3. $1 - 2x$

4. a. $x^2 + 15x^{-6}$
   b. $60(2x - 9)^4$
   c. $-x^{-\frac{3}{2}} + \frac{1}{\sqrt{3}} + 2x^{-\frac{2}{3}}$
   d. $\frac{5(x^2 + 6)^4(3x^2 + 8x - 18)}{(3x + 4)^6}$
   e. $2x(6x^2 - 7)^{-\frac{2}{3}}(8x^2 - 7)$
   f. $\frac{4x^5 - 18x + 8}{x^5}$

5. 14

6. $-\frac{40}{3}$

7. $60x + y - 61 = 0$

8. $\frac{75}{32}$ ppm/year

9. $\left(-\frac{1}{4}, \frac{1}{256}\right)$

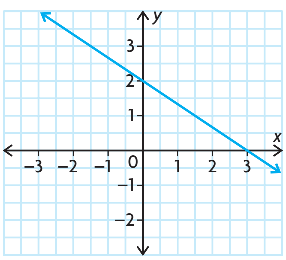
10. $\left(-\frac{1}{3}, \frac{32}{27}\right)$, (1, 0)

11. $a = 1, b = -1$

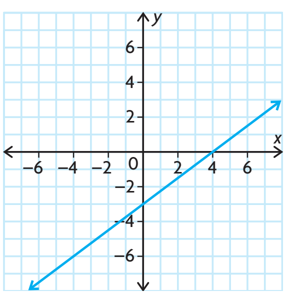
Chapter 3

Review of Prerequisite Skills, pp. 116–117

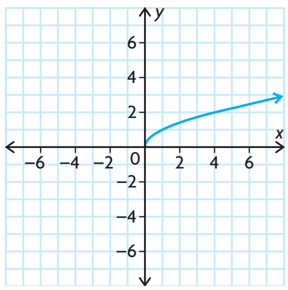
1. a.



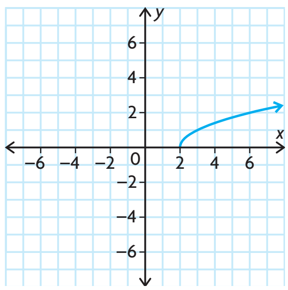
   b.



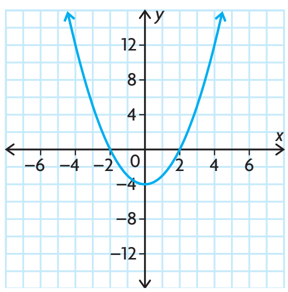
   c.



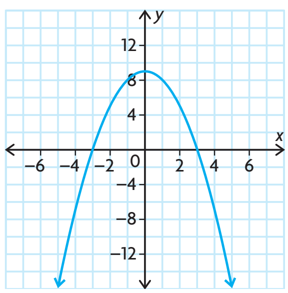
   d.



   e.



   f.



2. a. $x = \frac{14}{5}$
   b. $x = -13$
   c. $t = 3$ or $t = 1$
   d. $t = -\frac{1}{2}$ or $t = 3$
   e. $t = 3$ or $t = 6$
   f. $x = 0$ or $x = -3$ or $x = 1$
   g. $x = 0$ or $x = 4$
   h. $t = -3$ or $t = \frac{1}{2}$ or $t = -\frac{1}{2}$
   i. $t = \pm\frac{9}{4}$ or $t = \pm 1$

3. a. $x > 3$
   b. $x < 0$ or $x > 3$
   c. $0 < x < 4$

4. a. 25 cm^2
   b. 48 cm^2
   c. 49π cm^2
   d. 36π cm^2

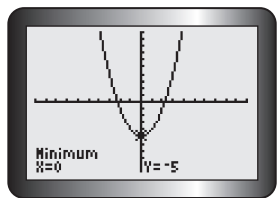
5. a. $SA = 56\pi$ cm^2, $V = 48\pi$ cm^3
   b. $h = 6$ cm, $SA = 80\pi$ cm^2
   c. $r = 6$ cm, $SA = 144\pi$ cm^2
   d. $h = 7$ cm, $V = 175\pi$ cm^3

6. a. $SA = 54$ cm^2, $V = 27$ cm^3
   b. $SA = 30$ cm^2, $V = 5\sqrt{5}$ cm^3
   c. $SA = 72$ cm^2, $V = 24\sqrt{3}$ cm^3
   d. $SA = 24k^2$ cm^2, $V = 8k^3$ cm^3

