

TEST BANK



THOMAS'
CALCULUS

Twelfth Edition

Multivariable

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

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

1) $y = x^2 + 1x, [1, 9]$ 1) _____
A) 11 B) 10 C) $\frac{88}{9}$ D) $\frac{45}{4}$

Answer: A

2) $y = 7x^3 + 4x^2 - 7, [-7, 5]$ 2) _____
A) 636 B) $\frac{968}{5}$ C) $\frac{242}{3}$ D) 265

Answer: D

3) $y = \sqrt{2x}, [2, 8]$ 3) _____
A) $\frac{3}{10}$ B) $\frac{1}{3}$ C) 7 D) 2

Answer: B

4) $y = \frac{3}{x-2}, [4, 7]$ 4) _____
A) $\frac{3}{10}$ B) 7 C) 2 D) $\frac{1}{3}$

Answer: A

5) $y = 4x^2, \left[0, \frac{7}{4}\right]$ 5) _____
A) 2 B) $\frac{3}{10}$ C) $\frac{1}{3}$ D) 7

Answer: D

6) $y = -3x^2 - x, [5, 6]$ 6) _____
A) $\frac{1}{2}$ B) $\frac{1}{6}$ C) -34 D) -2

Answer: C

7) $h(t) = \sin(4t), \left[0, \frac{\pi}{8}\right]$ 7) _____
A) $\frac{\pi}{8}$ B) $\frac{8}{\pi}$ C) $\frac{4}{\pi}$ D) $\frac{8}{\pi}$

Answer: B

8) $g(t) = 3 + \tan t, \left[-\frac{\pi}{4}, \frac{\pi}{4}\right]$ 8) _____
A) $\frac{8}{5}$ B) $\frac{4}{\pi}$ C) $\frac{4}{\pi}$ D) 0

Answer: B

Find the slope of the curve at the given point P and an equation of the tangent line at P.

9) $y = x^2 + 5x$, P(4, 36)

A) slope is $\frac{1}{20}$; $y = \frac{x}{20} + \frac{1}{5}$

C) slope is $-\frac{4}{25}$; $y = -\frac{4x}{25} + \frac{8}{5}$

Answer: B

B) slope is 13; $y = 13x - 16$

D) slope is -39; $y = -39x - 80$

9) _____

10) $y = x^2 + 11x - 15$, P(1, -3)

A) slope is $-\frac{4}{25}$; $y = -\frac{4x}{25} + \frac{8}{5}$

C) slope is $\frac{1}{20}$; $y = \frac{x}{20} + \frac{1}{5}$

Answer: D

B) slope is -39; $y = -39x - 80$

D) slope is 13; $y = 13x - 16$

10) _____

11) $y = x^3 - 5x$, P(1, -4)

A) slope is 3; $y = 3x - 3$

C) slope is -2; $y = -2x$

Answer: D

B) slope is 3; $y = 3x - 7$

D) slope is -2; $y = -2x - 2$

11) _____

12) $y = x^3 - 3x^2 + 4$, P(1, 2)

A) slope is -3; $y = -3x + 2$

C) slope is -3; $y = -3x + 5$

Answer: C

B) slope is 1; $y = x + 5$

D) slope is 0; $y = 5$

12) _____

13) $y = -3 - x^3$, (-1, -2)

A) slope is -1; $y = -x - 5$

C) slope is -3; $y = -3x - 5$

Answer: C

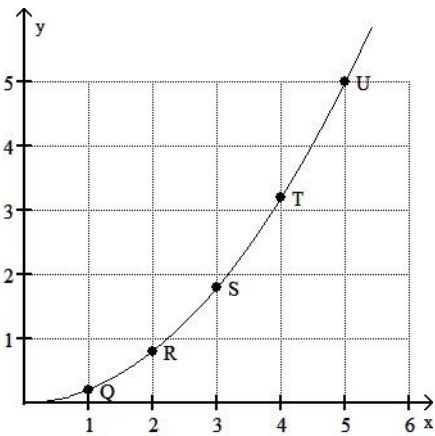
B) slope is 0; $y = -5$

D) slope is 3; $y = 3x - 5$

13) _____

Use the slopes of UQ, UR, US, and UT to estimate the rate of change of y at the specified value of x.

14) $x = 5$



A) 2

B) 1

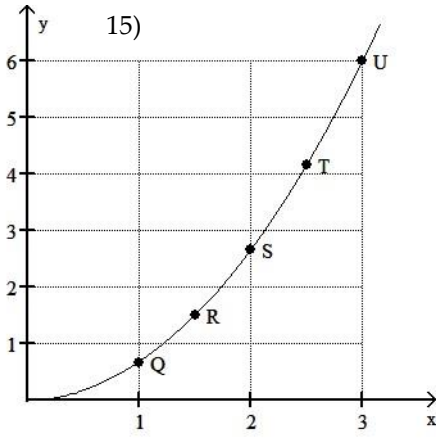
C) 5

D) 0

Answer: A

14) _____

15) $x = 3$



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A) 0
Answer: B

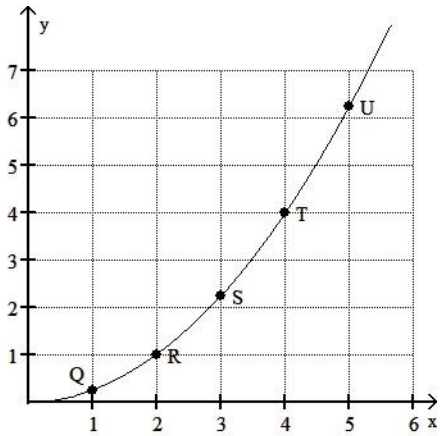
B) 4

C) 2

D) 6

16) $x = 5$

16) _____



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

B) $\frac{5}{2}$

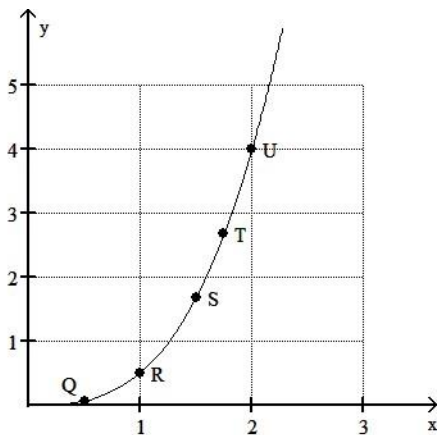
C) 0

D) $\frac{25}{4}$

Answer: B

17) $x = 2$

17) _____



A) 4

B) 0

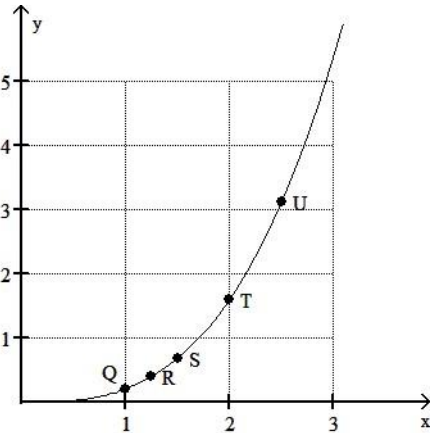
C) 3

D) 6

Answer: D

18) $x = 2.5$

18) _____



- A) 3.75 B) 7.5 C) 0 D) 1.25

Answer: A

Use the table to estimate the rate of change of y at the specified value of x .

19) $x = 1$.

19) _____

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) 1.5 B) 0.5 C) 1 D) 2

Answer: C

20) $x = 1$.

20) _____

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) 0.5 B) 2 C) 1.5 D) 1

Answer: A

21) $x = 1$.

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

21)

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- A) 6 B) 8 C) 4 D) 2
 Answer: A

22) $x = 2$.

22) _____

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) 4 B) 0 C) 8 D) -8
 Answer: B

23) $x = 1$.

23) _____

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) 1 B) 0.5 C) -0.5 D) 0
 Answer: B

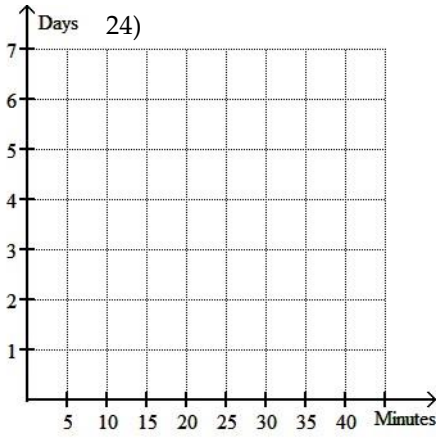
Solve the problem.

