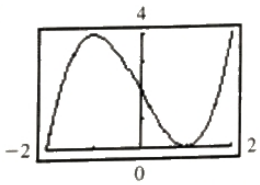
3.3 Exercises *(page 248)*

11. Yes **12.** No **13.** No **14.** Yes **15.** $(-8, -2); (0, 2); (5, \infty)$ **16.** $(-\infty, -8), (-2, 0), (2, 5)$ **17.** Yes; 10 **18.** No **19.** $-2, 2; 6, 10$
20. $-8, 0, 5; -4, 0, 0$ **21. (a)** $(-2, 0), (0, 3), (2, 0)$ **(b)** Domain: $\{x | -4 \le x \le 4\}$ or $[-4, 4]$; Range: $\{y | 0 \le y \le 3\}$ or $[0, 3]$
(c) Increasing on $(-2, 0)$ and $(2, 4)$; Decreasing on $(-4, -2)$ and $(0, 2)$ **(d)** Even **22. (a)** $(-1, 0), (0, 2), (1, 0)$
(b) Domain: $\{x | -3 \le x \le 3\}$ or $[-3, 3]$; Range: $\{y | 0 \le y \le 3\}$ or $[0, 3]$ **(c)** Increasing on $(-1, 0)$ and $(1, 3)$; Decreasing on $(-3, -1)$ and $(0, 1)$ **(d)** Even **23. (a)** $(0, 1)$ **(b)** Domain: all real numbers; Range: $\{y | y > 0\}$ or $(0, \infty)$ **(c)** Increasing on $(-\infty, \infty)$
(d) Neither **24. (a)** $(1, 0)$ **(b)** Domain: $\{x | x > 0\}$ or $(0, \infty)$; Range: all real numbers **(c)** Increasing on $(0, \infty)$ **(d)** Neither

