0^+} \ln x = 0$ and $\lim\limits_{x\to\infty} \ln x = 1$

Divide numerator and denominator by the highest power of x in the denominator to find the limit.

138) $\lim\limits_{x \to \infty} \sqrt{\dfrac{25x^2}{4 + 36x^2}}$ 138) ______

A) does not exist B) $\frac{25}{4}$ C) $\frac{25}{36}$ D) $\frac{5}{6}$

139) $\lim\limits_{x \to \infty} \sqrt{\dfrac{9x^2 + x - 3}{(x - 7)(x + 1)}}$ 139) ______

A) 0 B) 3 C) 9 D) ∞

140) $\lim\limits_{x \to \infty} \dfrac{3\sqrt{x} + x^{-1}}{-4x + 2}$ 140) ______

A) $-\frac{3}{4}$ B) ∞ C) 0 D) $\frac{1}{-4}$

141) $\lim\limits_{x \to \infty} \dfrac{3x^{-1} + 2x^{-3}}{4x^{-2} + x^{-5}}$ 141) ______

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

142) $\lim\limits_{x \to -\infty} \dfrac{\sqrt[3]{x} - 2x - 7}{3x + x^{2/3} + 4}$ 142) ______

A) $-\frac{2}{3}$ B) $-\infty$ C) $-\frac{3}{2}$ D) 0

143) $\lim\limits_{t \to \infty} \dfrac{\sqrt{64t^2 - 512}}{t - 8}$ 143) ______

A) 512 B) 8 C) does not exist D) 64

144) $\lim\limits_{t \to \infty} \dfrac{\sqrt{25t^2 - 125}}{t - 5}$ 144) ______

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

145) $\lim\limits_{x \to \infty} \dfrac{2x + 5}{\sqrt{5x^2 + 1}}$ 145) ______

A) ∞ B) 0 C) $\frac{2}{\sqrt{5}}$ D) $\frac{2}{5}$

Determine the limit.

146) $\lim\limits_{x \to \infty} \left(\dfrac{12x^2 + 7x + 1}{\sqrt{4x^4 + x^3}} \right)$ 146) ______

A) 4 B) 6 C) 3 D) 0

147) $\lim_{x \to \infty} \left(x - \sqrt{x^2 - 6x}\right)$ (Hint: Multiply by $\frac{x + \sqrt{x^2 - 6x}}{x + \sqrt{x^2 - 6x}}$ first.) 147) ______

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

Find all horizontal asymptotes of the given function, if any.

148) $h(x) = \frac{3x - 4}{x - 2}$ 148) ______

A) $y = 2$ B) $y = 3$
C) $y = 0$ D) no horizontal asymptotes

149) $h(x) = 7 - \frac{9}{x}$ 149) ______

A) $x = 0$ B) $y = 9$
C) $y = 7$ D) no horizontal asymptotes

150) $g(x) = \frac{x^2 + 3x - 4}{x - 4}$ 150) ______

A) $y = 4$ B) $y = 0$
C) $y = 1$ D) no horizontal asymptotes

151) $h(x) = \frac{8x^2 - 7x - 6}{9x^2 - 4x + 3}$ 151) ______

A) $y = \frac{7}{4}$ B) $y = 0$

C) $y = \frac{8}{9}$ D) no horizontal asymptotes

152) $h(x) = \frac{3x^4 - 8x^2 - 5}{8x^5 - 4x + 3}$ 152) ______

A) $y = \frac{3}{8}$ B) $y = 2$

C) $y = 0$ D) no horizontal asymptotes

153) $h(x) = \frac{7x^3 - 3x}{3x^3 - 4x + 3}$ 153) ______

A) $y = \frac{7}{3}$ B) $y = \frac{3}{4}$

C) $y = 0$ D) no horizontal asymptotes

154) $h(x) = \dfrac{3x^3 - 3x - 2}{6x^2 + 7}$ 154) ______

A) $y = 0$
B) $y = 3$
C) $y = \dfrac{1}{2}$
D) no horizontal asymptotes

155) $f(x) = \dfrac{2x + 1}{x^2 - 49}$ 155) ______

A) no horizontal asymptotes
B) $y = 0$
C) $y = -7, y = 7$
D) $y = 2$

156) $R(x) = \dfrac{-3x^2 + 1}{x^2 + 2x - 99}$ 156) ______

A) $y = -11, y = 9$
B) $y = -3$
C) $y = 0$
D) no horizontal asymptotes

157) $f(x) = \dfrac{x^2 - 5}{25x - x^4}$ 157) ______

A) $y = -5, y = 5$
B) $y = -1$
C) $y = 0$
D) no horizontal asymptotes

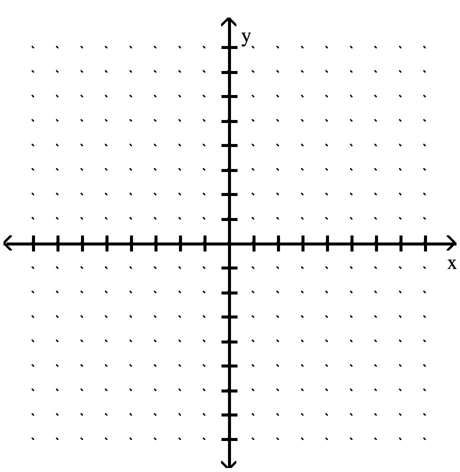
158) $f(x) = \dfrac{9x^4 + x^2 - 3}{x - x^3}$ 158) ______

A) $y = 0$
B) no horizontal asymptotes
C) $y = -9$
D) $y = -1, y = 1$

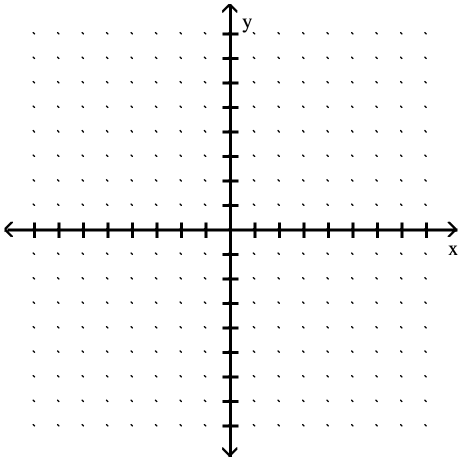
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Sketch the graph of a function y = f(x) that satisfies the given conditions.