24) When exposed to ethylene gas, green bananas will ripen at an accelerated rate. The number of days for ripening becomes shorter for longer exposure times. Assume that the table below gives average ripening times of bananas for several different ethylene exposure times:

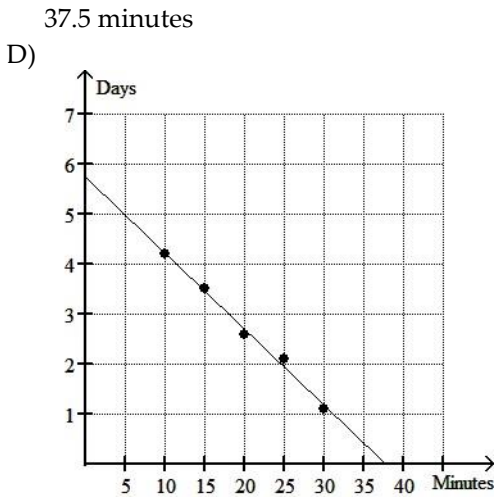
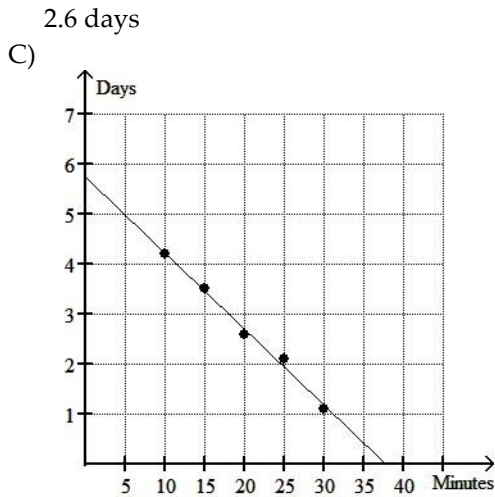
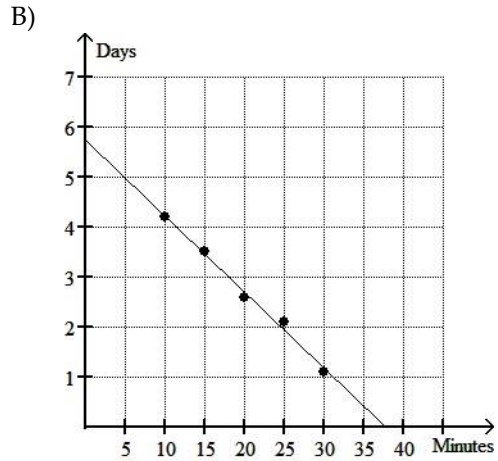
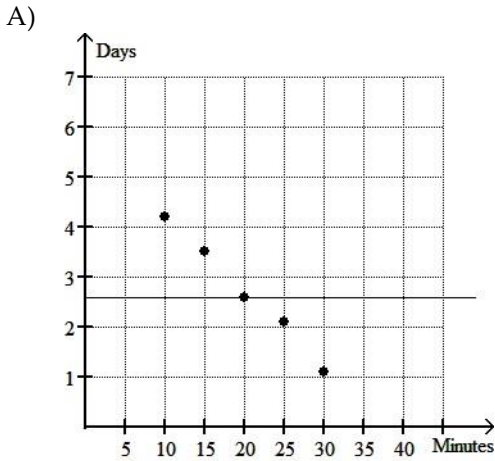
Exposure time (minutes)	Ripening Time (days)
10	4.2
15	3.5
20	2.6
25	2.1
30	1.1

Plot the data and then find a line approximating the data. With the aid of this line, find the limit

of the time the to average ethylene ripening time approaches 0.9. Round your answer as to the nearest tenth. osu



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0.1 day
Answer: D

5.8 days

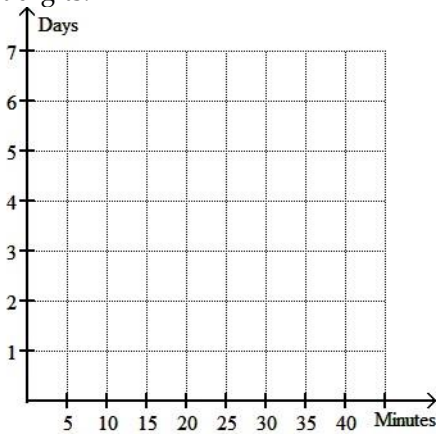
25) When exposed to ethylene gas, green bananas will ripen at an accelerated rate. The number of days for ripening becomes shorter for longer exposure times. Assume that the table below gives average ripening times of bananas for several different ethylene exposure times.

Exposure time (minutes)	Ripening time (days)
10	4.3
15	3.2
20	2.7
25	2.1
30	1.3

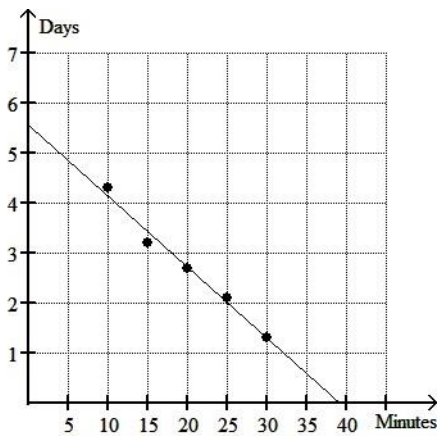
the data. 25)

With the aid of this line, determine the rate of change of ripening time with respect to exposure time. Round your answer to two significant digits.

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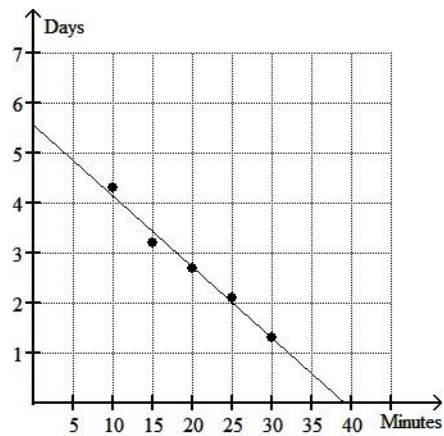
A)



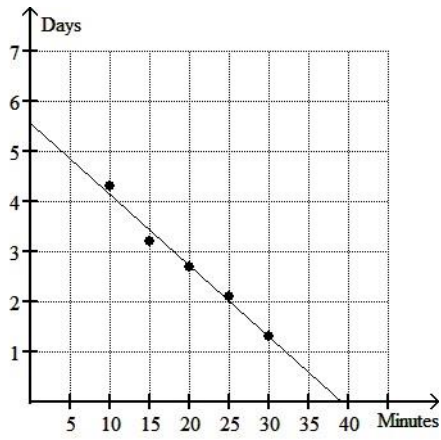
-6.7 days per minute

C)

B)

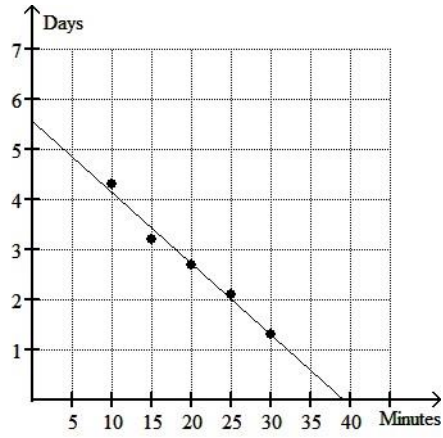


5.6 days



-0.14 day per
minute

D)

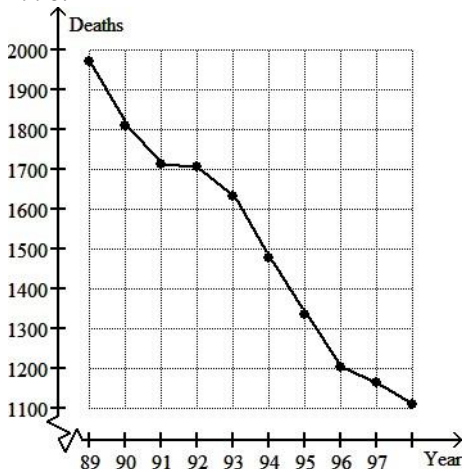


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Answer: C

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

26) _____



Estimate the average rate of change in tuberculosis deaths from 1991 to 1993.

