Review Exercise, pp. 263–265

1. **a.** $-e^x$
b. $2 + 3e^x$
c. $2e^{2x+3}$
d. $(-6x + 5)e^{-3x^2+5x}$
e. $e^x(x + 1)$
f. $\frac{2e^t}{(e^t + 1)^2}$

2. **a.** $10^x \ln 10$
b. $6x(4^{3x^2})\ln 4$
c. $5 \times 5^x(x \ln 5 + 1)$
d. $x^3 \times 2^x(x \ln 2 + 4)$
e. $\frac{4 - 4x \ln 4}{4^x}$
f. $5^{\sqrt{x}}\left(-\frac{1}{x^2} + \frac{\ln 5}{2x\sqrt{x}}\right)$

3. **a.** $6 \cos(2x) + 8 \sin(2x)$
b. $3 \sec^2(3x)$
c. $-\frac{\sin x}{(2 - \cos x)^2}$
d. $2x \sec^2(2x) + \tan 2x$
e. $e^{3x}(3 \sin 2x + 2 \cos 2x)$
f. $-4 \cos(2x)\sin(2x)$

4. **a.** $x = 1$
b. The function has a horizontal tangent at $(1, e)$. So this point could be possible local max or min.

5. **a.** 0
b. The slope of the tangent to $f(x)$ at the point with x-coordinate $\frac{1}{2}$ is 0.

6. **a.** $e^x(x + 1)$
b. $20e^{10x}(5x + 1)$

7. $y = \frac{e^{2x} - 1}{e^{2x} + 1}$

$$\frac{dy}{dx} = \frac{2e^{2x}(e^{2x} + 1) - (e^{2x} - 1)(2e^{2x})}{(e^{2x} + 1)^2}$$
$$= \frac{2e^{4x} + 2e^{2x} - 2e^{4x} + 2e^{2x}}{(e^{2x} + 1)^2}$$
$$= \frac{4e^{2x}}{(e^{2x} + 1)^2}$$

Now, $1 - y^2 = 1 - \frac{e^{4x} - 2e^{2x} + 1}{(e^{2x} + 1)^2}$

$$= \frac{e^{4x} + 2e^{2x} + 1 - e^{4x} + 2e^{2x} - 1}{(e^{2x} + 1)^2}$$
$$= \frac{4e^{2x}}{(3^{2x} + 1)^2} = \frac{dy}{dx}$$

8. $3x - y + 2 \ln 2 - 2 = 0$

9. $-x + y = 0$

10. about 0.3928 m per unit of time

11. **a.** $t = 20$
b. After 10 days, about 0.1156 mice are infected per day. Essentially, almost 0 mice are infected per day when $t = 10$.

12. **a.** c_2
b. c_1

13. **a.** $-9e^{-x}(2 + 3e^{-x})^2$
b. ex^{e-1}
c. e^{x+e^x}
d. $-25e^{5x}(1 - e^{5x})^4$

14. **a.** $5^x \ln 5$
b. $(0.47)^x \ln(0.47)$
c. $2(52)^{2x} \ln 52$
d. $5(2)^x \ln 2$
e. $4e^x$
f. $-6(10)^{3x} \ln 10$

15. **a.** $2^x \ln 2 \cos 2^x$
b. $x^2 \cos x + 2x \sin x$
c. $-\cos\left(\frac{\pi}{2} - x\right)$
d. $\cos^2 x - \sin^2 x$
e. $-2 \cos x \sin x$
f. $2 \sin x \cos^2 x - \sin^3 x$

16. $x + y - \frac{\pi}{2} = 0$

17. $v = \frac{ds}{dt}$;
Thus, $v = 8(\cos(10\pi t))(10\pi)$
$= 80\pi \cos(10\pi t)$
The acceleration at any time t is
$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$.
Hence, $a = 80\pi(-\sin(10\pi t))(10\pi)$
$= -800\pi^2 \sin(10\pi t)$. Now,
$\frac{d^2s}{dt^2} + 100\pi^2 s = -800\pi^2 \sin(10\pi t)$
$+ 100\pi^2(8 \sin(10\pi t)) = 0$.