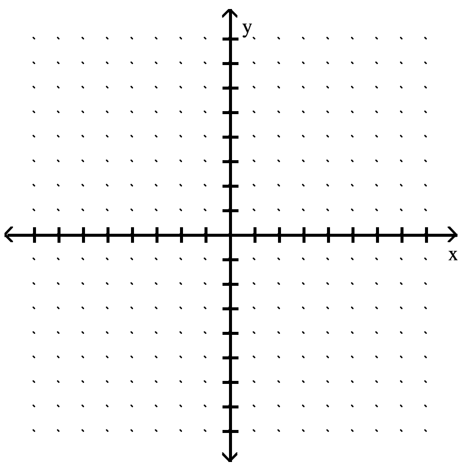
159) $f(0) = 0$, $f(1) = 6$, $f(-1) = -6$, $\lim\limits_{x \to -\infty} f(x) = -5$, $\lim\limits_{x \to \infty} f(x) = 5$. 159) ______________



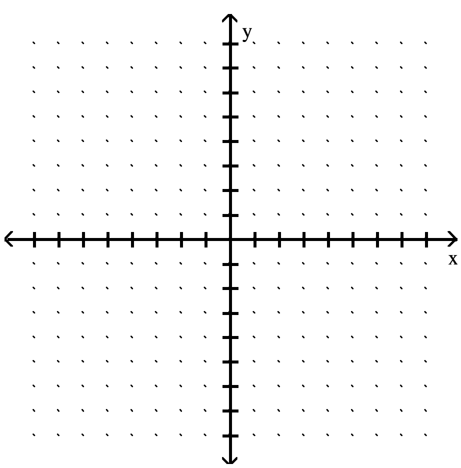
160) $f(0) = 0$, $f(1) = 5$, $f(-1) = 5$, $\lim\limits_{x \to \pm\infty} f(x) = -5$. 160) ______________



161) $f(0) = 2$, $f(1) = -2$, $f(-1) = -2$, $\lim\limits_{x \to \pm\infty} f(x) = 0$. 161) ______________

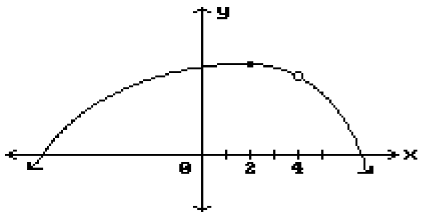


162) $f(0) = 0$, $\lim\limits_{x \to \pm\infty} f(x) = 0$, $\lim\limits_{x \to 3^-} f(x) = -\infty$, $\lim\limits_{x \to -3^+} f(x) = -\infty$, $\lim\limits_{x \to 3^+} f(x) = \infty$, $\lim\limits_{x \to -3^-} f(x) = \infty$. 162) ______________



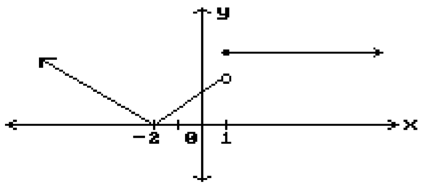
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find all points where the function is discontinuous.

163) 

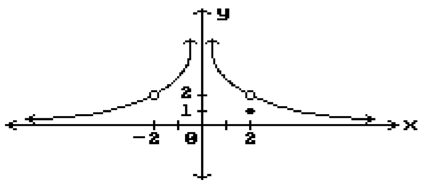
163) ______

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

164) 

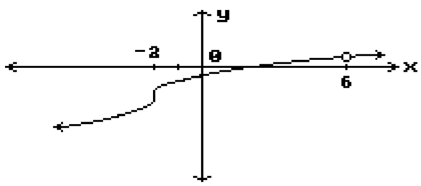
164) ______

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

165) 

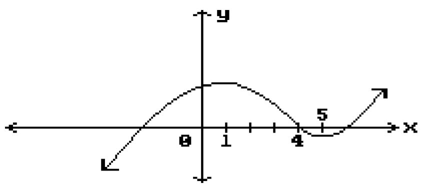
165) ______

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

166) 

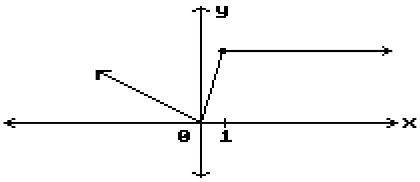
166) ______

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

167) 

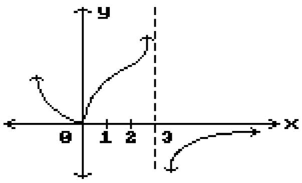
167) ______

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

168) 

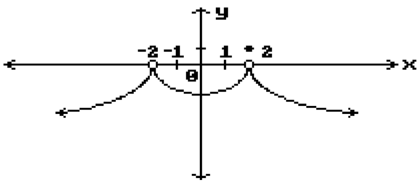
A) None B) $x = 0$ C) $x = 0, x = 1$ D) $x = 1$

168) ______

169) 

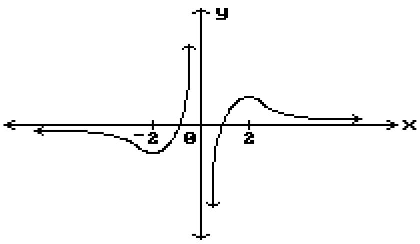
A) $x = 0$ B) None C) $x = 3$ D) $x = 0, x = 3$

169) ______

170) 

A) $x = 2$ B) None C) $x = -2, x = 2$ D) $x = -2$

170) ______

171) 

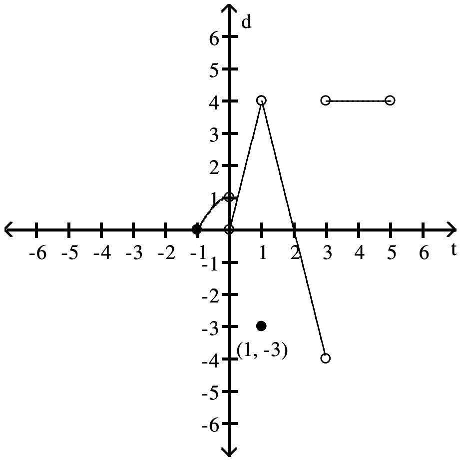
A) $x = 0$
B) $x = -2, x = 2$
C) None
D) $x = -2, x = 0, x = 2$

171) ______

Provide an appropriate response.