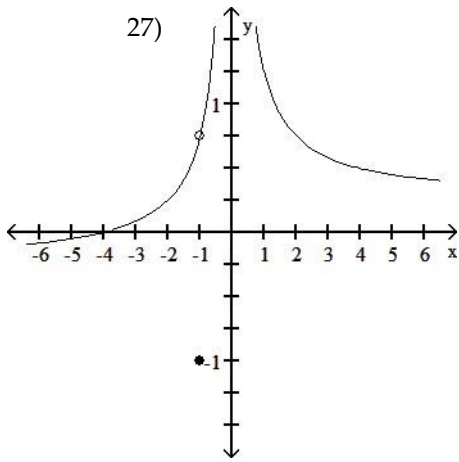
- A) About -30 deaths per year
C) About -0.4 deaths per year

- B) About -80 deaths per year
D) About -45 deaths per year

Answer: D

Use the graph to evaluate the limit.

27) $\lim_{x \rightarrow -1} f(x)$



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A) ∞

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

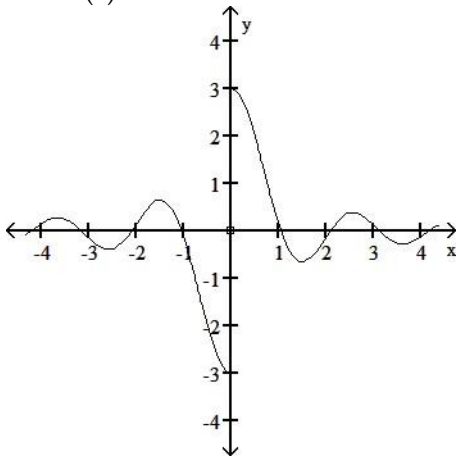
C) $\frac{3}{4}$

D) -1

Answer: B

28) $\lim_{x \rightarrow 0} f(x)$

28) _____



A) -3

B) 3

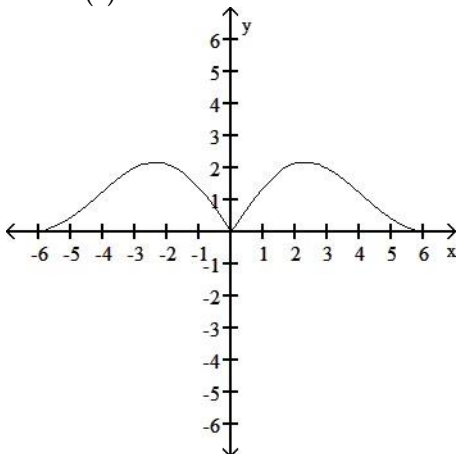
C) 0

D) does not exist

Answer: D

29) $\lim_{x \rightarrow 0} f(x)$

29) _____



A) 0

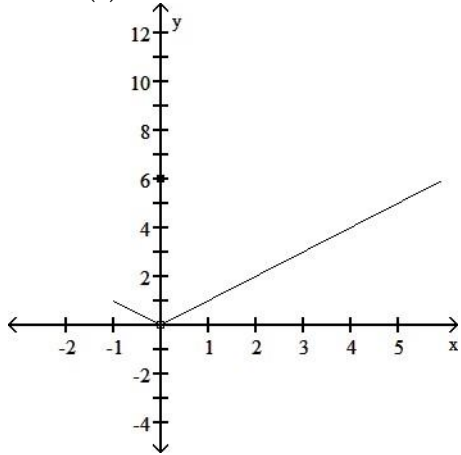
B) does not exist

C) -3

D) 3

Answer: A

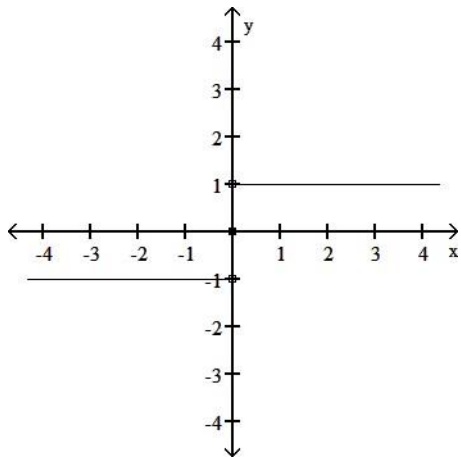
30) $\lim_{x \rightarrow 0} f(x)$



- A) does not exist B) -1 C) 6 D) 0
- Answer: D

30) _____

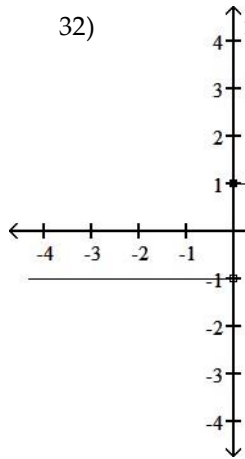
31) $\lim_{x \rightarrow 0} f(x)$



- A) ∞ B) does not exist C) -1 D) 1
- Answer: B

31) _____

32) $\lim_{x \rightarrow 0} f(x)$



32)

A) -1
Answer: B

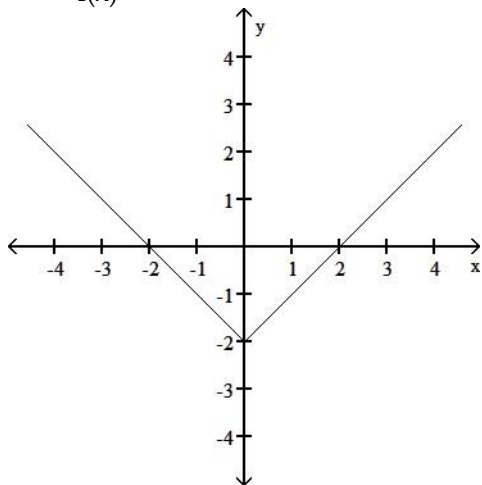
B) does not exist

C) 1

D) ∞

33) $\lim_{x \rightarrow 0} f(x)$

33) _____



A) 0
Answer: C

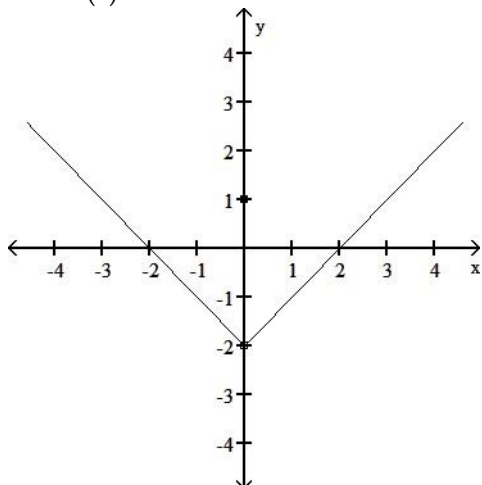
B) does not exist

C) -2

D) 2

34) $\lim_{x \rightarrow 0} f(x)$

34) _____



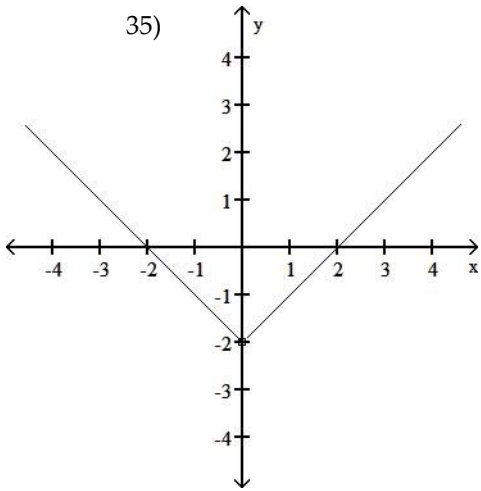
A) -2
Answer: A

B) 0

C) does not exist

D) 1

35) $\lim_{x \rightarrow 0} f(x)$

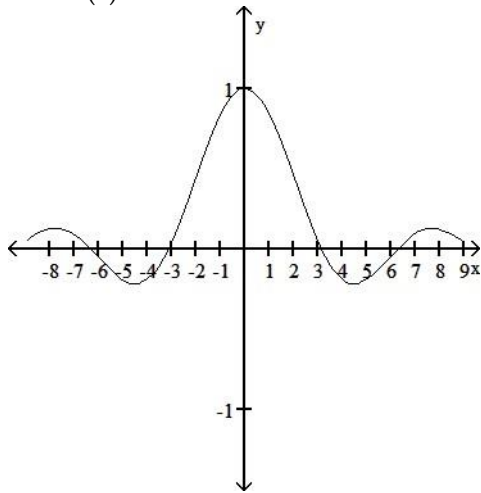


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- A) does not exist B) -1 C) 2 D) -2
 Answer: D

36) $\lim_{x \rightarrow 0} f(x)$

36) _____



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

Find the limit.

