**Determine the limit by substitution.**

1) $\lim_{x \to 0} (x^2 - 5)$

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

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

4) $\lim_{x \to 8} \frac{x^2 + 64}{x + 8}$

5) $\lim_{x \to 5} \sqrt{x^2 + 14x + 49}$

6) $\lim_{x \to 1} (x^2 - 4x)^3$

**Determine the limit algebraically, if it exists.**

7) $\lim_{x \to 4} \sqrt{x - 6}$

8) $\lim_{x \to 6} \frac{x + 6}{(x - 6)^2}$

9) $\lim_{x \to 7} \frac{|7 - x|}{7 - x}$

10) $\lim_{x \to -6} \frac{x^2 - 36}{x + 6}$

11) $\lim_{x \to -10} \frac{x^2 + 15x + 50}{x + 10}$

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

13) $\lim_{x \to 2} \frac{x^2 + 6x - 16}{x - 2}$

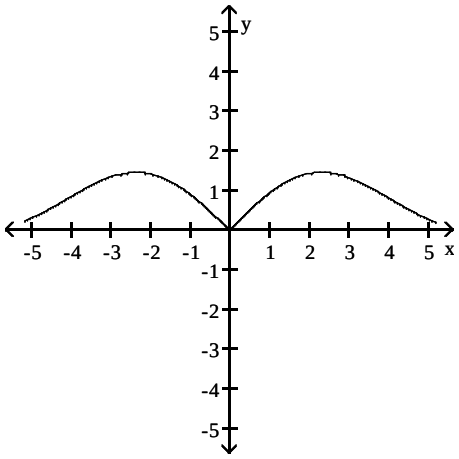
14) $\lim_{x \to 5} \dfrac{x^2 + 4x - 45}{x^2 - 25}$

15) $\lim_{x \to 0} \dfrac{\dfrac{1}{x+8} - \dfrac{1}{8}}{x}$

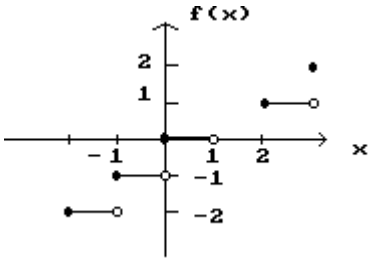
16) $\lim_{x \to 0} \dfrac{10 \sin x}{6x}$