172) Is f continuous at f(1)? 172) ______

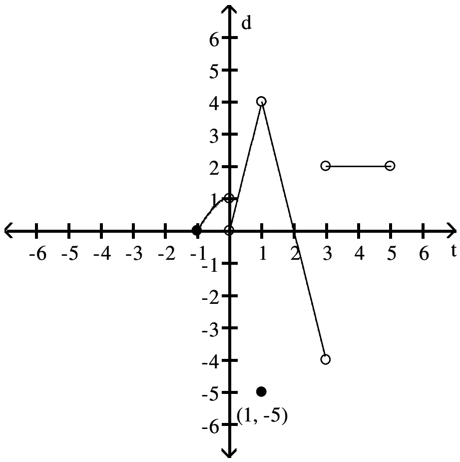
$$f(x) = \begin{cases} -x^2 + 1, & -1 \le x < 0 \\ 4x, & 0 < x < 1 \\ -3, & x = 1 \\ -4x + 8 & 1 < x < 3 \\ 4, & 3 < x < 5 \end{cases}$$



A) Yes B) No

173) Is f continuous at f(0)? 173) ______

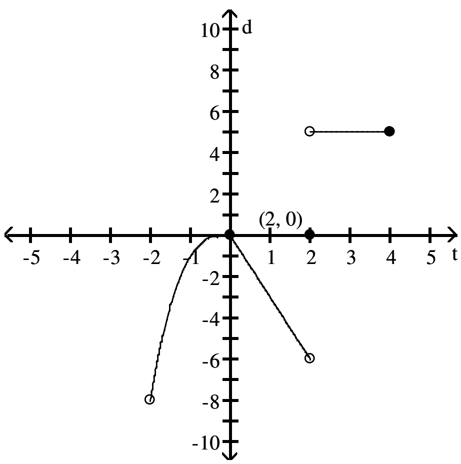
$$f(x) = \begin{cases} -x^2 + 1, & -1 \le x < 0 \\ 4x, & 0 < x < 1 \\ -5, & x = 1 \\ -4x + 8 & 1 < x < 3 \\ 2, & 3 < x < 5 \end{cases}$$



A) No B) Yes

174) Is f continuous at x = 0? 174) ______

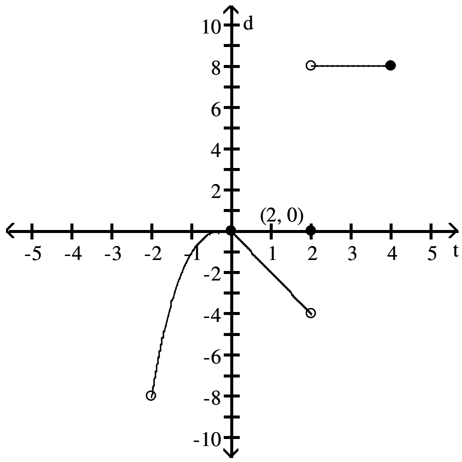
$$f(x) = \begin{cases} x^3, & -2 < x \le 0 \\ -3x, & 0 \le x < 2 \\ 5, & 2 < x \le 4 \\ 0, & x = 2 \end{cases}$$



A) Yes B) No

175) Is f continuous at x = 4? 175) ______

$$f(x) = \begin{cases} x^3, & -2 < x \le 0 \\ -2x, & 0 \le x < 2 \\ 8, & 2 < x \le 4 \\ 0, & x = 2 \end{cases}$$



A) No

B) Yes

Find the intervals on which the function is continuous.

176) $y = \dfrac{1}{x + 5} - 3x$ 176) ______

A) discontinuous only when $x = -8$

B) discontinuous only when $x = 5$

C) discontinuous only when $x = -5$

D) continuous everywhere

177) $y = \dfrac{1}{(x + 3)^2 + 6}$ 177) ______

A) discontinuous only when $x = 15$

B) discontinuous only when $x = -24$

C) discontinuous only when $x = -3$

D) continuous everywhere

178) $y = \dfrac{x + 3}{x^2 - 10x + 21}$ 178) ______

A) discontinuous only when $x = 3$ or $x = 7$

B) discontinuous only when $x = -3$ or $x = 7$

C) discontinuous only when $x = 3$

D) discontinuous only when $x = -7$ or $x = 3$

179) $y = \dfrac{3}{x^2 - 25}$ 179) ______

A) discontinuous only when $x = -5$ or $x = 5$

B) discontinuous only when $x = -25$ or $x = 25$

C) discontinuous only when $x = 25$

D) discontinuous only when $x = -5$

180) $y = \dfrac{5}{|x| + 1} - \dfrac{x^2}{3}$ 180) ______

A) discontinuous only when $x = -3$ or $x = -1$

B) discontinuous only when $x = -1$

C) continuous everywhere

D) discontinuous only when $x = -4$

181) $y = \frac{\sin(3\theta)}{5\theta}$ 181) ______

A) discontinuous only when $\theta = 0$

B) discontinuous only when $\theta = \pi$

C) discontinuous only when $\theta = \frac{\pi}{2}$

D) continuous everywhere

182) $y = \frac{4\cos\theta}{\theta + 1}$ 182) ______

A) discontinuous only when $\theta = -1$

B) continuous everywhere

C) discontinuous only when $\theta = 1$

D) discontinuous only when $\theta = \frac{\pi}{2}$

183) $y = \sqrt{7x + 6}$ 183) ______

A) continuous on the interval $\left[\frac{6}{7}, \infty\right)$

B) continuous on the interval $\left[-\frac{6}{7}, \infty\right)$

C) continuous on the interval $\left(-\frac{6}{7}, \infty\right)$

D) continuous on the interval $\left(-\infty, -\frac{6}{7}\right]$

184) $y = \sqrt[4]{7x - 1}$ 184) ______

A) continuous on the interval $\left[\frac{1}{7}, \infty\right)$

B) continuous on the interval $\left(\frac{1}{7}, \infty\right)$

C) continuous on the interval $\left(-\infty, \frac{1}{7}\right]$

D) continuous on the interval $\left[-\frac{1}{7}, \infty\right)$

185) $y = \sqrt{x^2 - 2}$ 185) ______

A) continuous on the interval $[-\sqrt{2}, \sqrt{2}]$

B) continuous on the intervals $(-\infty, -\sqrt{2}]$ and $[\sqrt{2}, \infty)$

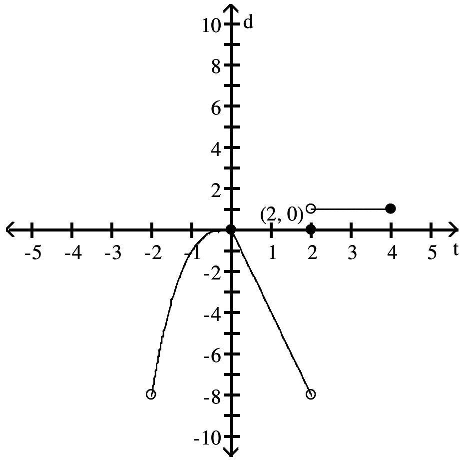
C) continuous everywhere

D) continuous on the interval $[\sqrt{2}, \infty)$

Provide an appropriate response.