37) $\lim_{x \rightarrow 2} (5x + 5)$

37) _____

- A) 10 B) 5 C) -5 D) 15
 Answer: D

38) $\lim_{x \rightarrow 2} (x^2 + 8x - 2)$

38) _____

- A) 0 B) 18 C) does not exist D) -18
 Answer: B

39) $\lim_{x \rightarrow 0} (x^2 - 5)$

39) _____

- A) -5 B) does not exist C) 0 D) 5
 Answer: A

40) $\lim_{x \rightarrow 0} (\sqrt{x} - 2)$ 40) _____
 A) 2 B) 0 C) does not exist D) -2
 Answer: D

41) $\lim_{x \rightarrow 2} (x^3 + 5x^2 - 7x + 1)$ 41) _____
 A) does not exist B) 29 C) 15 D) 0
 Answer: C

42) $\lim_{x \rightarrow 2} (3x^5 - 2x^4 + 4x^3 + x^2 + 5)$ 42) _____
 A) 41 B) 169 C) 105 D) 57
 Answer: C

43) $\lim_{x \rightarrow 3} \sqrt{x^2 + 10x + 25}$ 43) _____
 A) 8 B) does not exist C) 64 D) ± 8
 Answer: A

44) $\lim_{x \rightarrow -1} \frac{x}{3x + 2}$ 44) _____
 A) 0 B) does not exist C) 1 D) $\frac{1}{5}$
 Answer: C

Find the limit if it exists.

45) $\lim_{x \rightarrow 14} \sqrt{3}$ 45) _____
 A) 14 B) $\sqrt{14}$ C) $\sqrt{3}$ D) 3
 Answer: C

46) $\lim_{x \rightarrow -2} (6x - 3)$ 46) _____
 A) 9 B) 15 C) -9 D) -15
 Answer: D

47) $\lim_{x \rightarrow -13} (29 - 4x)$ 47) _____
 A) 81 B) -81 C) -23 D) 23
 Answer: A

48) $\lim_{x \rightarrow 10} (6x^2 - 9x - 10)$ 48) _____
 A) 520 B) 500 C) 680 D) 700
 Answer: B

49) $\lim_{x \rightarrow 1} 3x(x + 7)(x - 2)$ 49) _____
 A) 18 B) 24 C) 72 D) -24
 Answer: D

50) $\lim_{x \rightarrow \frac{1}{5}} \frac{1}{5x \left(x - \frac{1}{7} \right)}$ 50) _____

A) $\frac{12}{35}$ B) $\frac{2}{35}$ C) $\frac{2}{7}$ D) $\frac{2}{175}$

Answer: B

51) $\lim_{x \rightarrow 256} x^{3/4}$ 51) _____

A) 192 B) 256 C) 64 D) $\frac{3}{4}$

Answer: C

52) $\lim_{x \rightarrow 2} (x+1)^2(x-3)^3$ 52) _____

A) -1 B) 1125 C) 125 D) -9

Answer: D

53) $\lim_{x \rightarrow 5} \sqrt{3x+72}$ 53) _____

A) $\sqrt{87}$ B) $-\sqrt{87}$ C) -87 D) 87

Answer: A

54) $\lim_{x \rightarrow -3} (x+11)^{1/3}$ 54) _____

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

Answer: A

Find the limit, if it exists.

55) $\lim_{x \rightarrow 15} \frac{1}{x-15}$ 55) _____

A) 0 B) Does not exist C) 15 D) 30

Answer: B

56) $\lim_{x \rightarrow 0} \frac{x^3 - 6x + 8}{x - 2}$ 56) _____

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

Answer: A

57) $\lim_{x \rightarrow 1} \frac{2x-7}{4x+5}$ 57) _____

A) $\frac{7}{5}$ B) $\frac{5}{9}$ C) $\frac{1}{2}$ D) Does not exist

Answer: B

58) $\lim_{x \rightarrow 1} \frac{3x^2 + 7x - 2}{3x^2 - 4x - 2}$ 58) _____

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

Answer: A

59) $\lim_{x \rightarrow 6} \frac{x+6}{(x-6)^2}$ 59) _____

- A) 6 B) Does not exist C) -6 D) 0
Answer: B

60) $\lim_{x \rightarrow 5} \frac{x^2 - 2x - 15}{x + 3}$ 60) _____

- A) Does not exist B) 5 C) 0 D) -8
Answer: C

61) $\lim_{h \rightarrow 0} \frac{2}{\sqrt{3h+4} + 2}$ 61) _____

- A) 1 B) Does not exist C) 2 D) 1/2
Answer: D

62) $\lim_{h \rightarrow 0} \frac{19x + h}{x^3(x-h)}$ 62) _____

- A) Does not exist B) 19x C) $\frac{19}{x^4}$ D) $\frac{19}{x^3}$

Answer: D

63) $\lim_{x \rightarrow 0} \frac{\sqrt{1+x} - 1}{x}$ 63) _____

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

64) $\lim_{h \rightarrow 0} \frac{(1+h)^{1/3} - 1}{h}$ 64) _____

- A) 1/3 B) 0 C) Does not exist D) 3
Answer: A

65) $\lim_{x \rightarrow 0} \frac{x^3 + 12x^2 - 5x}{5x}$ 65) _____

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

66) $\lim_{x \rightarrow 1} \frac{x^4 - 1}{x - 1}$ 66) _____

- A) Does not exist B) 2 C) 0 D) 4
Answer: D

67) $\lim_{x \rightarrow 10} \frac{x^2 - 100}{x - 10}$ 67) _____

- A) 10 B) 1 C) 20 D) Does not exist
Answer: C

68) $\lim_{x \rightarrow -4} \frac{x^2 + 13x + 36}{x + 4}$ 68) _____

A) 104
Answer: D

B) 13

C) Does not exist

D) 5

69) $\lim_{x \rightarrow 3} \frac{x^2 + 6x - 27}{x - 3}$

69) _____

A) 0
Answer: D

B) Does not exist

C) 6

D) 12

70) $\lim_{x \rightarrow 2} \frac{x^2 + 8x - 20}{x^2 - 4}$

70) _____

A) 3
Answer: A

B) 0

C) Does not exist

D) -2

71) $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x^2 - 5x + 6}$

71) _____

A) 0
Answer: C

B) Does not exist

C) 6

D) 3

72) $\lim_{x \rightarrow 2} \frac{x^2 + 5x - 14}{x^2 + 5x - 14}$

72) _____

A) -1

B) 1

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

D) Does not exist

Answer: B

73) $\lim_{h \rightarrow 0} \frac{(x+h)^3 - x^3}{h}$

73) _____

A) 0
Answer: B

B) $3x^2$

C) Does not exist

D) $3x^2 + 3xh + h^2$

74) $\lim_{x \rightarrow 9} \frac{|9-x|}{9-x}$

74) _____

A) 0
Answer: B

B) Does not exist

C) -1

D) 1

Find the limit.

75) $\lim_{x \rightarrow 0} (3 \sin x - 1)$

75) _____

A) $3 - 1$
Answer: D

B) -1

C) 3

D) 0

76) $\lim_{x \rightarrow -\pi} \sqrt{x+8} \cos(x+\pi)$

76) _____

A) 0
Answer: B

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

C) 1

D) $-\sqrt{8-\pi}$

77) $\lim_{x \rightarrow 0} \sqrt{3 + \cos^2 x}$

77) _____

A) 2
Answer: A

B) 4

C) 3

D) $\sqrt{3}$

$$\lim_{x \rightarrow -1} f(x) = 4.$$

Find

$$\lim_{x \rightarrow -1} \sqrt{f(x)}.$$

A) 1.4142

B) -1

C) 2

D) 4

Answer: C

84) $\lim_{x \rightarrow 6} f(x) = -4$ and $\lim_{x \rightarrow 6} g(x) = -9$. Find $\lim_{x \rightarrow 6} [f(x) + g(x)]^2$.

