

47–50 ■ Find the average rate of change of the function between the given points.

47. $f(x) = x^2 + 3x$; $x = 0, x = 2$

48. $f(x) = \frac{1}{x-2}$; $x = 4, x = 8$

49. $f(x) = \frac{1}{x}$; $x = 3, x = 3 + h$

50. $f(x) = (x + 1)^2$; $x = a, x = a + h$

51–52 ■ Draw a graph of the function f , and determine the intervals on which f is increasing and on which f is decreasing.

51. $f(x) = x^3 - 4x^2$

52. $f(x) = |x^4 - 16|$

53. Suppose the graph of f is given. Describe how the graphs of the following functions can be obtained from the graph of f .

(a) $y = f(x) + 8$

(b) $y = f(x + 8)$

(c) $y = 1 + 2f(x)$

(d) $y = f(x - 2) - 2$

(e) $y = f(-x)$

(f) $y = -f(-x)$

(g) $y = -f(x)$

(h) $y = f^{-1}(x)$

54. The graph of f is given. Draw the graphs of the following functions.

(a) $y = f(x - 2)$

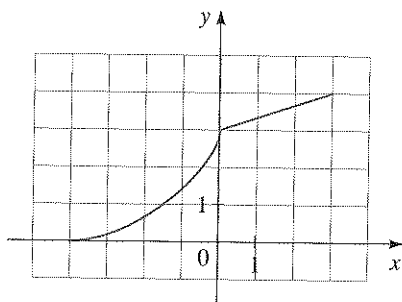
(b) $y = -f(x)$

(c) $y = 3 - f(x)$

(d) $y = \frac{1}{2}f(x) - 1$

(e) $y = f^{-1}(x)$

(f) $y = f(-x)$



55. Determine whether f is even, odd, or neither.

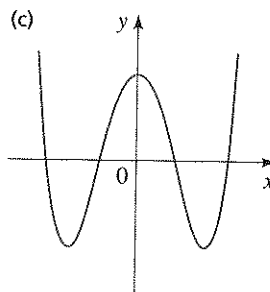
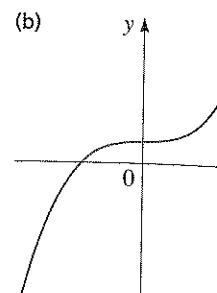
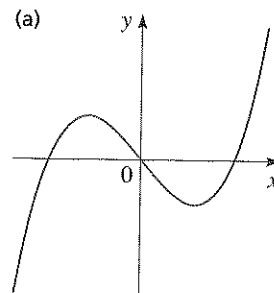
(a) $f(x) = 2x^5 - 3x^2 + 2$

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

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

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

56. Determine whether the function in the figure is even or neither.



57. Express the quadratic function $f(x) = x^2 + 4x + 1$ in standard form.

58. Express the quadratic function $f(x) = -2x^2 + 12x + 1$ in standard form.

59. Find the minimum value of the function $g(x) = 2x^2 + 4x - 5$.

60. Find the maximum value of the function $f(x) = 1 - x - x^2$.

61. A stone is thrown upward from the top of a building. Its height (in feet) above the ground after t seconds is given by $h(t) = -16t^2 + 48t + 32$. What maximum height does it reach?

62. The profit P (in dollars) generated by selling x units of a certain commodity is given by

$$P(x) = -1500 + 12x - 0.0004x^2$$

What is the maximum profit, and how many units must be sold to generate it?

63–64 ■ Find the local maximum and minimum values of the function and the values of x at which they occur. State each answer correct to two decimal places.

63. $f(x) = 3.3 + 1.6x - 2.5x^3$

64. $f(x) = x^{2/3}(6-x)^{1/3}$

65. If $f(x) = x^2 - 3x + 2$ and $g(x) = 4 - 3x$, find the following functions.

(a) $f + g$ (b) $f - g$ (c) fg
 (d) f/g (e) $f \circ g$ (f) $g \circ f$

66. If $f(x) = 1 + x^2$ and $g(x) = \sqrt{x-1}$, find the following functions.

(a) $f \circ g$ (b) $g \circ f$ (c) $(f \circ g)(2)$
 (d) $(f \circ f)(2)$ (e) $f \circ g \circ f$ (f) $g \circ f \circ g$

67-68 ■ Find the functions $f \circ g$, $g \circ f$, $f \circ f$, and $g \circ g$ and their domains.

67. $f(x) = 3x - 1$, $g(x) = 2x - x^2$

68. $f(x) = \sqrt{x}$, $g(x) = \frac{2}{x-4}$

69. Find $f \circ g \circ h$, where $f(x) = \sqrt{1-x}$, $g(x) = 1 - x^2$, and $h(x) = 1 + \sqrt{x}$.

70. If $T(x) = \frac{1}{\sqrt{1+\sqrt{x}}}$, find functions f , g , and h such that $f \circ g \circ h = T$.

71-76 ■ Determine whether the function is one-to-one.

71. $f(x) = 3 + x^3$

72. $g(x) = 2 - 2x + x^2$

73. $h(x) = \frac{1}{x^4}$

74. $r(x) = 2 + \sqrt{x+3}$

75. $p(x) = 3.3 + 1.6x - 2.5x^3$

76. $q(x) = 3.3 + 1.6x + 2.5x^3$

77-80 ■ Find the inverse of the function.

77. $f(x) = 3x - 2$

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

79. $f(x) = (x+1)^3$

80. $f(x) = 1 + \sqrt[3]{x-2}$

81. (a) Sketch the graph of the function

$$f(x) = x^2 - 4, \quad x \geq 0$$

(b) Use part (a) to sketch the graph of f^{-1} .
 (c) Find an equation for f^{-1} .

82. (a) Show that the function $f(x) = 1 + \sqrt{x}$ is one-to-one.

(b) Sketch the graph of f .
 (c) Use part (b) to sketch the graph of f^{-1} .
 (d) Find an equation for f^{-1} .