**Determine the limit graphically, if it exists.**

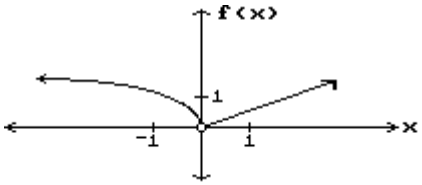
17) $\lim_{x \to 0} f(x)$



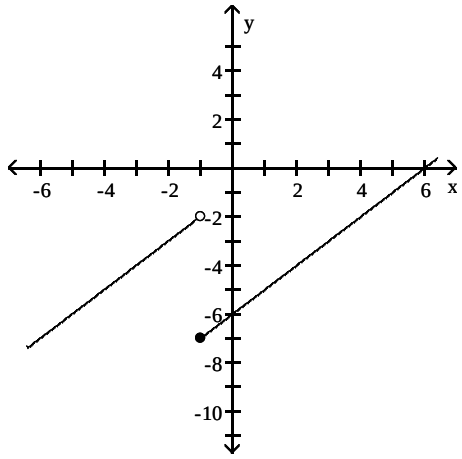

18) $\lim_{x \to -1/2} f(x)$



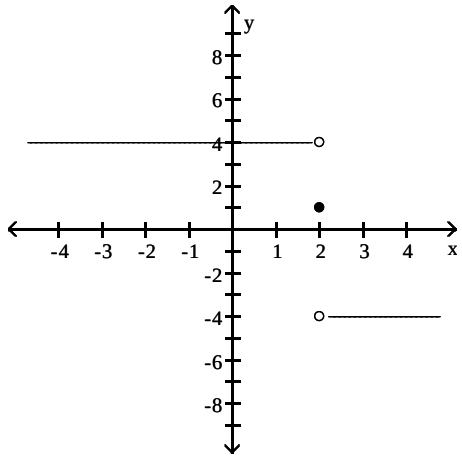

19) $\lim_{x \to 0} f(x)$



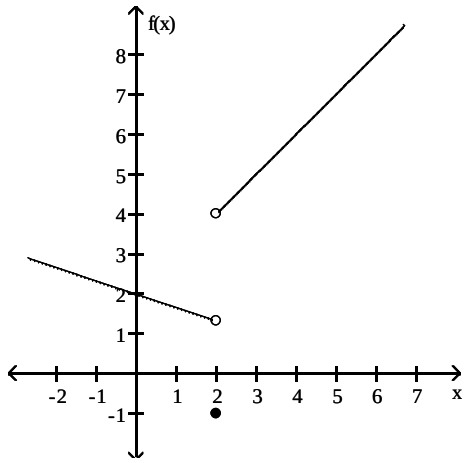
20) Find $\lim_{x\to -1^-} f(x)$ and $\lim_{x\to -1^+} f(x)$.



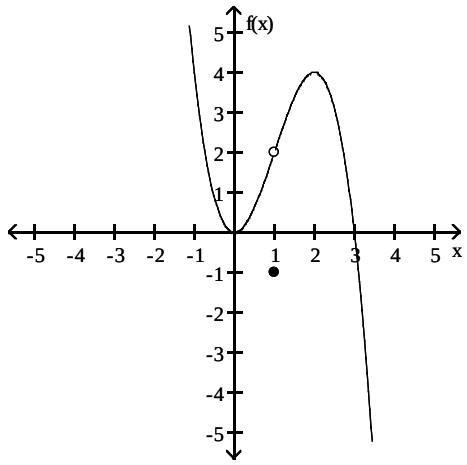

21) Find $\lim_{x\to 2^-} f(x)$ and $\lim_{x\to 2^+} f(x)$.



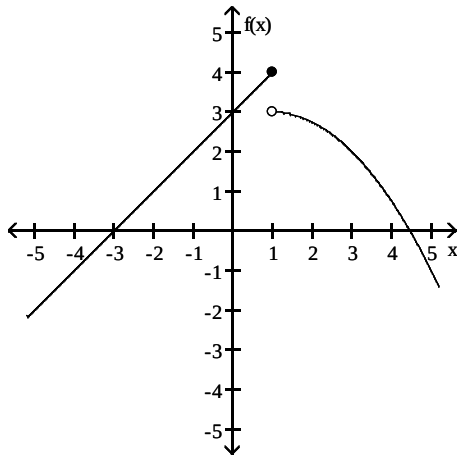

22) $\lim_{x\to 2^-} f(x)$



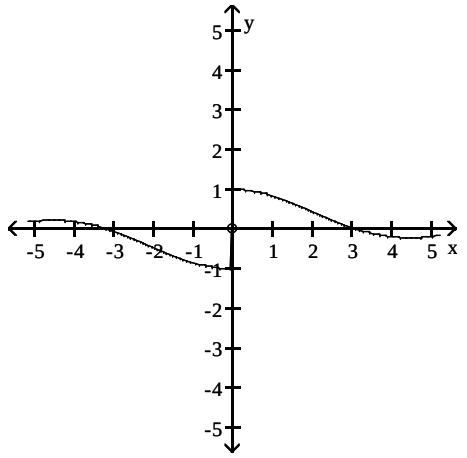
23) $\lim_{x \to 1^-} f(x)$



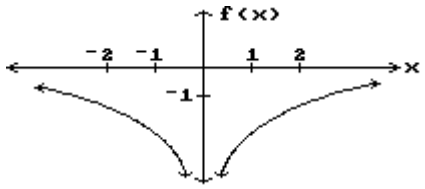

24) $\lim_{x \to 1^+} f(x)$




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



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




**Find the indicated limit.**

27) $\lim_{x \to 4^-} \text{int } x$

28) $\lim_{x \to -8^+} \text{int } x$

29) $\lim_{x \to 0^+} \frac{8x}{|x|}$

30) $\lim_{x \to 0^-} \frac{8x}{|x|}$

**Match the function with the correct table values.**

31) $f(x) = x^2 + 8x - 2$

| x | 1.9 | 1.99 | 1.999 | 2.001 | 2.01 | 2.1 |
|---|---|---|---|---|---|---|
| f(x) | | | | | | |