A) 169

B) -13

C) 97

D) 5

Answer: A

85) $\lim_{x \rightarrow 10} f(x) = 3$. Find $\lim_{x \rightarrow 10} (-3)f(x)$.

A) -27

B) 3

C) 59,049

D) -3

Answer: A

86) $\lim_{x \rightarrow 8} f(x) = 1024$. Find $\lim_{x \rightarrow 8} \sqrt[5]{f(x)}$.

A) 4

B) 5

C) 8

D) 1024

Answer: A

87) $\lim_{x \rightarrow 6} f(x) = -2$ and $\lim_{x \rightarrow 6} g(x) = 4$. Find $\lim_{x \rightarrow 6} \left[\frac{7f(x) - 7g(x)}{10 + g(x)} \right]$.

A) 1

B) 6

C) -3

D) $\frac{42}{5}$

Answer: C

Evaluate $\lim_{h \rightarrow 0} \frac{f(x_0 + h) - f(x_0)}{h}$ for the given x_0 and function f .

88) $f(x) = 5x^2$ for $x_0 = 3$

A) Does not exist

B) 30

C) 15

D) 45

Answer: B

89) $f(x) = 5x^2 - 3$ for $x_0 = 4$

A) 80

B) 40

C) 37

D) Does not exist

Answer: B

90) $f(x) = 2x + 5$ for $x_0 = 8$

A) 2

B) 16

C) 21

D) Does not exist

Answer: A

91) $f(x) = \frac{x}{2} + 3$ for $x_0 = 10$

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

B) Does not exist

C) 8

D) 5

Answer: A

Answer: A

- 92) $f(x) = \frac{4}{x}$ for $x_0 = -6$ 92) _____
A) $\frac{2}{3}$ B) 24 C) $\frac{1}{9}$ D) Does not exist

Answer: C

- 93) $f(x) = 3\sqrt{x}$ for $x_0 = 25$ 93) _____
A) Does not exist B) $\frac{3}{10}$ C) $\frac{15}{2}$ D) $\frac{75}{2}$

Answer: B

- 94) $f(x) = \sqrt{x}$ for $x_0 = 5$ 94) _____
A) Does not exist B) $\frac{\sqrt{5}}{10}$ C) $\frac{5}{2}$ D) $\frac{\sqrt{5}}{5}$

Answer: B

- 95) $f(x) = 3\sqrt{x} + 2$ for $x_0 = 4$ 95) _____
A) $\frac{3}{4}$ B) 6 C) Does not exist D) 3

Answer: A

Provide an appropriate response.

- 96) 96) _____
It can be shown that the inequalities $-x \leq x \cos\left(\frac{1}{x}\right) \leq x$ hold for all values of $x \geq 0$.
Find $\lim_{x \rightarrow 0} x \cos\left(\frac{1}{x}\right)$ if it exists.
A) does not exist B) 0 C) 1 D) 0.0007

Answer: B

- 97) 97) _____
The inequality $1 - \frac{x^2}{2} < \frac{\sin x}{x} < 1$ holds when x is measured in radians and $|x| < 1$.
Find $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ if it exists.
A) 0 B) 0.0007 C) does not exist D) 1

Answer: D

- 98) 98) _____
If $x^3 \leq f(x) \leq x$ for x in $[-1,1]$, find $\lim_{x \rightarrow 0} f(x)$ if it exists.
A) does not exist B) -1 C) 1 D) 0

Answer: D

Use a graphing calculator to graph f near x_0 and use Zoom and Trace to estimate the y -value on the graph as $x \rightarrow x_0$.

- 99) 99) _____
 $\lim_{x \rightarrow 3} \frac{x^2 - 9}{\sqrt{x^2 + 7} - 4}$
A) 8 B) 3 C) $\frac{1}{4}$ D) 4

Answer: A

100) $\lim_{x \rightarrow -1} \frac{x^2 - 1}{\sqrt{x^2 + 3} - 2}$

100) _____

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

Answer: B

101) $\lim_{x \rightarrow 2} \frac{x^2 + 3x + 2}{x^2 + 1x - 2}$

101) _____

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

Answer: A

102) $\lim_{x \rightarrow 2} \frac{x^2 - 4}{|x| - 2}$

102) _____

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

Answer: A

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

103) Let $f(x) = x^2 + 8x - 2$, find $\lim_{x \rightarrow 2} f(x)$.

103) _____

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)	16.810	17.880	17.988	18.012	18.120	19.210

 ; limit = 18.0

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 = ∞

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

Answer: B

104) Let $f(x) = \frac{x - 4}{\sqrt{x} - 2}$, find $\lim_{x \rightarrow 4} f(x)$.

104) _____

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)	3.97484	3.99750	3.99975	4.00025	4.00250	4.02485

 ; limit = 4.0

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

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 = 1.20

Answer: A

105)

Let $f(x) = x^2 - 5$, find $\lim_{x \rightarrow 0} f(x)$.

105) _____

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)	-1.4970	-1.4999	-1.5000	-1.5000	-1.4999	-1.4970

; limit = -15.0

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)	-4.9900	-4.9999	-5.0000	-5.0000	-4.9999	-4.9900

; limit = -5.0

Answer: D

106)

Let $f(x) = \frac{x-5}{x^2-2x-15}$, find $\lim_{x \rightarrow 5} f(x)$.

106) _____

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)	0.0266	0.0252	0.0250	0.0250	0.0248	0.0235

; limit = 0.025

B)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	0.1266	0.1252	0.1250	0.1250	0.1248	0.1235

; limit = 0.125

C)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	0.2266	0.2252	0.2250	0.2250	0.2248	0.2235

; limit = 0.225

D)

x	4.9	4.99	4.999	5.001	5.01	5.1
f(x)	-0.1266	-0.1252	-0.1250	-0.1250	-0.1248	-0.1235

; limit = -0.125

Answer: B

107)

Let $f(x) =$

$$\frac{x^2 + 7x + 10}{x^2 + 5x + 4}$$

, find
 $\lim_{x \rightarrow -4} f(x)$.

x	-4.1	-4.01	-4.001	-3.999	-3.99	-3.9
f(x)						

A)

x	-4.1	-4.01	-4.001	-3.999	-3.99	-3.9
f(x)	0.2548	0.2355	0.2336	0.2331	0.2311	0.2103

; limit = 0.2333

B)

x	-4.1	-4.01	-4.001	-3.999	-3.99	-3.9
f(x)	1.4082	1.4008	1.4001	1.3999	1.3992	1.3922

; limit = 1.4

C)

x	-4.1	-4.01	-4.001	-3.999	-3.99	-3.9
f(x)	0.4548	0.4355	0.4336	0.4331	0.4311	0.4103

; limit = 0.4333

D)

x	-4.1	-4.01	-4.001	-3.999	-3.99	-3.9
f(x)	0.3548	0.3355	0.3336	0.3331	0.3311	0.3103

; limit = 0.3333

Answer: D

108) Let $f(x) = \frac{\sin(7x)}{x}$, find $\lim_{x \rightarrow 0} f(x)$.

108) _____

x	-0.1	-0.01	-0.001	0.001	0.01	0.1
f(x)		6.99428473			6.99428473	

- A) limit = 0
 B) limit does not exist
 C) limit = 7
 D) limit = 6.5

Answer: C

109) Let $f(\theta) = \frac{\cos(8\theta)}{\theta}$, find $\lim_{\theta \rightarrow 0} f(\theta)$.

109) _____

x	-0.1	-0.01	-0.001	0.001	0.01	0.1
f(θ)	-6.9670671					6.9670671

- A) limit = 8
 B) limit = 0
 C) limit does not exist
 D) limit = 6.9670671

Answer: C

Provide an appropriate response.

110) If $\lim_{x \rightarrow 2} \frac{f(x) - 1}{x - 1} = 2$, find $\lim_{x \rightarrow 2} f(x)$.