18. displacement: 5,
velocity: 10,
acceleration: 20

19. each angle $\frac{\pi}{4}$ rad, or 45°

20. 4.5 m

21. 2.5 m

22. 5.19 ft

23. **a.** $f''(x) = -8 \sin^2(x - 2)$
$+ 8 \cos^2(x - 2)$
b. $f''(x) = (4 \cos x)(\sec^2 x \tan x)$
$- 2 \sin x(\sec x)^2$

Chapter 5 Test, p. 266

1. **a.** $-4xe^{-2x^2}$
b. $3e^{x^2+3x} \cdot \ln 3 \cdot (2x + 3)$
c. $\frac{3}{2}[e^{3x} - e^{-3x}]$
d. $2 \cos x + 15 \sin 5x$
e. $6x \sin^2(x^2)\cos(x^2)$
f. $-\frac{\sec^2 \sqrt{1 - x}}{2\sqrt{1 - x}}$

2. $-6x + y = 2$,
The tangent line is the given line.

3. $-2x + y = 1$

4. **a.** $a(t) = v'(t) = -10ke^{-kt}$
$= -k(10e^{-kt})$
$= -kv(t)$
Thus, the acceleration is a constant multiple of the velocity. As the velocity of the particle decreases, the acceleration increases by a factor of k.
b. 10 cm/s
c. $\frac{\ln 2}{k}$; $-5k$

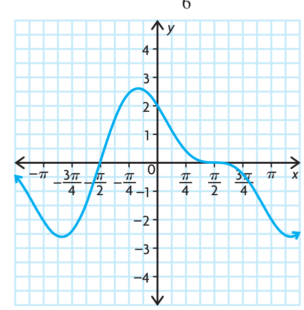
5. **a.** $f''(x) = 2(\sin^2 x - \cos^2 x)$
b. $f''(x) = \csc x \cot^2 x$
$+ \csc^3 x + \sin x$

6. absolute max: 1,
absolute min: 0

7. 40.24

8. minimum: $\left(-4, -\frac{1}{e^4}\right)$, no maximum

9. **a.** $x = -\frac{\pi}{6}, -\frac{5\pi}{6}, \frac{\pi}{2}$
b. increasing: $-\frac{5\pi}{6} < x < -\frac{\pi}{6}$;
decreasing: $-\pi \le x < -\frac{5\pi}{6}$ and $-\frac{\pi}{6} < x < \pi$
c. local maximum at $x = -\frac{\pi}{6}$; local minimum at $x = -\frac{5\pi}{6}$
d.



Cumulative Review of Calculus, pp. 267–270

1. **a.** 16
b. −2
c. $\frac{1}{6}$
d. $160 \ln 2$

2. **a.** 13 m/s
b. 15 m/s

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

4. **a.** 19.6 m/s
b. 19.6 m/s
c. 53.655 m/s

5. a. 19 000 fish/year
b. 23 000 fish/year

6. a. i. 3
ii. 1
iii. 3
iv. 2
b. No, $\lim_{x \to 4} f(x)$ does not exist. In order for the limit to exist, $\lim_{x \to 4^-} f(x)$ and $\lim_{x \to 4^+} f(x)$ must exist and they must be the same. In this case, $\lim_{x \to 4^-} f(x) = \infty$, but $\lim_{x \to 4^+} f(x) = -\infty$, so $\lim_{x \to 4} f(x)$ does not exist.

7. $f(x)$ is discontinuous at $x = 2$. $\lim_{x \to 2^-} f(x) = 5$, but $\lim_{x \to 2^+} f(x) = 3$.

8. a. $-\frac{1}{5}$
b. 6
c. $-\frac{1}{9}$
d. $\frac{4}{3}$
e. $\frac{1}{12}$
f. $\frac{1}{2}$

9. a. $6x + 1$
b. $-\frac{1}{x^2}$

10. a. $3x^2 - 8x + 5$
b. $\frac{3x^2}{\sqrt{2x^3 + 1}}$
c. $\frac{6}{(x + 3)^2}$
d. $4x(x^2 + 3)(4x^5 + 5x + 1) + (x^2 + 3)^2(20x^4 + 5)$
e. $\frac{(4x^2 + 1)^4(84x^2 - 80x - 9)}{(3x - 2)^4}$
f. $5[x^2 + (2x + 1)^3]^4 \times [2x + 6(2x + 1)^2]$

11. $4x + 3y - 10 = 0$

12. 3

13. a. $p'(t) = 4t + 6$
b. 46 people per year
c. 2006

14. a. $f'(x) = 5x^4 - 15x^2 + 1$; $f''(x) = 20x^3 - 30x$
b. $f'(x) = \frac{4}{x^3}$; $f''(x) = -\frac{12}{x^4}$
c. $f'(x) = -\frac{2}{\sqrt{x^3}}$; $f''(x) = \frac{3}{\sqrt{x^5}}$
d. $f'(x) = 4x^3 + \frac{4}{x^5}$; $f''(x) = 12x^2 - \frac{20}{x^6}$