32) $f(x) = \frac{x^4 - 1}{x - 1}$

| x | 0.9 | 0.99 | 0.999 | 1.001 | 1.01 | 1.1 |
|---|---|---|---|---|---|---|
| f(x) | | | | | | |

33) $f(x) = \frac{x^3 - 6x + 8}{x - 2}$

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

34) $f(x) = \frac{x - 4}{\sqrt{x} - 2}$

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

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

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

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

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

37) $f(x) = \dfrac{x^2 - 16}{x - 4}$

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

38) $f(x) = \dfrac{x + 2}{x^2 - 2x - 8}$

| x | −2.1 | −2.01 | −2.001 | −1.999 | −1.99 | −1.9 |
|---|---|---|---|---|---|---|
| f(x) | | | | | | |

39) $f(x) = \dfrac{x^2 - 3x - 4}{x^2 - 2x - 8}$

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

**Find the limit.**

40) Let $\lim_{x \to 3} f(x) = -4$ and $\lim_{x \to 3} g(x) = 9$. Find $\lim_{x \to 3} [f(x) - g(x)]$.

41) Let $\lim_{x \to 8} f(x) = -7$ and $\lim_{x \to 8} g(x) = -6$. Find $\lim_{x \to 8} [f(x) \cdot g(x)]$.

42) Let $\lim_{x \to 9} f(x) = 10$ and $\lim_{x \to 9} g(x) = -1$. Find $\lim_{x \to 9} \dfrac{f(x)}{g(x)}$.

43) Let $\lim_{x \to 9} f(x) = 100$. Find $\lim_{x \to 9} \sqrt{f(x)}$.

44) Let $\lim_{x \to 5} f(x) = -4$ and $\lim_{x \to 5} g(x) = 9$. Find $\lim_{x \to 5} [f(x) + g(x)]^2$.

45) Let $\lim_{x \to -5} f(x) = -7$ and $\lim_{x \to -5} g(x) = 9$. Find $\lim_{x \to -5} \dfrac{-5f(x) - 9g(x)}{-5 + g(x)}$.

46) Let $\lim_{x \to -6} f(x) = -10$ and $\lim_{x \to -6} g(x) = 7$. Find $\lim_{x \to -6} \frac{[f(x)]^2}{-3 + g(x)}$.

**Evaluate or determine that the limit does not exist for each of the limits (a) $\lim_{x \to d-} f(x)$, (b) $\lim_{x \to d+} f(x)$, and (c) $\lim_{x \to d} f(x)$ for the given function f and number d.**

47)

$$f(x) = \begin{cases} x^2 - 2, & \text{for } x < 0, \\ 1, & \text{for } x \geq 0 \end{cases}$$

$d = -4$

48)

$$f(x) = \begin{cases} -4x - 3, & \text{for } x < 1, \\ 1, & \text{for } x = 1, \\ -2x - 3, & \text{for } x > 1 \end{cases}$$

$d = 1$

49)

$$f(x) = \begin{cases} -5x - 1, & \text{for } x \leq 1, \\ -7x + 1, & \text{for } x > 1 \end{cases}$$

$d = 1$

50)

$$f(x) = \begin{cases} \frac{1}{x - 3}, & \text{for } x > 3, \\ x^2 - 4x, & \text{for } x \leq 3 \end{cases}$$