110) _____

- A) 4
 B) 2
 C) 3
 D) Does not exist

Answer: C

111)

If

111) $\lim_{x \rightarrow 2} \frac{f(x)}{x} = 3$, find $\lim_{x \rightarrow 2} f(x)$ _____

- A) 3 B) 6 C) 2 D) Does not exist
 Answer: B

112) $\lim_{x \rightarrow 2} \frac{f(x)}{x^2} = 4$, find $\lim_{x \rightarrow 2} \frac{f(x)}{x}$ 112) _____
 A) 16 B) 2 C) 8 D) 4
 Answer: C

113) $\lim_{x \rightarrow 0} \frac{f(x)}{x} = 1$, find $\lim_{x \rightarrow 0} f(x)$ 113) _____
 A) 0 B) 2 C) 1 D) Does not exist
 Answer: A

114) $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = 1$, find $\lim_{x \rightarrow 0} \frac{f(x)}{x}$ 114) _____
 A) 1 B) 0 C) 2 D) Does not exist
 Answer: B

115) $\lim_{x \rightarrow 1} \frac{f(x) - 3}{x - 1} = 2$, find $\lim_{x \rightarrow 1} f(x)$ 115) _____
 A) 2 B) 1 C) 3 D) Does not exist
 Answer: C

116) Find $\lim_{x \rightarrow 0} \frac{\frac{1}{x+5} - \frac{1}{5}}{x}$ 116) _____
 A) $\frac{1}{25}$ B) $\frac{1}{25}$ C) 0 D) Does not exist
 Answer: B

Given the interval (a, b) on the x -axis with the point x_0 inside, find the greatest value for $\delta > 0$ such that for all x , $0 < |x - x_0| < \delta \Rightarrow a < x < b$.

117) $a = 7, b = 17, x_0 = 15$ 117) _____
 A) 4 B) 2 C) 8 D) 1
 Answer: B

118) $a = \frac{3}{9}, b = \frac{9}{9}, x_0 = \frac{4}{9}$ 118) _____
 A) $\delta = 1$ B) $\delta = \frac{5}{9}$ C) $\delta = 0$ D) $\delta = \frac{1}{9}$
 $\delta =$

Answer: D

119) $a = 1.442, b = 2.852, x_0 = 1.903$

A) $\delta = 0.461$

B) $\delta = 1.41$

C) $\delta = 0.949$

D) $\delta = 1$

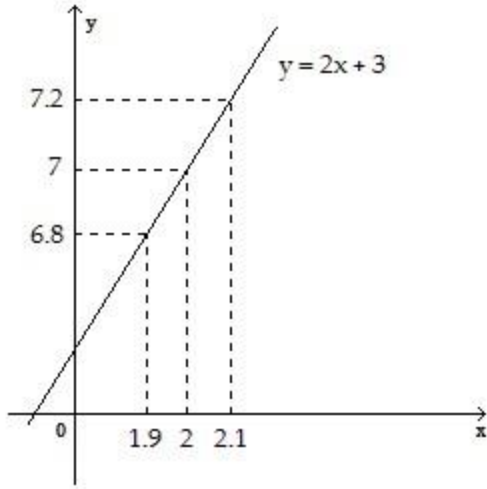
Answer: A

119) _____

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

120)

120) _____



$f(x) = 2x + 3$

$x_0 = 2$

$L = 7$

$\epsilon = 0.2$

A) 0.2

B) 0.4

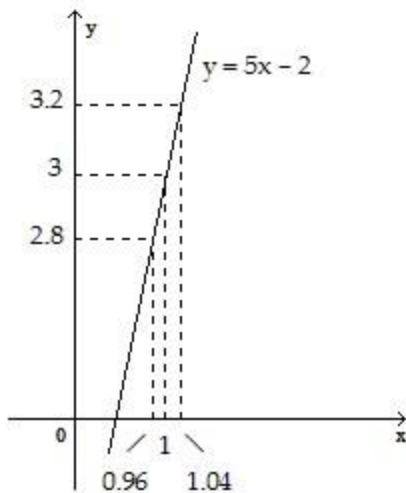
C) 5

D) 0.1

Answer: D

121)

121) _____



$f(x) = 5x - 2$

$x_0 = 1$

$L = 3$

$\epsilon = 0.2$

A) 0.04

B) 0.4

C) 0.08

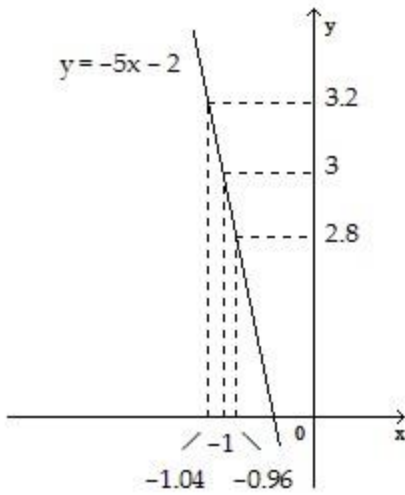
D) 2

Answer: A

122)

122)
 $f(x) = -5x - 2$
 $x_0 = -1$
 $L = 3$
 $\varepsilon = 0.2$

 -



NOT TO SCALE

A) 0.4
 Answer: C

B) -0.04

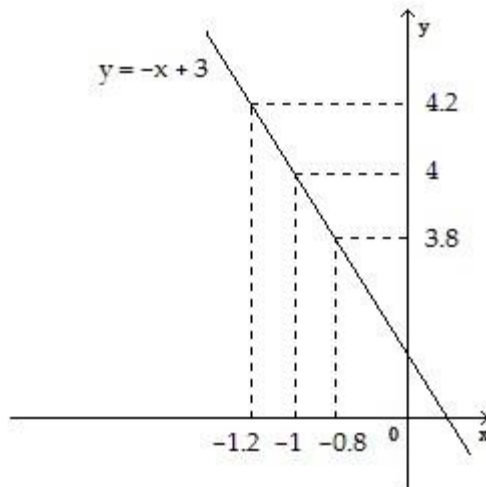
C) 0.04

D) 8

123)

123) ____

$f(x) = -x + 3$
 $x_0 = -1$
 $L = 4$
 $\varepsilon = 0.2$



NOT TO SCALE

A) 5

B) -0.2

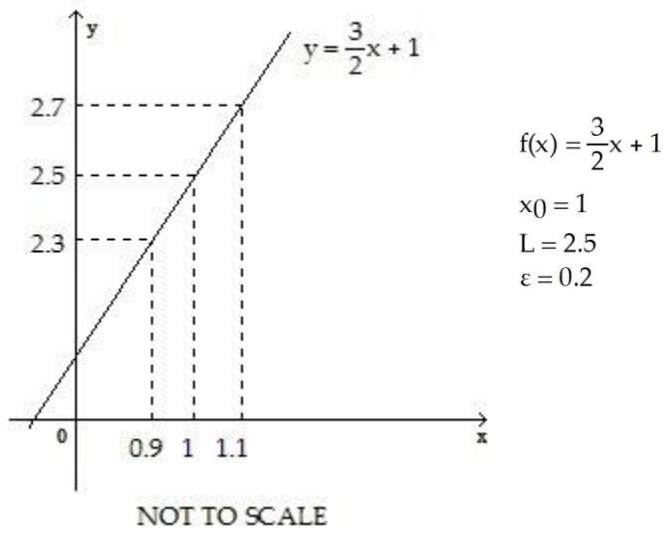
C) 0.2

D) 0.4

Answer: C

124)

124) _____



A) 1.5
Answer: B

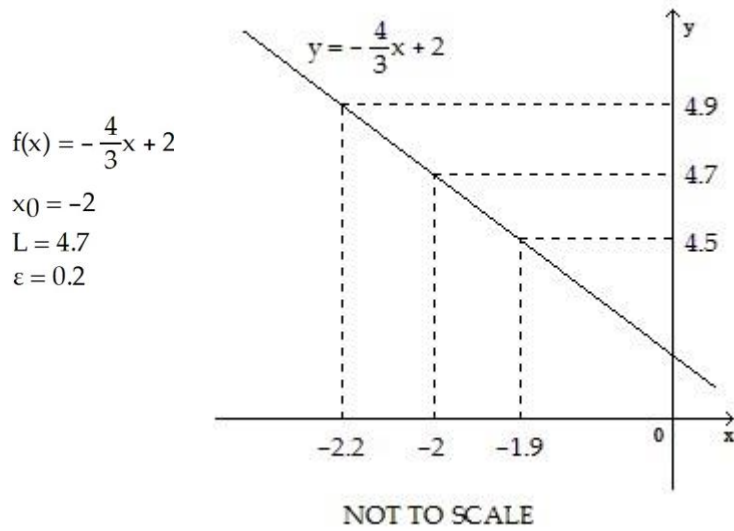
B) 0.1

C) -0.2

D) 0.2

125)