186) Is f continuous on $(-2, 4]$? 186) ______

$$f(x) = \begin{cases} x^3, & -2 < x \le 0 \\ -4x, & 0 \le x < 2 \\ 1, & 2 < x \le 4 \\ 0, & x = 2 \end{cases}$$



A) Yes B) No

Find the limit, if it exists.

187) $\lim\limits_{x \to -3} (x^2 - 16 + \sqrt[3]{x^2 - 36})$ 187) ______

A) -4 B) 4 C) -10 D) Does not exist

188) $\lim\limits_{x \to 2} \sqrt{x^2 + 14x + 49}$ 188) ______

A) 81 B) ± 9 C) 9 D) Does not exist

189) $\lim\limits_{x \to 1} \sqrt{x - 9}$ 189) ______

A) 2.82842712 B) 0 C) -2.8284271 D) Does not exist

190) $\lim\limits_{x \to 14} \sqrt{x^2 - 9}$ 190) ______

A) $\pm\sqrt{187}$ B) 93.5 C) $\sqrt{187}$ D) Does not exist

191) $\lim\limits_{x \to -9^-} \sqrt{x^2 - 81}$ 191) ______

A) 0 B) 4.5 C) $9\sqrt{3}$ D) Does not exist

192) $\lim\limits_{x \to 7^+} \dfrac{5\sqrt{(x - 7)^3}}{x - 7}$ 192) ______

A) 0 B) 5 C) $5\sqrt{7}$ D) Does not exist

193) $\lim\limits_{t \to 1^+} \dfrac{\sqrt{(t + 25)(t - 1)^2}}{11t - 11}$ 193) ______

A) $\dfrac{1}{11}$ B) $\dfrac{\sqrt{26}}{11}$ C) 0 D) Does not exist

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

Provide an appropriate response.

194) Use the Intermediate Value Theorem to prove that $8x^3 + 6x^2 - 9x + 4 = 0$ has a solution between -2 and -1. 194) ____________

195) Use the Intermediate Value Theorem to prove that $-2x^4 + 6x^3 + 5x - 2 = 0$ has a solution between 3 and 4. 195) ____________

196) Use the Intermediate Value Theorem to prove that $x(x - 2)^2 = 2$ has a solution between 1 and 3. 196) ____________

197) Use the Intermediate Value Theorem to prove that $3 \sin x = x$ has a solution between $\frac{\pi}{2}$ and π. 197) ____________

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

Find numbers a and b, or k, so that f is continuous at every point.

198) 198) ______

$$f(x) = \begin{cases} -2, & x < -5 \\ ax + b, & -5 \le x \le -3 \\ 2, & x > -3 \end{cases}$$

A) $a = -2, b = 2$ B) $a = 2, b = -4$ C) $a = 2, b = 8$ D) Impossible

199) 199) ______

$$f(x) = \begin{cases} x^2, & x < -5 \\ ax + b, & -5 \le x \le -4 \\ x + 20, & x > -4 \end{cases}$$

A) $a = -9, b = -20$ B) $a = 9, b = -20$ C) $a = -9, b = 20$ D) Impossible

200) 200) ______

$$f(x) = \begin{cases} 7x + 10, & \text{if } x < -5 \\ kx + 6, & \text{if } x \ge -5 \end{cases}$$

A) $k = -\frac{6}{5}$ B) $k = \frac{6}{5}$ C) $k = 11$ D) $k = \frac{31}{5}$

201) 201) ______

$$f(x) = \begin{cases} x^2, & \text{if } x \le 4 \\ x + k, & \text{if } x > 4 \end{cases}$$

A) $k = -4$ B) $k = 12$ C) $k = 20$ D) Impossible

202) 202) ______

$$f(x) = \begin{cases} x^2, & \text{if } x \le 4 \\ kx, & \text{if } x > 4 \end{cases}$$

A) $k = 4$ B) $k = \frac{1}{4}$ C) $k = 16$ D) Impossible

Solve the problem.

203) Select the correct statement for the definition of the limit: $\lim\limits_{x \to x_0} f(x) = L$ 203) ______

means that ________________

A) if given a number $\varepsilon > 0$, there exists a number $\delta > 0$, such that for all x, $0 < |x - x_0| < \delta$ implies $|f(x) - L| > \varepsilon$.

B) if given any number $\varepsilon > 0$, there exists a number $\delta > 0$, such that for all x, $0 < |x - x_0| < \varepsilon$ implies $|f(x) - L| > \delta$.

C) if given any number $\varepsilon > 0$, there exists a number $\delta > 0$, such that for all x, $0 < |x - x_0| < \varepsilon$ implies $|f(x) - L| < \delta$.

D) if given any number $\varepsilon > 0$, there exists a number $\delta > 0$, such that for all x, $0 < |x - x_0| < \delta$ implies $|f(x) - L| < \varepsilon$.

204) Identify the incorrect statements about limits. 204) ______

I. The number L is the limit of f(x) as x approaches x_0 if f(x) gets closer to L as x approaches x_0.

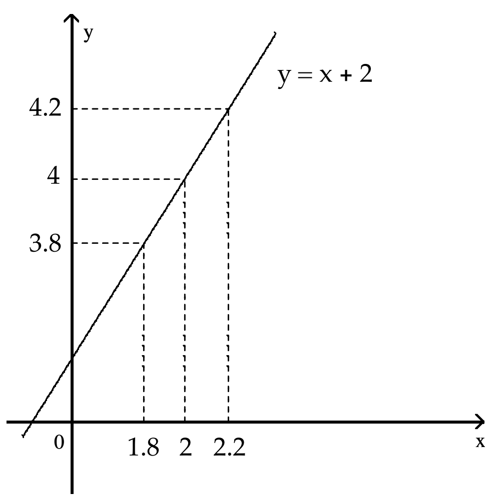
II. The number L is the limit of f(x) as x approaches x_0 if, for any $\varepsilon > 0$, there corresponds a $\delta > 0$ sucl that $|f(x) - L| < \varepsilon$ whenever $0 < |x - x_0| < \delta$.

III. The number L is the limit of f(x) as x approaches x_0 if, given any $\varepsilon > 0$, there exists a value of x fo which $|f(x) - L| < \varepsilon$.

A) I and II B) II and III C) I and III D) I, II, and III

Use the graph to find a $\delta > 0$ such that for all x, $0 < |x - x_0| < \delta \Rightarrow |f(x) - L| < \varepsilon$.

