77. Horizontal asymptote at $y = -3/5$; vertical asymptote at $x = 3$.

79. No horizontal asymptote; vertical asymptote at $x = 1$.

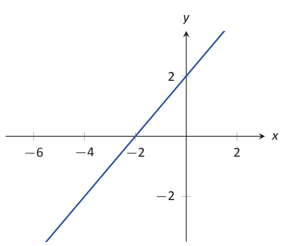
81. Horizontal asymptote at $y = -1$; no vertical asymptotes

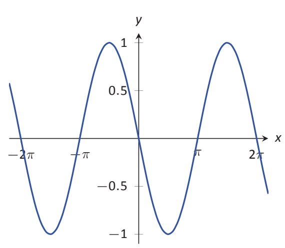
83. 1

Chapter 2

Section 2.1

1. T
3. Answers will vary.
5. Answers will vary.
7. $f'(x) = 2$
9. $g'(x) = 2x$
11. $f'(x) = 3x^2$
13. $f'(x) = \frac{1}{2\sqrt{x}}$
15. (a) $y = 6$
    (b) $x = -2$
17. (a) $y = -3x + 4$
    (b) $y = \dfrac{1}{3}(x - 7) - 17$
19. (a) $y = -7(x + 1) + 8$
    (b) $y = \dfrac{1}{7}(x + 1) + 8$
21. (a) $y = -\dfrac{1}{4}(x + 2) - \dfrac{1}{2}$
    (b) $y = 4(x + 2) - \dfrac{1}{2}$
23. (a) $y = -1(x - 3) + 1$
    (b) $y = 1(x - 3) + 1$
25. $y = -0.099(x - 9) + 1$
27. $y = -0.05x + 1$
29. (a) Approximations will vary; they should match (c) closely.
    (b) $f'(x) = -1/(x + 1)^2$
    (c) At $(0, 1)$, slope is -1. At $(1, 0.5)$, slope is $-1/4$.

31. 

33. 

35. Approximately 24.
37. (a) $(-\infty, \infty)$
    (b) $(-\infty, -1) \cup (-1, 1) \cup (1, \infty)$
    (c) $(-\infty, 5]$
    (d) $[-5, 5]$

Section 2.2

1. Velocity
3. Linear functions.
5. -17
7. $f(10.1)$ is likely most accurate, as accuracy is lost the farther from $x = 10$ we go.
9. 6
11. ft/s^2
13. (a) thousands of dollars per car
    (b) It is likely that $P(0) < 0$. That is, negative profit for not producing any cars.
15. $f(x) = g'(x)$
17. Either $g(x) = f'(x)$ or $f(x) = g'(x)$ is acceptable. The actual answer is $g(x) = f'(x)$, but is very hard to show that $f(x) \neq g'(x)$ given the level of detail given in the graph.
19. $f'(x) = 10x$
21. $f'(\pi) \approx 0$.

Section 2.3

1. Power Rule.
3. One answer is $f(x) = 10e^x$.
5. Answers may vary.
7. Answers will vary.
9. No such function exists.
11. $f'(x)$ is a velocity function, and $f''(x)$ is acceleration.
13. $f'(x) = 14x - 5$
15. $m'(t) = 45t^4 - \frac{3}{8}t^2 + 3$
17. $f'(\theta) = 9\cos\theta - 10\sin\theta$
19. $f'(r) = 6e^r$
21. $g'(t) = 40t^3 + \sin t + 7\cos t$
23. $f'(x) = \frac{1}{2}x^{-1/2} - \frac{1}{2}x^{-3/2} = \frac{1}{2\sqrt{x}} - \frac{1}{2\sqrt{x^3}}$
25. $f'(x) = -\dfrac{5}{4x^{5/4}}$
27. $g'(t) = 0$
29. $f'(x) = -5/x^2$
31. $h'(t) = e^t - \cos t + \sin t$
33. $g'(x) = 1 + 3/x^2$
35. $f'(t) = 0$
37. $f'(v) = \dfrac{9\ln(1/2)}{2^v} = -\dfrac{9\ln 2}{2^v}$
39. $g'(t) = 18t + 6$
41. $f'(x) = -3x^2 + 6x - 3$
43. $f'(x) = 18x - 12$
45. $f'(x) = 6x^5$ $f''(x) = 30x^4$ $f'''(x) = 120x^3$ $f^{(4)}(x) = 360x^2$
47. $h'(t) = 2t - e^t$ $h''(t) = 2 - e^t$ $h'''(t) = -e^t$ $h^{(4)}(t) = -e^t$
49. $p'(\theta) = 4\theta^3 - 3\theta^2$ $p''(\theta) = 12\theta^2 - 6\theta$ $p'''(\theta) = 24\theta - 6$ $p^{(4)}(\theta) = 24$
51. $f'(x) = f''(x) = f'''(x) = f^{(4)}(x) = 0$