$d = 3$

**Find the limit, if it exists.**

51) $\lim_{x \to \infty} \frac{x^2 - 4x + 14}{x^3 + 9x^2 + 5}$

52) $\lim_{x \to -\infty} \frac{-8x^2 + 9x + 5}{-15x^2 + 7x + 14}$

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

54) $\lim_{x \to \infty} \frac{7x^3 - 3x^2 + 3x}{-x^3 - 2x + 7}$

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

56) $\lim_{x \to -\infty} \dfrac{-6 + (2/x)}{7 - (1/x^2)}$

57) $\lim_{x \to -\infty} \dfrac{\cos 3x}{x}$

58) $\lim_{x \to \infty} \dfrac{-5\sqrt{x} + x^{-1}}{-4x + 2}$

59) $\lim_{x \to \infty} \dfrac{3x^{-1} + -2x^{-3}}{3x^{-2} + x^{-5}}$

60) $\lim_{x \to -\infty} \dfrac{\sqrt[3]{x} + 5x + -5}{3x + x^{2/3} + -4}$

**Find the limit.**

61) $\lim_{x \to (-2)^-} \dfrac{1}{x + 2}$

62) $\lim_{x \to (-2)^+} \dfrac{1}{x + 2}$

63) $\lim_{x \to -2} \dfrac{1}{x + 2}$

64) $\lim_{x \to 0} \dfrac{1}{x^{2/3}}$

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

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

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

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

**Find the vertical asymptotes of the graph of f(x).**

69) $f(x) = \frac{1}{x - 8}$

70) $f(x) = \frac{x}{x - 9}$

71) $f(x) = \frac{x}{x + 8}$

72) $f(x) = \frac{1}{(x - 6)^2}$

73) $f(x) = \frac{1}{x^2 - 16}$

74) $f(x) = \cot x$

75) $f(x) = \tan x$

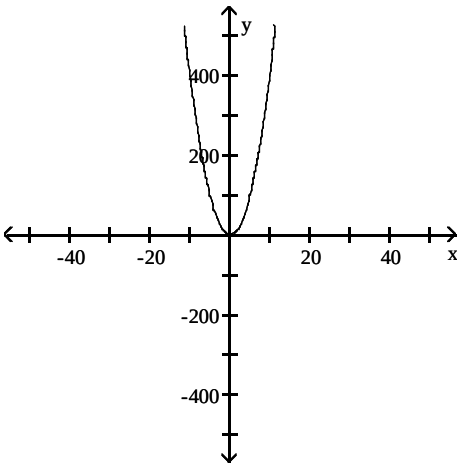
76) $f(x) = \sec x$

77) $f(x) = \csc x$

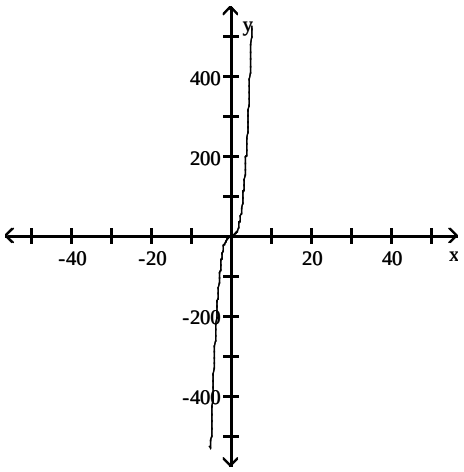
**Match the function with the graph of its end behavior model.**

78) $y = \dfrac{4x^3 + 2x^2 + 1}{x + 5}$

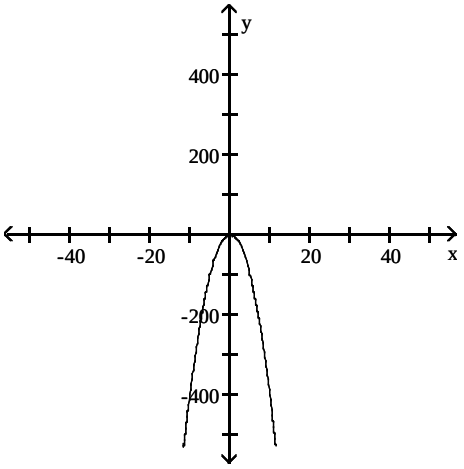
A)