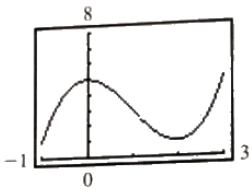
25. **(a)** $(-\pi, 0), (0, 0), (\pi, 0)$ **(b)** Domain: $\{x | -\pi \le x \le \pi\}$ or $[-\pi, \pi]$; Range: $\{y | -1 \le y \le 1\}$ or $[-1, 1]$ **(c)** Increasing on $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$; Decreasing on $\left(-\pi, -\frac{\pi}{2}\right)$ and $\left(\frac{\pi}{2}, \pi\right)$ **(d)** Odd **26.** **(a)** $\left(-\frac{\pi}{2}, 0\right), (0, 1), \left(\frac{\pi}{2}, 0\right)$ **(b)** Domain: $\{x | -\pi \le x \le \pi\}$ or $[-\pi, \pi]$; Range: $\{y | -1 \le y \le 1\}$ or $[-1, 1]$ **(c)** Increasing on $(-\pi, 0)$; Decreasing on $(0, \pi)$ **(d)** Even **27.** **(a)** $\left(0, \frac{1}{2}\right), \left(\frac{1}{2}, 0\right), \left(\frac{5}{2}, 0\right)$ **(b)** Domain: $\{x | -3 \le x \le 3\}$ or $[-3, 3]$; Range: $\{y | -1 \le y \le 2\}$ or $[-1, 2]$ **(c)** Increasing on $(2, 3)$; Decreasing on $(-1, 1)$; Constant on $(-3, -1)$ and $(1, 2)$ **(d)** Neither **28.** **(a)** $(-2.3, 0), (0, 1), (3, 0)$ **(b)** Domain: $\{x | -3 \le x \le 3\}$ or $[-3, 3]$; Range: $\{y | -2 \le y \le 2\}$ or $[-2, 2]$ **(c)** Increasing on $(-3, -2)$ and $(0, 2)$; Decreasing on $(2, 3)$; Constant on $(-2, 0)$ **(d)** Neither **29.** **(a)** 0; 3 **(b)** $-2, 2; 0, 0$ **30.** **(a)** 0; 2 **(b)** $-1, 1; 0, 0$ **31.** **(a)** $\frac{\pi}{2}; 1$ **(b)** $-\frac{\pi}{2}; -1$ **32.** **(a)** 0; 1 **(b)** $-\pi, \pi; -1, -1$ **33.** **(a)** -4 **(b)** -8 **(c)** -10 **34.** **(a)** -4 **(b)** -13 **(c)** -1 **35.** **(a)** 5 **(b)** 5 **(c)** $y = 5x$ **36.** **(a)** -4 **(b)** -4 **(c)** $y = -4x$ **37.** **(a)** -3 **(b)** -3 **(c)** $y = -3x + 1$ **38.** **(a)** $x + 1$ **(b)** 3 **(c)** $y = 3x - 1$ **39.** **(a)** $x - 1$ **(b)** 1 **(c)** $y = x - 2$ **40.** **(a)** $-2x - 1$ **(b)** -5 **(c)** $y = -5x + 4$ **41.** **(a)** $x(x + 1)$ **(b)** 6 **(c)** $y = 6x - 6$ **42.** **(a)** $x^2 + x + 2$ **(b)** 8 **(c)** $y = 8x - 6$ **43.** **(a)** $\frac{-1}{x + 1}$ **(b)** $-\frac{1}{3}$ **(c)** $y = -\frac{1}{3}x + \frac{4}{3}$ **44.** **(a)** $-\frac{x + 1}{x^2}$ **(b)** $-\frac{3}{4}$ **(c)** $y = -\frac{3}{4}x + \frac{7}{4}$ **45.** **(a)** $\frac{\sqrt{x} - 1}{x - 1}$ **(b)** $\sqrt{2} - 1$ **(c)** $(\sqrt{2} - 1)x - \sqrt{2} + 2$ **46.** **(a)** $\frac{\sqrt{x + 3} - 2}{x - 1}$ **(b)** $\sqrt{5} - 2$ **(c)** $y = (\sqrt{5} - 2)x - \sqrt{5} + 4$ **47.** Odd **48.** Even **49.** Even **50.** Neither **51.** Odd **52.** Neither **53.** Neither **54.** Even **55.** Even **56.** Odd **57.** Odd **58.** Odd

59.



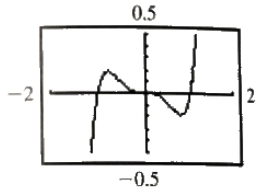
Increasing: $(-2, -1), (1, 2)$
Decreasing: $(-1, 1)$
Local maximum: $(-1, 4)$
Local minimum: $(1, 0)$

60.



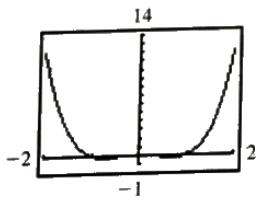
Increasing: $(-1, 0), (2, 3)$
Decreasing: $(0, 2)$
Local maximum: $(0, 5)$
Local minimum: $(2, 1)$

61.



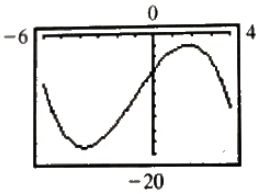
Increasing: $(-2, -0.77), (0.77, 2)$
Decreasing: $(-0.77, 0.77)$
Local maximum: $(-0.77, 0.19)$
Local minimum: $(0.77, -0.19)$

62.



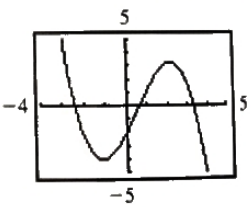
Increasing: $(-0.71, 0), (0.71, 2)$
Decreasing: $(-2, -0.71), (0, 0.71)$
Local maximum: $(0, 0)$
Local minima: $(-0.71, -0.25), (0.71, -0.25)$

63.