53. Tangent line: $y = t + 4$
Normal line: $y = -t + 4$

55. Tangent line: $y = 4$
Normal line: $x = \pi/2$

57. Tangent line: $y = 2x + 3$
Normal line: $y = -\frac{1}{2}(x - 5) + 13$

59. Tangent line: $y = -\frac{8}{243}(x - 3) + \frac{2}{81}$
Normal line: $y = \frac{243}{8}(x - 3) + \frac{2}{81}2$

61. The tangent line to $f(x) = e^x$ at $x = 0$ is $y = x + 1$; thus $e^{0.1} \approx y(0.1) = 1.1$.

Section 2.4

1. F

3. T

5. (a) $f'(x) = (x^2 + 3x) + x(2x + 3)$
(b) $f'(x) = 3x^2 + 6x$
(c) They are equal.

7. (a) $h'(s) = 2(s + 4) + (2s - 1)(1)$
(b) $h'(s) = 4s + 7$
(c) They are equal.

9. (a) $f'(x) = \frac{x(2x) - (x^2+3)1}{x^2}$
(b) $f'(x) = 1 - \frac{3}{x^2}$
(c) They are equal.

11. (a) $g'(x) = \frac{\sqrt{x}(1) - (x+7)\left(\frac{1}{2}x^{-1/2}\right)}{x}$
(b) $g'(x) = \frac{1}{2\sqrt{x}} - \frac{7}{2\sqrt{x^3}}$
(c) They are equal.

13. (a) $h'(s) = \frac{4s^3(0) - 3(12s^2)}{16s^6}$
(b) $h'(s) = -\frac{9}{4}s^{-4}$
(c) They are equal.

15. (a) $f'(x) = \frac{(x+2)(4x^3+6x^2) - (x^4+2x^3)(1)}{(x+2)^2}$
(b) $f(x) = x^3$ when $x \neq -2$, so $f'(x) = 3x^2$.
(c) They are equal.

17. $f'(t) = \frac{-2}{t^3}(\csc t - 4) + \frac{1}{t^2}(-\csc t \cot t)$

19. $g'(t) = \frac{(\cos t - 2t^2)(5t^4) - (t^5)(-\sin t - 4t)}{(\cos t - 2t^2)^2}$

21. $h'(x) = -\csc^2 x - e^x$

23. $h'(x) = e^x + xe^x$

25. $f'(x) = 7$

27. $f'(x) = \dfrac{e^x + 1 - xe^x}{(e^x + 1)^2}$

29. $f'(t) = 5t^4(\sec t + e^t) + t^5(\sec t \tan t + e^t)$

31. $m'(w) = \frac{2^w\left(\ln 3 \cdot 3^w - \ln 2 \cdot (3^w+1)\right)}{2^{2w}}$

33. $g'(x) = 0$

35. $f'(x) = \frac{(t^2 \cos t + 2)(2t \sin t + t^2 \cos t) - (t^2 \sin t + 3)(2t \cos t - t^2 \sin t)}{(t^2 \cos t + 2)^2}$

37. $g'(x) = 2 \sin x \sec x + 2x \cos x \sec x + 2x \sin x \sec x \tan x = 2 \tan x + 2x + 2x \tan^2 x = 2 \tan x + 2x \sec^2 x$