205) 205) ______

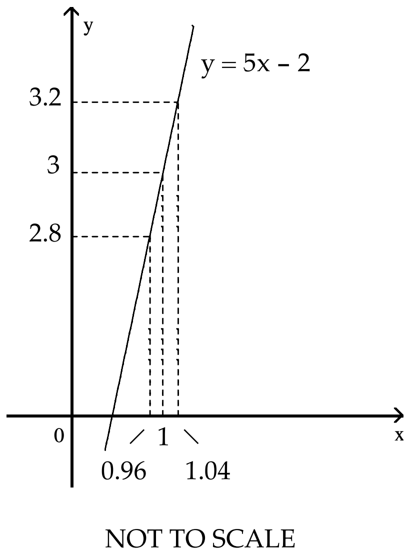


NOT TO SCALE

$f(x) = x + 2$
$x_0 = 2$
$L = 4$
$\varepsilon = 0.2$

A) 0.1 B) 2 C) 0.4 D) 0.2

206)



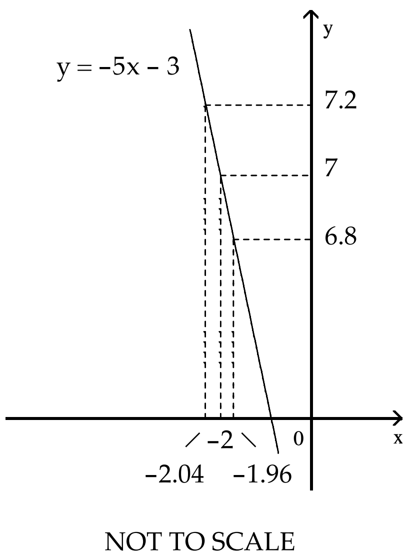
$f(x) = 5x - 2$
$x_0 = 1$
$L = 3$
$\varepsilon = 0.2$

206) ______

A) 2 B) 0.04 C) 0.4 D) 0.08

207)

$f(x) = -5x - 3$
$x_0 = -2$
$L = 7$
$\varepsilon = 0.2$

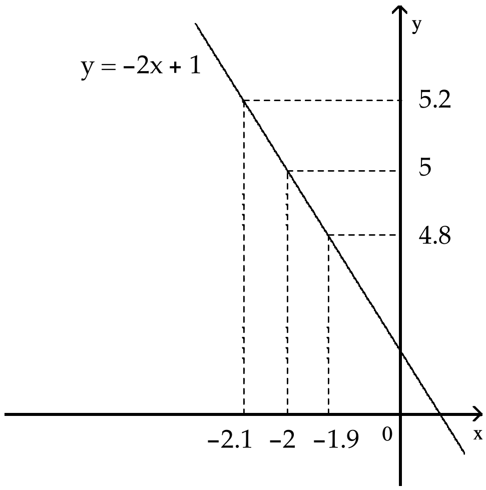


207) ______

A) –0.04 B) 0.4 C) 0.04 D) 15

208) 208) ______

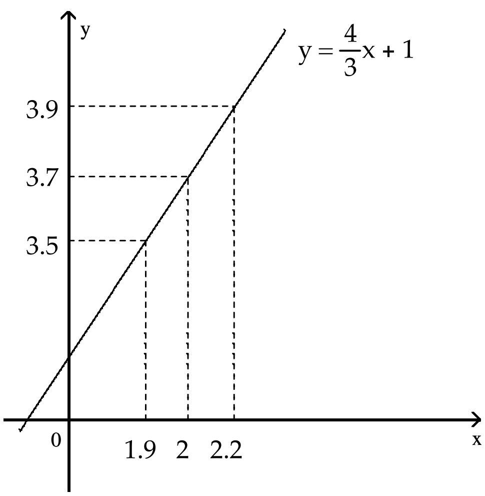
$f(x) = -2x + 1$
$x_0 = -2$
$L = 5$
$\varepsilon = 0.2$



NOT TO SCALE

A) 7 B) 0.1 C) 0.2 D) −0.1

209) 209) ______



NOT TO SCALE

$f(x) = \frac{4}{3}x + 1$
$x_0 = 2$
$L = 3.7$
$\varepsilon = 0.2$

A) 0.1 B) −0.3 C) 0.3 D) 1.7

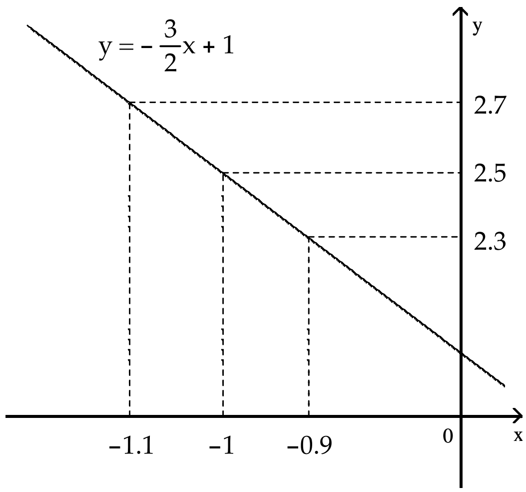
210) 210) ______

$f(x) = -\frac{3}{2}x + 1$

$x_0 = -1$

$L = 2.5$

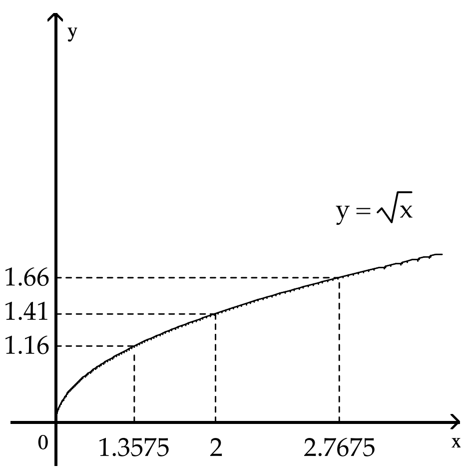
$\varepsilon = 0.2$



NOT TO SCALE

A) 3.5 B) 0.1 C) 0.2 D) −0.2

211) 211) ______



$f(x) = \sqrt{x}$

$x_0 = 2$

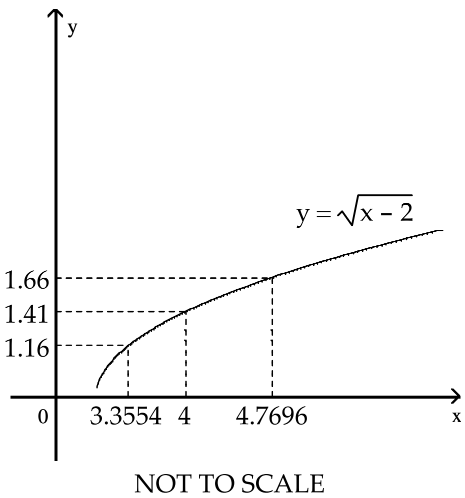
$L = \sqrt{2}$

$\varepsilon = \frac{1}{4}$

NOT TO SCALE

A) −0.59 B) 1.41 C) 0.7675 D) 0.6425

212)