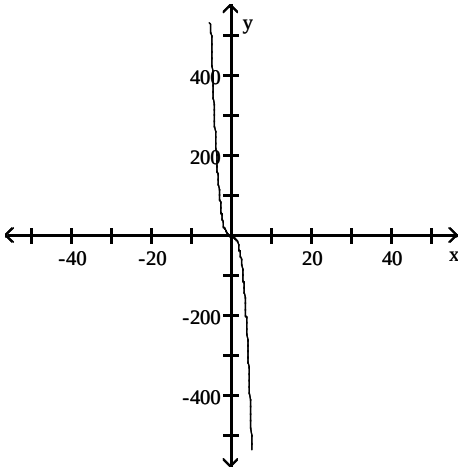

B)




C)

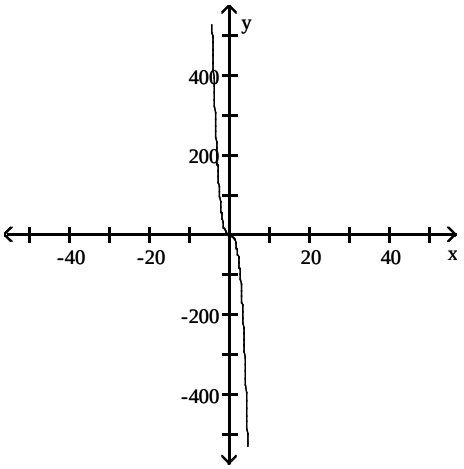



D)

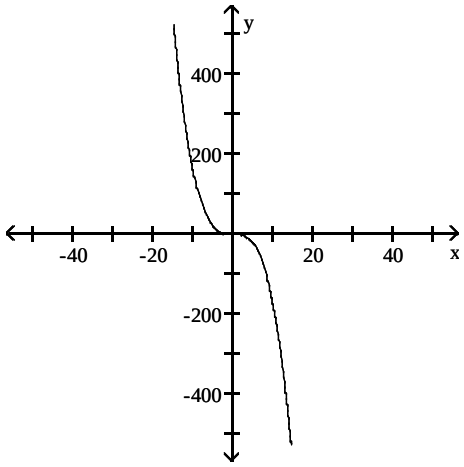


79) $y = \dfrac{x^5 - x^4 + x^2 + 1}{6x^2 + 4}$

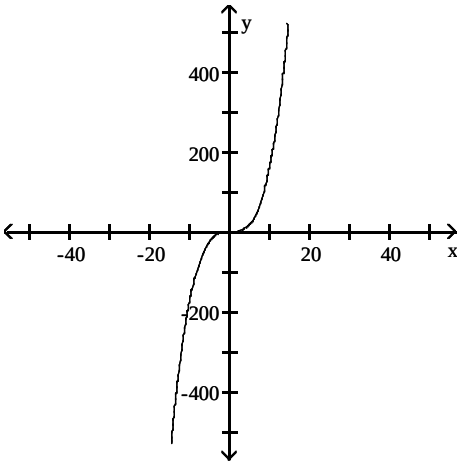
A)



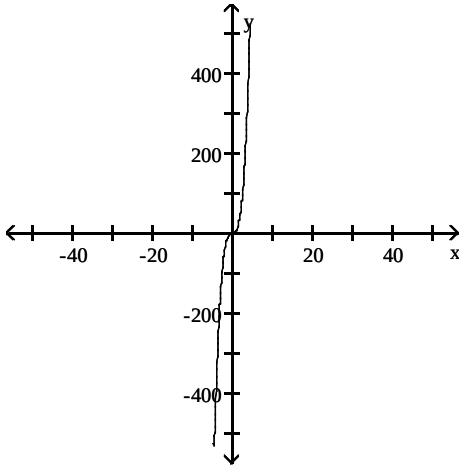

B)