15. a. maximum: 82, minimum: 6
b. maximum: $9\frac{1}{3}$, minimum: 2
c. maximum: $\frac{e^4}{1 + e^4}$, minimum: $\frac{1}{2}$
d. maximum: 5, minimum: 1

16. a. $v(t) = 9t^2 - 81t + 162$, $a(t) = 18t - 81$
b. stationary when $t = 6$ or $t = 3$, advancing when $v(t) > 0$, and retreating when $v(t) < 0$
c. $t = 4.5$
d. $0 \le t < 4.5$
e. $4.5 < t \le 8$

17. 14 062.5 m^2

18. $r \doteq 4.3$ cm, $h \doteq 8.6$ cm

19. $r = 6.8$ cm, $h = 27.5$ cm

20. a. $140 - 2x$
b. 101 629.5 cm^3; 46.7 cm by 46.7 cm by 46.6 cm

21. $x = 4$

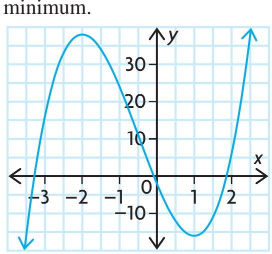
22. \$70 or \$80

23. \$1140

24. a. $\frac{dy}{dx} = -10x + 20$,
$x = 2$ is critical number,
Increase: $x < 2$,
Decrease: $x > 2$
b. $\frac{dy}{dx} = 12x + 16$,
$x = -\frac{4}{3}$ is critical number,
Increase: $x > -\frac{4}{3}$,
Decrease: $x < -\frac{4}{3}$
c. $\frac{dy}{dx} = 6x^2 - 24$,
$x = \pm 2$ are critical numbers,
Increase: $x < -2$, $x > 2$,
Decrease: $-2 < x < 2$
d. $\frac{dy}{dx} = -\frac{2}{(x - 2)^2}$. The function has no critical numbers. The function is decreasing everywhere it is defined, that is, $x \ne 2$.

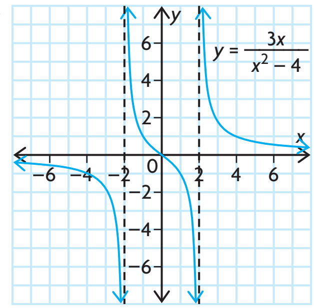
25. a. $y = 0$ is a horizontal asymptote.
$x = \pm 3$ are the vertical asymptotes.
There is no oblique asymptote.
$\left(0, -\frac{8}{9}\right)$ is a local maximum.
b. There are no horizontal asymptotes.
$x = \pm 1$ are the vertical asymptotes.
$y = 4x$ is an oblique asymptote.
$(-\sqrt{3}, -6\sqrt{3})$ is a local maximum, $(\sqrt{3}, 6\sqrt{3})$ is a local minimum.

26. a.



$y = 4x^3 + 6x^2 - 24x - 2$

b.



27. a. $(-20)e^{5x+1}$
b. $e^{3x}(3x + 1)$
c. $(3 \ln 6)6^{3x-8}$
d. $(\cos x)e^{\sin x}$

28. $y = 2e(x - 1) + e$

29. a. 5 days
b. 27

30. a. $2 \cos x + 15 \sin 5x$
b. $8 \cos 2x(\sin 2x + 1)^3$
c. $\frac{2x + 3 \cos 3x}{2\sqrt{x^2 + \sin 3x}}$
d. $\frac{1 + 2 \cos x}{(\cos x + 2)^2}$
e. $2x \sec^2 x^2 - 2 \tan x \sec^2 x$
f. $-2x \sin x^2 \cos(\cos x^2)$

31. about 4.8 m

32. about 8.5 m

Chapter 6

Review of Prerequisite Skills, p. 273

1. a. $\frac{\sqrt{3}}{2}$
b. $-\sqrt{3}$
c. $\frac{1}{2}$
d. $\frac{\sqrt{3}}{2}$
e. $\frac{\sqrt{2}}{2}$
f. 1

2. $\frac{4}{3}$

3. a. $AB \doteq 29.7$, $\angle B \doteq 36.5°$, $\angle C \doteq 53.5°$
b. $\angle A \doteq 97.9°$, $\angle B \doteq 29.7°$, $\angle C \doteq 52.4°$

4. $\angle Z \doteq 50°$, $XZ \doteq 7.36$, $YZ \doteq 6.78$

5. $\angle R \doteq 44°$, $\angle S \doteq 102°$, $\angle T \doteq 34°$

6. 5.82 km

7. 8.66 km

8. 21.1 km

9. 59.4 cm^2