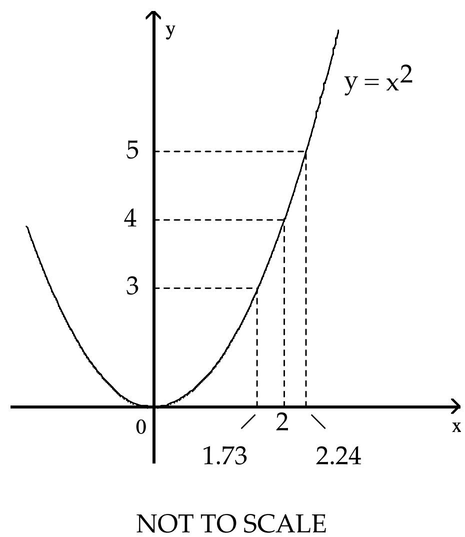


$f(x) = \sqrt{x - 2}$
$x_0 = 4$
$L = \sqrt{2}$
$\varepsilon = \dfrac{1}{4}$

212) ______

A) 2.59 B) 1.4142 C) 0.7696 D) 0.6446

213)

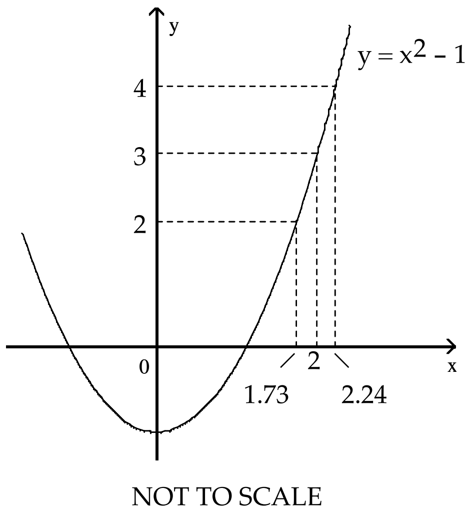


$f(x) = x^2$
$x_0 = 2$
$L = 4$
$\varepsilon = 1$

213) ______

A) 2 B) 0.51 C) 0.24 D) 0.27

214) 214) ______



$f(x) = x^2 - 1$
$x_0 = 2$
$L = 3$
$\varepsilon = 1$

A) 1 B) 0.51 C) 0.27 D) 0.24

A function f(x), a point x_0, the limit of f(x) as x approaches x_0, and a positive number ε is given. Find a number δ > 0 such that for all x, $0 < |x - x_0| < \delta \Rightarrow |f(x) - L| < \varepsilon$.

215) $f(x) = 2x + 2$, $L = 10$, $x_0 = 4$, and $\varepsilon = 0.01$ 215) ______
A) 0.005 B) 0.0025 C) 0.025 D) 0.01

216) $f(x) = 3x - 1$, $L = 5$, $x_0 = 2$, and $\varepsilon = 0.01$ 216) ______
A) 0.003333 B) 0.001667 C) 0.005 D) 0.006667

217) $f(x) = -4x + 2$, $L = -2$, $x_0 = 1$, and $\varepsilon = 0.01$ 217) ______
A) 0.0025 B) −0.01 C) 0.01 D) 0.005

218) $f(x) = -5x - 2$, $L = -17$, $x_0 = 3$, and $\varepsilon = 0.01$ 218) ______
A) 0.004 B) 0.001 C) −0.003333 D) 0.002

219) $f(x) = 5x^2$, $L = 20$, $x_0 = 2$, and $\varepsilon = 0.2$ 219) ______
A) 0.00998 B) 2.00998 C) 1.98997 D) 0.01003

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

Prove the limit statement

220) $\lim_{x \to 6} (2x - 1) = 11$ 220) ______________

221) $\lim_{x \to 3} \frac{x^2 - 9}{x - 3} = 6$ 221) ______________

222) $\lim_{x \to 4} \frac{5x^2 - 19x - 4}{x - 4} = 21$ 222) ______________

223) $\lim_{x \to 3} \frac{1}{x} = \frac{1}{3}$ 223) ______________

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

Use the precise definition of a limit to prove the limit. Specify a relationship between ε and δ that guarantees the limit exists.

224) $\lim_{x \to 2} x^4 = 16$ 224) ______

A) $\delta = \min\left\{1, \frac{\varepsilon}{65}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 2| < \delta$. Then $|x^4 - 16| = |x^2 + 4|\,|x + 2|\,|x - 2| <$ $(13)(5)\frac{\varepsilon}{65} = \varepsilon$. That is, for any $\varepsilon > 0$, $|x^4 - 16| < \varepsilon$ whenever $0 < |x-2| < \delta$, provided $0 < \delta \le \frac{\varepsilon}{65}$.

Therefore, $\lim_{x \to 2} x^4 = 16$.

B) $\delta = \min\left\{1, \frac{\varepsilon}{32}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 2| < \delta$. Then $|x^4 - 16| = |x^2 + 4|\,|x + 2|\,|x - 2| <$ $(8)(4)\frac{\varepsilon}{32} = \varepsilon$. That is, for any $\varepsilon > 0$, $|x^4 - 16| < \varepsilon$ whenever $0 < |x-2| < \delta$, provided $0 < \delta \le \frac{\varepsilon}{32}$.

Therefore, $\lim_{x \to 2} x^4 = 16$.

C) $\delta = \min\left\{1, \frac{\varepsilon}{32}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 2| < \delta$. Then $|x^4 - 16| = |x^2 + 4|\,|x + 2|\,|x - 2| =$ $(8)(4)\frac{\varepsilon}{32} = \varepsilon$. That is, for any $\varepsilon > 0$, $|x^4 - 16| = \varepsilon$ whenever $0 < |x - 2| < \delta$, provided $0 < \delta \le \frac{\varepsilon}{32}$.

Therefore, $\lim_{x \to 2} x^4 = 16$.

D) $\delta = \min\left\{1, \frac{\varepsilon}{65}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 2| < \delta$. Then $|x^4 - 16| = |x^2 + 4|\,|x + 2|\,|x - 2| =$ $(13)(5)\frac{\varepsilon}{65} = \varepsilon$. That is, for any $\varepsilon > 0$, $|x^4 - 16| = \varepsilon$ whenever $0 < |x - 2| < \delta$, provided $0 < \delta \le \frac{\varepsilon}{65}$.

Therefore, $\lim_{x \to 2} x^4 = 16$.