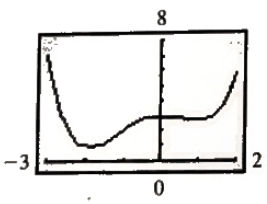
Increasing: $(-3.77, 1.77)$
Decreasing: $(-6, -3.77), (1.77, 4)$
Local maximum: $(1.77, -1.91)$
Local minimum: $(-3.77, -18.89)$

64.



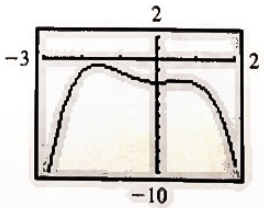
Increasing: $(-1.16, 2.16)$
Decreasing: $(-4, -1.16), (2.16, 5)$
Local maximum: $(2.16, 3.25)$
Local minimum: $(-1.16, -4.05)$

65.



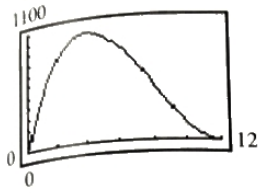
Increasing: $(-1.87, 0), (0.97, 2)$
Decreasing: $(-3, -1.87), (0, 0.97)$
Local maximum: $(0, 3)$
Local minima: $(-1.87, 0.95), (0.97, 2.65)$

66.

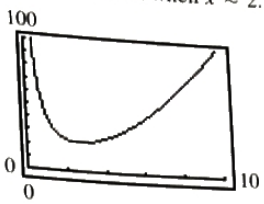


Increasing: $(-3, -1.57), (0, 0.64)$
Decreasing: $(-1.57, 0), (0.64, 2)$
Local maxima: $(-1.57, -0.52), (0.64, -1.87)$
Local minimum: $(0, -2)$

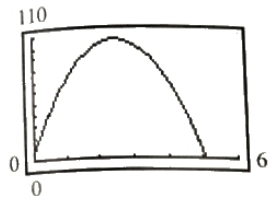
67. **(a)** $V(x) = x(24 - 2x)^2$
(b) 972 in.^{3} **(c)** 160 in.^{3}
(d) V is largest when $x = 4$.



68. **(a)** $A(x) = x^2 + \frac{40}{x}$
(b) 41 ft^2 **(c)** 24 ft^2
(d) A is smallest when $x \approx 2.71$ ft.

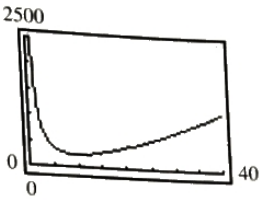


69. **(a)**



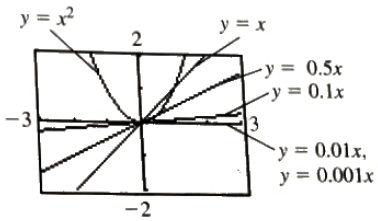
(b) 2.5 sec
(c) 106 ft

70. **(a)**



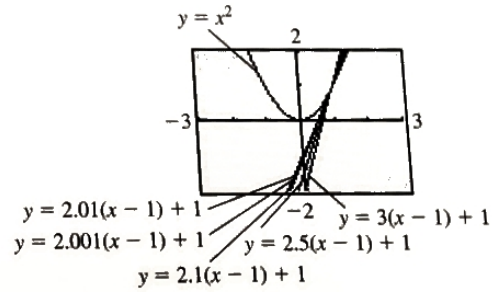
(b) 9.66 riding lawn mowers/hr
(c) $238.65/mower

71. **(a)** 1 **(b)** 0.5 **(c)** 0.1 **(d)** 0.01 **(e)** 0.001 **(f)**



(g) They are getting closer to the tangent line at $(0, 0)$.
(h) They are getting closer to 0.

72. **(a)** 3 **(b)** 2.5 **(c)** 2.1 **(d)** 2.01 **(e)** 2.001 **(f)**



(g) They are getting closer to the tangent line at $(1, 1)$.
(h) They are getting closer to 2.

75. At most one **77.** Yes; the function $f(x) = 0$ is both even and odd.