125) _____



A) 0.1
Answer: A

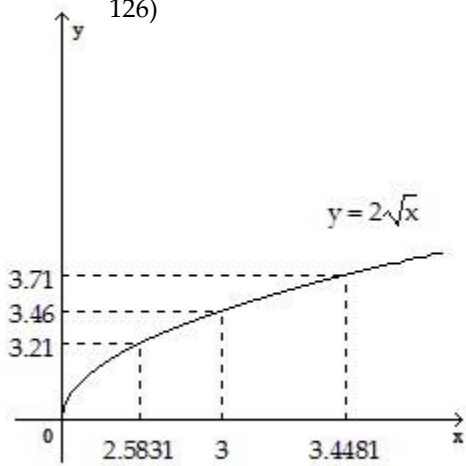
B) -0.3

C) 0.3

D) 6.7

126)

126)



NOT TO SCALE

$$f(x) = 2\sqrt{x}$$

$$x_0 = 3$$

$$L = 2\sqrt{3}$$

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

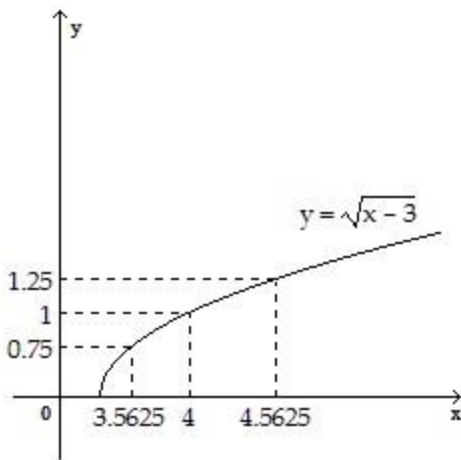
A) 0.865
Answer: D

B) 0.4481

C) 0.46

D) 0.4169

127)



NOT TO SCALE

$$f(x) = \sqrt{x-3}$$

$$x_0 = 4$$

$$L = 1$$

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

A) 0.5625
Answer: C

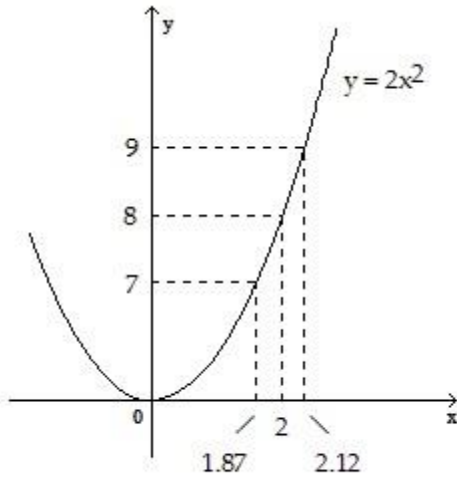
B) 3

C) 0.4375

D) 1

127) _____

128)



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

$$x_0 = 2$$

$$L = 8$$

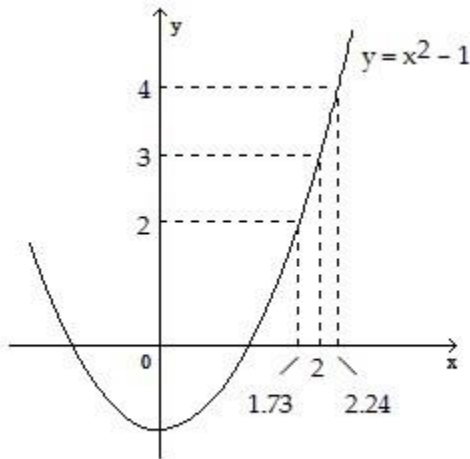
$$\epsilon = 1$$

NOT TO SCALE

- A) 6 B) 0.25 C) 0.13 D) 0.12
- Answer: D

128) _____

129)



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

$$x_0 = 2$$

$$L = 3$$

$$\epsilon = 1$$

NOT TO SCALE

- A) 0.24 B) 1 C) 0.27 D) 0.51
- Answer: A

129) _____

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 $\delta > 0$ such that for all x , $0 < |x - x_0| < \delta \Rightarrow |f(x) - L| < \epsilon$.

- 130) $f(x) = 10x + 7, L = 37, x_0 = 3$, and $\epsilon = 0.01$ 130) _____
- A) 0.003333 B) 0.005 C) 0.002 D) 0.001
- Answer: D

- 131) $f(x) = 7x - 9, L = 12, x_0 = 3$, and $\epsilon = 0.01$ 131) _____
- A) 0.002857 B) 0.003333 C) 0.000714 D) 0.001429
- Answer: D

132) $f(x) = -9x + 8, L = -10, x_0 = 2, \text{ and } \varepsilon = 0.01$ 132) _____
 A) 0.002222 B) 0.001111 C) -0.005 D) 0.004444
 Answer: B

133) $f(x) = -2x - 8, L = -16, x_0 = 4, \text{ and } \varepsilon = 0.01$ 133) _____
 A) 0.0025 B) 0.005 C) -0.0025 D) 0.01
 Answer: B

134) $f(x) = \sqrt{x+2}, L = 2, x_0 = 2, \text{ and } \varepsilon = 1$ 134) _____
 A) 5 B) 1 C) 3 D) 9
 Answer: C

135) $f(x) = \sqrt{8-x}, L = 2, x_0 = 4, \text{ and } \varepsilon = 1$ 135) _____
 A) 3 B) 4 C) 7 D) -5
 Answer: A

136) $f(x) = 5x^2, L = 245, x_0 = 7, \text{ and } \varepsilon = 0.3$ 136) _____
 A) 0.00429 B) 6.99571 C) 0.00428 D) 7.00428
 Answer: C

137) $f(x) = 1/x, L = 1/8, x_0 = 8, \text{ and } \varepsilon = 0.4$ 137) _____
 A) 6.0952 B) 0.7619 C) -29.0909 D) -11.6364
 Answer: A

138) $f(x) = mx, m > 0, L = 6m, x_0 = 6, \text{ and } \varepsilon = 0.06$ 138) _____
 A) $\frac{0.06}{m}$ B) $\delta = 0.06$ C) $\frac{0.06}{6 + m}$ D) $\delta = 6 - m$
 $\delta = \frac{0.06}{m}$
 Answer: A

139) $f(x) = mx + b, m > 0, L = (m/7) + b, x_0 = 1/7, \text{ and } \varepsilon = c > 0$ 139) _____
 A) $\frac{c}{m}$ B) $\frac{1}{7} + \frac{c}{m}$ C) $\frac{7}{m}$ D) $\frac{c}{7}$
 $\delta = \frac{c}{m}$ $\delta = \frac{1}{7} + \frac{c}{m}$ $\delta = \frac{7}{m}$ $\delta = \frac{c}{7}$
 Answer: A

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

140) $f(x) = -2x + 4, x_0 = -5, \varepsilon = 0.06$ 140) _____
 A) $L = 14; \delta = 0.03$ B) $L = -6; \delta = 0.04$ C) $L = 14; \delta = 0.04$ D) $L = 6; \delta = 0.03$
 Answer: A

141) $f(x) = \frac{x^2 + -1x + -72}{x + -9}, x_0 = 9, \varepsilon = 0.04$ 141) _____
 A) $L = -1; \delta = 0.05$ B) $L = 0; \delta = 0.04$
 C) $L = 16; \delta = 0.05$ D) $L = 17; \delta = 0.04$
 Answer: D