C)




D)




**Find a power function end behavior model.**

80) $y = 5x^2 - 7x + 2$

81) $y = \dfrac{3x^2 + x - 1}{x^3 - 8x^2}$

**Find a simple basic function as a right–end behavior model and a simple basic function as a left–end behavior model.**

82) $y = e^x + 3x$

83) $y = e^{-x} + 4x$

84) $y = \dfrac{x^2}{5} + e^x$

85) $y = \frac{x^2}{5} - e^x$

86) $y = 4x + \ln|x|$

87) $y = 7x^2 - 7 \sin x$

88) $y = -7x^2 - 7 \cos x$

**Find the intervals on which the function is continuous.**

89) $y = \frac{4}{(x + 3)^2 + 6}$

90) $y = \frac{x + 4}{x^2 - 12x + 32}$

91) $y = \sqrt{5x + 1}$

92) $y = \sqrt[4]{10x - 1}$

93) $y = e^{1/x}$

94) $y = \ln(2x - 9)$

95) $y = \cot x$

**Find the points of discontinuity. Identify each type of discontinuity.**

96) $y = \frac{2}{(x + 1)^2 + 2}$

97) $y = \frac{x + 5}{x^2 - 12x + 35}$

98) $y = \sqrt{6x + 3}$

99) $y = \sqrt[4]{6x - 6}$

100) $y = e^{1/x}$

101) $y = \ln(2x - 3)$

102) $y = \cot x$

**Find all points where the function is discontinuous.**

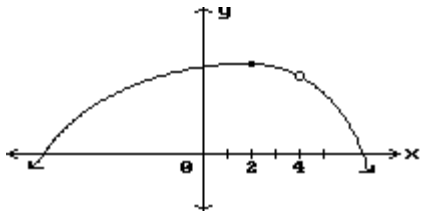
103) $f(x) = \begin{cases} 0, & x < 0 \\ x^2 - 7x, & 0 \le x \le 7 \\ 7, & x > 7 \end{cases}$

104) $f(x) = \begin{cases} \dfrac{x^2 - 1}{x + 1}, & x \ne -1 \\ 2, & x = -1 \end{cases}$

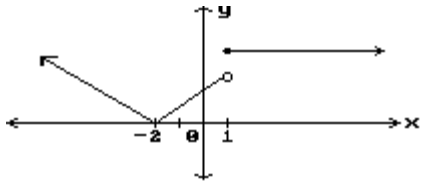
105) $f(x) = \begin{cases} \dfrac{x(x^2 - 4)}{x + 2}, & x \ne -2 \\ -3, & x = -2 \end{cases}$

106) $f(x) = \begin{cases} 4, & x = 1, \\ \dfrac{1}{2}x^2 - 2.5, & x \ne 1; \end{cases}$

107)

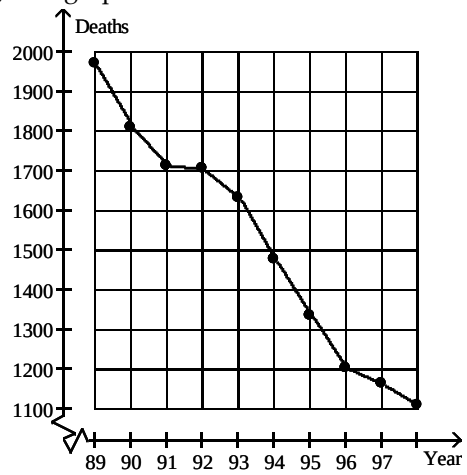



108)



**Solve the problem.**

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




Estimate the average rate of change in tuberculosis deaths from 1991 to 1996.