225) $\lim\limits_{x \to 3} \frac{1}{x^2} = \frac{1}{9}$ 225) ______

A) $\delta = \min\left\{1, \frac{36\varepsilon}{7}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 3| < \delta$. Then $\left|\frac{1}{x^2} - \frac{1}{9}\right| = \frac{|-1||x + 3||x - 3|}{|9x^2|} = \frac{7}{36}$

$\left(\frac{36\varepsilon}{7}\right) = \varepsilon$. That is, for any $\varepsilon > 0$, $\left|\frac{1}{x^2} - \frac{1}{9}\right| = \varepsilon$ whenever $0 < |x - 3| < \delta$, provided $0 < \delta \le \frac{36\varepsilon}{7}$.

Therefore, $\lim\limits_{x \to 2} \frac{1}{x^2} = \frac{1}{9}$.

B) $\delta = \min\left\{1, \frac{36\varepsilon}{7}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 3| < \delta$. Then $\left|\frac{1}{x^2} - \frac{1}{9}\right| = \frac{|-1|\,|x + 3|\,|x - 3|}{|9x^2|} < \frac{7}{36}$

$\left(\frac{36\varepsilon}{7}\right) = \varepsilon$. That is, for any $\varepsilon > 0$, $\left|\frac{1}{x^2} - \frac{1}{9}\right| < \varepsilon$ whenever $0 < |x - 3| < \delta$, provided $0 < \delta \le \frac{36\varepsilon}{7}$.

Therefore, $\lim\limits_{x \to 2} \frac{1}{x^2} = \frac{1}{9}$.

C) $\delta = \min\left\{1, \frac{144\varepsilon}{7}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 3| < \delta$. Then $\left|\frac{1}{x^2} - \frac{1}{9}\right| = \frac{|-1||x + 3||x - 3|}{|9x^2|} = \frac{7}{144}$

$\left(\frac{144\varepsilon}{7}\right) = \varepsilon$. That is, for any $\varepsilon > 0$, $\left|\frac{1}{x^2} - \frac{1}{9}\right| <= \varepsilon$ whenever $0 < |x - 3| < \delta$, provided $0 < \delta \le \frac{144\varepsilon}{7}$.

Therefore, $\lim\limits_{x \to 2} \frac{1}{x^2} = \frac{1}{9}$.

D) $\delta = \min\left\{1, \frac{144\varepsilon}{7}\right\}$; Let $\varepsilon > 0$ and assume $0 < |x - 3| < \delta$. Then $\left|\frac{1}{x^2} - \frac{1}{9}\right| = \frac{|-1|\,|x + 3||x - 3|}{|9x^2|} < \frac{7}{144}$

$\left(\frac{144\varepsilon}{7}\right) = \varepsilon$. That is, for any $\varepsilon > 0$, $\left|\frac{1}{x^2} - \frac{1}{9}\right| < \varepsilon$ whenever $0 < |x - 3| < \delta$, provided $0 < \delta \le \frac{144\varepsilon}{7}$.

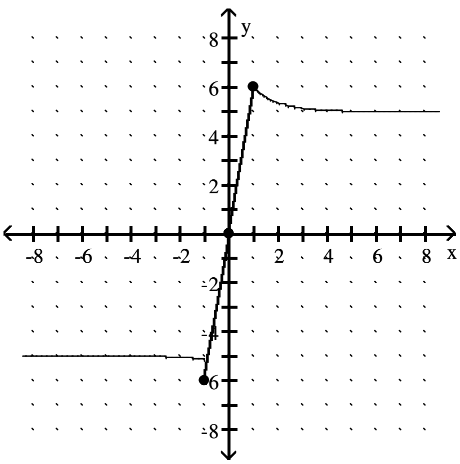
Therefore, $\lim\limits_{x \to 2} \frac{1}{x^2} = \frac{1}{9}$.

1) A
2) A
3) C
4) C
5) A
6) A
7) B
8) C
9) A
10) B
11) C
12) B
13) C
14) C
15) B
16) A
17) D
18) C
19) C
20) B
21) D
22) B
23) A
24) B
25) A
26) A
27) D
28) A
29) C
30) B
31) A
32) C
33) D
34) B
35) D
36) D
37) B
38) D
39) C
40) Answers may vary. One possibility: $\lim\limits_{x \to 0} 1 - \frac{x^2}{6} = \lim\limits_{x \to 0} 1 = 1$. According to the squeeze theorem, the function $\frac{x \sin(x)}{2 - 2\cos(x)}$, which is squeezed between $1 - \frac{x^2}{6}$ and 1, must also approach 1 as x approaches 0. Thus, $\lim\limits_{x \to 0} \frac{x \sin(x)}{2 - 2\cos(x)} = 1$.
41) D
42) D
43) D

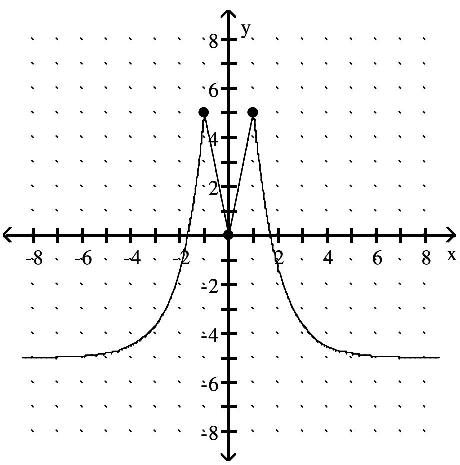
44) A
45) C
46) A
47) C
48) B
49) A
50) A
51) C
52) B
53) C
54) C
55) D
56) D
57) B
58) C
59) D
60) B
61) C
62) B
63) B
64) D
65) B
66) B
67) B
68) C
69) D
70) C
71) B
72) D
73) D
74) B
75) B
76) A
77) C
78) B
79) B
80) D
81) B
82) C
83) D
84) B
85) C
86) A
87) B
88) B
89) B
90) C
91) B
92) A
93) C

94) D
95) B
96) B
97) C
98) C
99) B
100) D
101) A
102) B
103) C
104) D
105) A
106) A
107) D
108) D
109) D
110) C
111) D
112) C
113) B
114) C
115) C
116) C
117) B
118) B
119) D
120) B
121) B
122) B
123) B
124) C
125) A
126) D
127) A
128) D
129) B
130) D
131) C
132) A
133) D
134) A
135) C
136) C
137) B
138) D
139) B
140) C
141) D
142) A
143) B