39. $j'(3) = 39$

41. Tangent line: $y = 2x + 2$
Normal line: $y = -1/2x + 2$

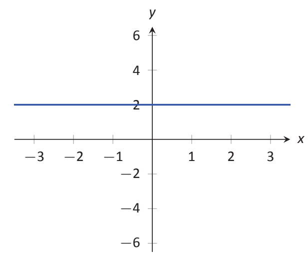
43. Tangent line: $y = 4$
Normal line: $x = 2$

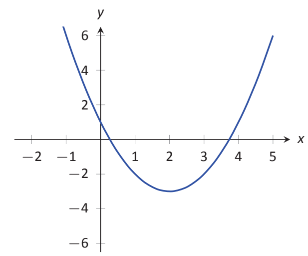
45. $x = 3/2$

47. $f'(x)$ is never 0.

49. $f''(x) = 2\cos x - x \sin x$

51. $f''(x) = \cot^2 x \csc x + \csc^3 x$

53. 

55. 

Section 2.5

1. T

3. F

5. T

7. $f'(t) = 15(3t - 2)^4$

9. $h'(t) = (6t + 1)e^{3t^2+t-1}$

11. $f'(x) = -3\sin(3x)$

13. $h'(t) = 8\sin^3(2t)\cos(2t)$

15. $f'(x) = -\tan x$

17. $f'(x) = 2/x$

19. $f'(m) = \frac{1}{2m\sqrt{\ln m}}$

21. $g'(t) = -\ln 5 \cdot 5^{\cos t} \sin t$

23. $f'(x) = 5x^2\cos(5x) + 2x\sin(5x)$

25. $f'(x) = \frac{2\sqrt{x}+1}{4\sqrt{x^2+x^{3/2}}}$

27. $g'(t) = 5\cos(t^2+3t)\cos(5t-7) - (2t+3)\sin(t^2+3t)\sin(5t-7)$

29. (a) $f'(x) = \frac{e^x}{(2-e^x)^2}$
(b) $f'(x) = \frac{e^x}{(2-e^x)^2}$

31. Tangent line: $y = 15(t - 1) + 1$
Normal line: $y = -1/15(t - 1) + 1$

33. Tangent line: $y = -5e(t + 1) + e$
Normal line: $y = 1/(5e)(t + 1) + e$

35. In both cases the derivative is the same: k/x.

37. $j'(3) = 3$

39. (a) $^\circ$ F/mph

(b) The sign would be negative; when the wind is blowing at 10 mph, any increase in wind speed will make it feel colder, i.e., a lower number on the Fahrenheit scale.

Section 2.6

1. Answers will vary.
3. $\frac{dy}{dx} = \frac{-4x^3}{2y+1}$
5. $\frac{dy}{dx} = \sin(x)\sec(y)$
7. $\frac{dy}{dx} = \frac{y}{x}$
9. $\frac{dy}{dx} = \frac{1}{e^y+x}$
11. $-\frac{2\sin(y)\cos(y)}{x}$
13. $\frac{1}{2y+2}$
15. $\frac{-\cos(x)(x+\cos(y))+\sin(x)+y}{\sin(y)(\sin(x)+y)+x+\cos(y)}$
17. $-\frac{2x+y}{2y+x}$
19. (a) $y = 0$
    (b) $y = -1.859(x - 0.1) + 0.281$
21. (a) $y = 4$
    (b) $y = 0.93(x - 2) + \sqrt[4]{108}$
23. (a) $y = -\frac{1}{\sqrt{3}}(x - \frac{7}{2}) + \frac{6+3\sqrt{3}}{2}$
    (b) $y = \sqrt{3}(x - \frac{4+3\sqrt{3}}{2}) + \frac{3}{2}$
25. $\frac{d^2y}{dx^2} = \frac{3}{5}\frac{y^{3/5}}{x^{8/5}} + \frac{3}{5}\frac{1}{yx^{6/5}}$
27. $\frac{d^2y}{dx^2} = 0$
29. $y' = (2x)^{x^2}\left(2x\ln(2x) + x\right)$
    Tangent line: $y = (2 + 4\ln 2)(x - 1) + 2$
31. $y' = x^{\sin(x)+2}\left(\cos x \ln x + \frac{\sin x + 2}{x}\right)$
    Tangent line: $y = (3\pi^2/4)(x - \pi/2) + (\pi/2)^3$
33. $y' = \frac{(x+1)(x+2)}{(x+3)(x+4)}\left(\frac{1}{x+1} + \frac{1}{x+2} - \frac{1}{x+3} - \frac{1}{x+4}\right)$
    Tangent line: $y = 11/72x + 1/6$