142) $f(x) = \sqrt{115 - 5x}$

$$x_0 = 142)$$

$$3, \epsilon =$$

$$0.5$$

$$A) L = 10; \delta = 1.95$$

$$B) L = 11; \delta = 1.95$$

$$C) L = 9; \delta = 0.95$$

$$D) L = 10; \delta = 2.05$$

Answer: A

$$143) \frac{28}{x}$$

$$f(x) = \frac{28}{x}, x_0 = 7, \epsilon = 0.3$$

$$A) L = 4; \delta = 0.57$$

$$B) L = 4; \delta = 5.68$$

$$C) L = 4; \delta = 0.49$$

$$D) L = 4; \delta = 1.14$$

Answer: A

143) _____

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

Prove the limit statement

$$144) \lim_{x \rightarrow 3} (3x - 4) = 5$$

144) _____

Answer:

Let $\epsilon > 0$ be given. Choose $\delta = \epsilon/3$. Then $0 < |x - 3| < \delta$ implies that

$$\begin{aligned} |(3x - 4) - 5| &= |3x - 9| \\ &= |3(x - 3)| \\ &= 3|x - 3| < 3\delta = \epsilon \end{aligned}$$

Thus, $0 < |x - 3| < \delta$ implies that $|(3x - 4) - 5| < \epsilon$

$$145) \lim_{x \rightarrow 5} \frac{x^2 - 25}{x - 5} = 10$$

145) _____

Answer: Let $\epsilon > 0$ be given. Choose $\delta = \epsilon$. Then $0 < |x - 5| < \delta$ implies that

$$\begin{aligned} \left| \frac{x^2 - 25}{x - 5} - 10 \right| &= \left| \frac{(x - 5)(x + 5)}{x - 5} - 10 \right| \\ &= |x + 5 - 10| \quad \text{for } x \neq 5 \\ &= |x - 5| < \delta = \epsilon \end{aligned}$$

Thus, $0 < |x - 5| < \delta$ implies that $\left| \frac{x^2 - 25}{x - 5} - 10 \right| < \epsilon$

$$146) \lim_{x \rightarrow 3} \frac{3x^2 - 8x - 3}{x - 3} = 10$$

146) _____

Answer: Let $\epsilon > 0$ be given. Choose $\delta = \epsilon/3$. Then $0 < |x - 3| < \delta$ implies that

$$\begin{aligned} \left| \frac{3x^2 - 8x - 3}{x - 3} - 10 \right| &= \left| \frac{(x - 3)(3x + 1)}{x - 3} - 10 \right| \\ &= |(3x + 1) - 10| \quad \text{for } x \neq 3 \\ &= |3x - 9| \\ &= |3(x - 3)| \\ &= 3|x - 3| < 3\delta = \epsilon \end{aligned}$$

Thus, $0 < |x - 3| < \delta$ implies that $\left| \frac{3x^2 - 8x - 3}{x - 3} - 10 \right| < \epsilon$

$$147) \lim_{x \rightarrow 9} \frac{1}{x} = \frac{1}{9}$$

147) _____

Answer:

Let $\varepsilon > 0$ be given. Choose $\delta = \min\left\{\frac{1}{x} - \frac{1}{9}, \left|\frac{9-x}{9x}\right|\right\}$. Then $0 < |x-9| < \delta$ implies that

$$\begin{aligned} \left|\frac{1}{x} - \frac{1}{9}\right| &= \left|\frac{9-x}{9x}\right| \\ &= \frac{1}{|x|} \cdot \frac{1}{9} \cdot |x-9| \\ &< \frac{1}{9/2} \cdot \frac{1}{9} \cdot \frac{81\varepsilon}{2} = \varepsilon \end{aligned}$$

Thus, $0 < |x-9| < \delta$ implies that $\left|\frac{1}{x} - \frac{1}{9}\right| < \varepsilon$

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

- 148) You are asked to make some circular cylinders, each with a cross-sectional area of 2 cm^2 . To do this, you need to know how much deviation from the ideal cylinder diameter of $x_0 = 4.37 \text{ cm}$ you can allow and still have the area come within 0.1 cm^2 of the required 2 cm^2 . To find out, let $A = \pi\left(\frac{x}{2}\right)^2$ and look for the interval in which you must hold x to make $|A - 2| < 0.1$. What interval do you find? 148) _____

- A) $(0.5642, 0.5642)$ B) $(1.5554, 1.6352)$ C) $(1.0998, 1.1562)$ D) $(2.7568, 2.8983)$

Answer: B

- 149) Ohm's Law for electrical circuits is stated $V = RI$, where V is a constant voltage, R is the resistance in ohms and I is the current in amperes. Your firm has been asked to supply the resistors for a circuit in which V will be 10 volts and I is to be 5 ± 0.1 amperes. In what interval does R have to lie for I to be within 0.1 amps of the target value $I_0 = 5$? 149) _____

- A) $\left(\frac{10}{49}, \frac{10}{51}\right)$ B) $\left(\frac{100}{49}, \frac{100}{51}\right)$ C) $\left(\frac{100}{51}, \frac{100}{49}\right)$ D) $\left(\frac{51}{100}, \frac{49}{100}\right)$

Answer: C

- 150) The cross-sectional area of a cylinder is given by $A = \pi D^2/4$, where D is the cylinder diameter. Find the tolerance range of D such that $|A - 10| < 0.01$ as long as $D_{\min} < D < D_{\max}$. 150) _____

- A) $D_{\min} = 3.558, D_{\max} = 3.570$ B) $D_{\min} = 3.558, D_{\max} = 3.578$
 C) $D_{\min} = 3.567, D_{\max} = 3.578$ D) $D_{\min} = 3.567, D_{\max} = 3.570$

Answer: D

- 151) The current in a simple electrical circuit is given by $I = V/R$, where I is the current in amperes, V is the voltage in volts, and R is the resistance in ohms. When $V = 12$ volts, what is a 12Ω resistor's tolerance for the current to be within 1 ± 0.01 amp? 151) _____

- A) 0.1% B) 10% C) 0.01% D) 1%

Answer: D

- 152) Select the correct statement for the definition of the limit: $\lim_{x \rightarrow x_0} f(x) = L$ 152) _____

means that _____

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

$0 < |x - x_0| < \delta$ implies $|f(x) - L| > \varepsilon$.

Answer: A

153) Identify the incorrect statements about limits.

153) _____

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 $\delta > 0$ such 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 for which $|f(x) - L| < \varepsilon$.

A) II and III

B) I and III

C) I and II

D) I, II, and III

Answer: B

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

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

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

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

$$\begin{aligned} |(3x - 4) - 5| &= |3x - 9| \\ &= |3(x - 3)| \\ &= 3|x - 3| < 3\delta = \varepsilon \end{aligned}$$

Thus, $0 < |x - 3| < \delta$ implies that $|(3x - 4) - 5| < \varepsilon$

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

$$\begin{aligned} \left| \frac{x^2 - 25}{x - 5} - 10 \right| &= \left| \frac{(x - 5)(x + 5)}{x - 5} - 10 \right| \\ &= |(x + 5) - 10| \quad \text{for } x \neq 5 \\ &= |x - 5| < \delta = \varepsilon \end{aligned}$$

Thus $0 < |x-5| < \delta$ implies that $\left| \frac{x^2 - 25}{x - 5} - 10 \right| < \varepsilon$

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

$$\begin{aligned} \left| \frac{3x^2 - 8x - 3}{x - 3} - 10 \right| &= \left| \frac{(x-3)(3x+1)}{x-3} - 10 \right| \\ &= |(3x+1) - 10| \quad \text{for } x \neq 3 \\ &= |3x - 9| \\ &= |3(x-3)| \\ &= 3|x-3| < 3\delta = \varepsilon \end{aligned}$$

Thus, $0 < |x-3| < \delta$ implies that $\left| \frac{3x^2 - 8x - 3}{x - 3} - 10 \right| < \varepsilon$

147) Let $\varepsilon > 0$ be given. Choose $\delta = \min\{9/2, 81\varepsilon/2\}$. Then $0 < |x-9| < \delta$ implies that

$$\begin{aligned} \left| \frac{1}{x} - \frac{1}{9} \right| &= \left| \frac{9-x}{9x} \right| \\ &= \frac{1}{|x|} \cdot \frac{1}{9} \cdot |x-9| \\ &< \frac{1}{9/2} \cdot \frac{1}{9} \cdot \frac{81\varepsilon}{2} = \varepsilon \end{aligned}$$

Thus, $0 < |x-9| < \delta$ implies that $\left| \frac{1}{x} - \frac{1}{9} \right| < \varepsilon$

148) B

149) C

150) D

151) D

152) A

153) B