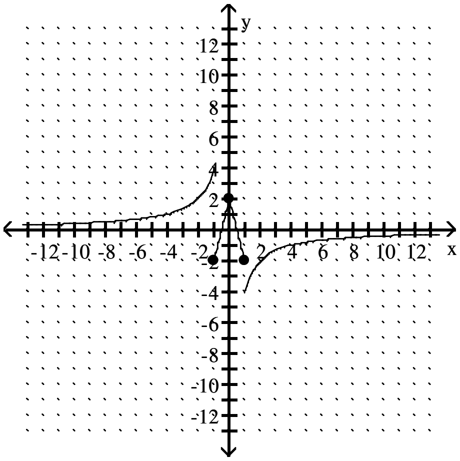
144) B
145) C
146) B
147) D
148) B
149) C
150) D
151) C
152) C
153) A
154) D
155) B
156) B
157) C
158) B
159) Answers may vary. One possible answer:



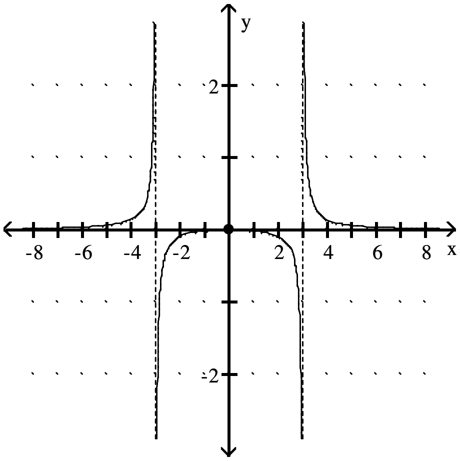
160) Answers may vary. One possible answer:



161) Answers may vary. One possible answer:



162) Answers may vary. One possible answer:



163) B
164) B
165) A
166) C
167) A
168) A
169) C
170) C
171) A
172) B
173) A
174) A
175) B
176) C
177) D
178) A
179) A
180) C
181) A
182) A
183) B

184) A
185) B
186) B
187) C
188) C
189) D
190) C
191) A
192) A
193) B
194) Let $f(x) = 8x^3 + 6x^2 - 9x + 4$ and let $y_0 = 0$. $f(-2) = -18$ and $f(-1) = 11$. Since f is continuous on $[-2, -1]$ and since $y_0 = 0$ is between $f(-2)$ and $f(-1)$, by the Intermediate Value Theorem, there exists a c in the interval $(-2, -1)$ with the property that $f(c) = 0$. Such a c is a solution to the equation $8x^3 + 6x^2 - 9x + 4 = 0$.
195) Let $f(x) = -2x^4 + 6x^3 + 5x - 2$ and let $y_0 = 0$. $f(3) = 13$ and $f(4) = -110$. Since f is continuous on $[3, 4]$ and since $y_0 = 0$ is between $f(3)$ and $f(4)$, by the Intermediate Value Theorem, there exists a c in the interval $(3, 4)$ with the property that $f(c) = 0$. Such a c is a solution to the equation $-2x^4 + 6x^3 + 5x - 2 = 0$.
196) Let $f(x) = x(x - 2)^2$ and let $y_0 = 2$. $f(1) = 1$ and $f(3) = 3$. Since f is continuous on $[1, 3]$ and since $y_0 = 2$ is between $f(1)$ and $f(3)$, by the Intermediate Value Theorem, there exists a c in the interval $(1, 3)$ with the property that $f(c) = 2$. Such a c is a solution to the equation $x(x - 2)^2 = 2$.
197) Let $f(x) = \frac{\sin x}{x}$ and let $y_0 = \frac{1}{3}$. $f\left(\frac{\pi}{2}\right) \approx 0.6366$ and $f(\pi) = 0$. Since f is continuous on $\left[\frac{\pi}{2}, \pi\right]$ and since $y_0 = \frac{1}{3}$ is between $f\left(\frac{\pi}{2}\right)$ and $f(\pi)$, by the Intermediate Value Theorem, there exists a c in the interval $\left(\frac{\pi}{2}, \pi\right)$, with the property that $f(c) = \frac{1}{3}$. Such a c is a solution to the equation $3 \sin x = x$.
198) C
199) A
200) D
201) B
202) A
203) D
204) C
205) D
206) B
207) C
208) B
209) A
210) B
211) D
212) D
213) C
214) D
215) A
216) A
217) A
218) D
219) A

220)

Let $\varepsilon > 0$ be given. Choose $\delta = \varepsilon/2$. Then $0 < |x - 6| < \delta$ implies that

$$\begin{aligned} |(2x - 1) - 11| &= |2x - 12| \\ &= |2(x - 6)| \\ &= 2|x - 6| < 2\delta = \varepsilon \end{aligned}$$

Thus, $0 < |x - 6| < \delta$ implies that $|(2x - 1) - 11| < \varepsilon$

221) Let $\varepsilon > 0$ be given. Choose $\delta = \varepsilon$. Then $0 < |x - 3| < \delta$ implies that

$$\begin{aligned} \left|\frac{x^2 - 9}{x - 3} - 6\right| &= \left|\frac{(x - 3)(x + 3)}{x - 3} - 6\right| \\ &= |(x + 3) - 6| \qquad \text{for } x \neq 3 \\ &= |x - 3| < \delta = \varepsilon \end{aligned}$$

Thus, $0 < |x - 3| < \delta$ implies that $\left|\dfrac{x^2 - 9}{x - 3} - 6\right| < \varepsilon$

222) Let $\varepsilon > 0$ be given. Choose $\delta = \varepsilon/5$. Then $0 < |x - 4| < \delta$ implies that

$$\begin{aligned} \left|\frac{5x^2 - 19x - 4}{x - 4} - 21\right| &= \left|\frac{(x - 4)(5x + 1)}{x - 4} - 21\right| \\ &= |(5x + 1) - 21| \qquad \text{for } x \neq 4 \\ &= |5x - 20| \\ &= |5(x - 4)| \\ &= 5|x - 4| < 5\delta = \varepsilon \end{aligned}$$

Thus, $0 < |x - 4| < \delta$ implies that $\left|\dfrac{5x^2 - 19x - 4}{x - 4} - 21\right| < \varepsilon$

223) Let $\varepsilon > 0$ be given. Choose $\delta = \min\{3/2, 9\varepsilon/2\}$. Then $0 < |x - 3| < \delta$ implies that

$$\begin{aligned} \left|\frac{1}{x} - \frac{1}{3}\right| &= \left|\frac{3 - x}{3x}\right| \\ &= \frac{1}{|x|} \cdot \frac{1}{3} \cdot |x - 3| \\ &< \frac{1}{3/2} \cdot \frac{1}{3} \cdot \frac{9\varepsilon}{2} = \varepsilon \end{aligned}$$

Thus, $0 < |x - 3| < \delta$ implies that $\left|\dfrac{1}{x} - \dfrac{1}{3}\right| < \varepsilon$

224) A

225) B