Section 2.7

1. F
3. The point $(10, 1)$ lies on the graph of $y = f^{-1}(x)$ (assuming f is invertible).
5. Compose $f(g(x))$ and $g(f(x))$ to confirm that each equals x.
7. Compose $f(g(x))$ and $g(f(x))$ to confirm that each equals x.
9. $\left(f^{-1}\right)'(20) = \frac{1}{f'(2)} = 1/5$
11. $\left(f^{-1}\right)'(\sqrt{3}/2) = \frac{1}{f'(\pi/6)} = 1$
13. $\left(f^{-1}\right)'(1/2) = \frac{1}{f'(1)} = -2$
15. $h'(t) = \frac{2}{\sqrt{1-4t^2}}$
17. $g'(x) = \frac{2}{1+4x^2}$
19. $g'(t) = \cos^{-1}(t)\cos(t) - \frac{\sin(t)}{\sqrt{1-t^2}}$
21. $h'(x) = \frac{\sin^{-1}(x)+\cos^{-1}(x)}{\sqrt{1-x^2}\cos^{-1}(x)^2}$
23. $f'(x) = -\frac{1}{\sqrt{1-x^2}}$
25. (a) $f(x) = x$, so $f'(x) = 1$
    (b) $f'(x) = \cos(\sin^{-1} x)\frac{1}{\sqrt{1-x^2}} = 1.$
27. (a) $f(x) = \sqrt{1 - x^2}$, so $f'(x) = \frac{-x}{\sqrt{1-x^2}}$
    (b) $f'(x) = \cos(\cos^{-1} x)(\frac{1}{\sqrt{1-x^2}} = \frac{-x}{\sqrt{1-x^2}}$
29. $y = -4(x - \sqrt{3}/4) + \pi/6$
31. $y = -4/5(x - 1) + 2$

Chapter 3

Section 3.1

1. Answers will vary.
3. Answers will vary.
5. F
7. A: abs. min B: none C: abs. max D: none E: none
9. $f'(0) = 0\, f'(2) = 0$
11. $f'(0) = 0\, f'(3.2) = 0\, f'(4)$ is undefined
13. $f'(0)$ is not defined
15. min: $(-0.5, 3.75)$
    max: $(2, 10)$
17. min: $(\pi/4, 3\sqrt{2}/2)$
    max: $(\pi/2, 3)$
19. min: $(\sqrt{3}, 2\sqrt{3})$
    max: $(5, 28/5)$
21. min: $(\pi, -e^{\pi})$
    max: $(\pi/4, \frac{\sqrt{2}e^{\pi/4}}{2})$
23. min: $(1, 0)$
    max: $(e, 1/e)$
25. min: $(-1, -1/e)$
    max: $(1, e)$
27. No. The function $f(x)$ is not defined at $x = 0$ and therefore not continuous on $[0, 10]$.
29. No. The interval $[1, \infty)$ is not a closed interval $[a, b]$.
31. Yes
33. $y = -4/5(x - 1) + 2$

Section 3.2

1. Answers will vary.
3. Any c in $[-1, 1]$ is valid.
5. $c = -1/2$
7. Rolle's Thm. does not apply.
9. Rolle's Thm. does not apply.
11. $c = 0$
13. $c = 3/\sqrt{2}$
15. The Mean Value Theorem does not apply.
17. $c = e^{5ln(5)/4-1} = \sqrt[4]{3125}/e$
19. $c = -2/3$
21. $c = \frac{\pm\sqrt{\pi^2-4}}{\pi}$
23. $c = \frac{4+\sqrt{31}}{3}$
25. Yes.