**Find the slope of the line tangent to the curve at the given value of x.**

110) $f(x) = \begin{cases} 8 + x & x \le 6 \\ -x - 4 & x > 6 \end{cases}$ at $x = 6$

**Find the equation for the tangent to the curve at the given point.**

111) $f(x) = -8 - x^2$ at $x = 7$

1) –5
2) 15
3) –4
4) 8
5) 12
6) –27
7) Does not exist
8) Does not exist
9) Does not exist
10) –12
11) –5
12) –1
13) 10
14) $\frac{7}{5}$
15) $-\frac{1}{64}$
16) $\frac{5}{3}$
17) 0
18) –1
19) 0
20) –2; –7
21) 4; –4
22) 1.3
23) 2
24) 3
25) Does not exist
26) Does not exist
27) 3
28) –8
29) 8
30) –8
31) 16.810; 17.880; 17.988; 18.012; 18.120; 19.210
32) 3.439; 3.940; 3.994; 4.006; 4.060; 4.641
33) –4.09476; –4.00995; –4.00100; –3.99900; –3.98995; –3.89526
34) 3.97484; 3.99750; 3.99975; 4.00025; 4.00250; 4.02485
35) –4.9900; –4.9999; –5.0000; –5.0000; –4.9999; –4.9900
36) –0.02516; –0.00250; –0.00025; 0.00025; 0.00250; 0.02485
37) 7.9000; 7.9900; 7.9990; 8.0010; 8.0100; 8.1000
38) –0.1639; –0.1664; –0.1666; –0.1667; –0.1669; –0.1695
39) 0.8305; 0.8331; 0.8333; 0.8334; 0.8336; 0.8361
40) –13
41) 42
42) – 10
43) 10
44) 25
45) $-\frac{23}{2}$

46) 25
47) (a) 14
(b) 14
(c) 14
48) (a) –7
(b) –5
(c) Does not exist
49) (a) –6
(b) –6
(c) –6
50) (a) –3
(b) Does not exist
(c) Does not exist
51) 0
52) $\frac{8}{15}$
53) $\frac{3}{11}$
54) –7
55) $\infty$
56) $-\frac{6}{7}$
57) 0
58) 0
59) $\infty$
60) $\frac{5}{3}$
61) $-\infty$
62) $\infty$
63) Does not exist
64) $\infty$
65) $-\infty$
66) $\infty$
67) $\infty$
68) Does not exist
69) $x = 8$
70) $x = 9$
71) $x = -8$
72) $x = 6$
73) $x = -4$ and $x = 4$
74) $x = n\pi$, n is any integer
75) $x = \frac{\pi}{2} + n\pi$, n is any integer
76) $x = \frac{\pi}{2} + n\pi$, n is any integer
77) $x = n\pi$, n is any integer
78) A
79) C

80) $y = 5x^2$

81) $y = \frac{3}{x}$

82) $y = e^x$; $y = 3x$

83) $y = e^{-x}$; $y = 4x$

84) $y = e^x$; $y = \frac{x^2}{5}$

85) $y = -e^x$; $y = \frac{x^2}{5}$

86) $y = 4x$; $y = 4x$

87) $y = 7x^2$; $y = 7x^2$

88) $y = -7x^2$; $y = -7x^2$

89) $(-\infty, \infty)$

90) $(-\infty, 4), (4, 8), (8, \infty)$

91) $\left[-\frac{1}{5}, \infty\right)$

92) $\left[\frac{1}{10}, \infty\right)$

93) $(-\infty, 0), (0, \infty)$

94) $\left(\frac{9}{2}, \infty\right)$

95) $(-\infty, \infty)$ except where $x = n\pi$, n is any integer

96) None

97) $x = 5$, $x = 7$, both infinite discontinuities

98) $x < -\frac{1}{2}$, all points not in the domain

99) $x < 1$, all points not in the domain

100) $x = 0$, infinite discontinuity

101) $x < \frac{3}{2}$, all points not in the domain

102) $x = n\pi$, n is any integer, infinite discontinuity

103) $x = 7$

104) $x = -1$

105) $x = -2$

106) $x = 1$

107) $x = 4$

108) $x = 1$

109) About –100 deaths per year

110) Does not exist

111) $y = -14x + 41$