7. a. $(3, \infty)$
   b. $(-\infty, -2]$
   c. $(-\infty, 0)$
   d. $[-5, \infty)$
   e. $(-2, 8]$
   f. $(-4, 4)$

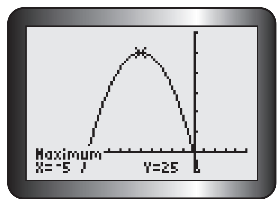
8. a. $\{x \in \mathbf{R} \mid x > 5\}$
   b. $\{x \in \mathbf{R} \mid x \leq -1\}$
   c. $\{x \in \mathbf{R}\}$
   d. $\{x \in \mathbf{R} \mid -10 \leq x \leq 12\}$
   e. $\{x \in \mathbf{R} \mid -1 < x < 3\}$
   f. $\{x \in \mathbf{R} \mid 2 \leq x < 20\}$

9. a.



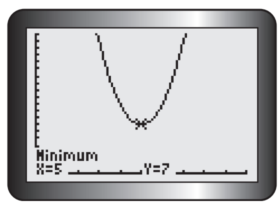
The function has a minimum value of −5 and no maximum value.

   b.



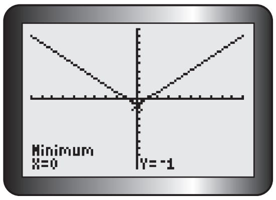
The function has a maximum value of 25 and no minimum value.

   c.



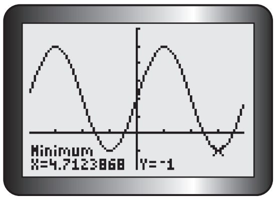
The function has a minimum value of 7 and no maximum value.

d.

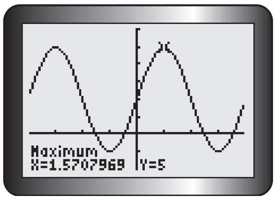


The function has a minimum value of -1 and no maximum value.

e.

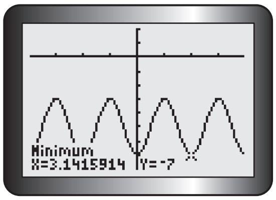


The function has a minimum value of -1.

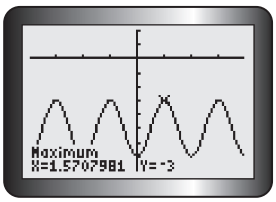


The function has a maximum value of 5.

f.



The function has a minimum value of -7.



The function has a maximum value of -3.

Section 3.1, pp. 127–129

1. At $t = 1$, the velocity is positive; this means that the object is moving in whatever is the positive direction for the scenario. At $t = 5$, the velocity is negative; this means that the object is moving in whatever is the negative direction for the scenario.

2. **a.** $y'' = 90x^8 + 90x^4$

b. $f''(x) = -\frac{1}{4}x^{-\frac{3}{2}}$

c. $y'' = 2$

d. $h''(x) = 36x^2 - 24x - 6$

e. $y'' = \frac{3}{\sqrt{x}} - \frac{6}{x^4}$

f. $f''(x) = \frac{-4x - 4}{(x + 1)^4}$

g. $y'' = 2 + \frac{6}{x^4}$

h. $g''(x) = -\frac{9}{4(3x - 6)^{\frac{3}{2}}}$

i. $y'' = 48x + 96$

j. $h''(x) = \frac{10}{9x^{\frac{1}{3}}}$

3. **a.** $v(t) = 10t - 3$, $a(t) = 10$

b. $v(t) = 6t^2 + 36$, $a(t) = 12t$

c. $v(t) = 1 - 6t^{-2}$, $a(t) = 12t^{-3}$

d. $v(t) = 2(t - 3)$, $a(t) = 2$

e. $v(t) = \frac{1}{2}(t + 1)^{\frac{1}{2}}$, $a(t) = -\frac{1}{4}(t + 1)^{\frac{3}{2}}$

f. $v(t) = \frac{27}{(t + 3)^2}$, $a(t) = -54(t + 3)^{-3}$

4. **a.** **i.** $t = 3$
ii. $1 < t < 3$
iii. $3 < t < 5$

b. **i.** $t = 3, t = 7$
ii. $1 < t < 3, 7 < t < 9$
iii. $3 < t < 7$

5. **a.** $v(t) = t^2 - 4t + 3$, $a(t) = 2t - 4$

b. at $t = 1$ and $t = 3$

c. after 3 s

6. **a.** For $t = 1$, moving in a positive direction.
For $t = 4$, moving in a negative direction.

b. For $t = 1$, the object is stationary.
For $t = 4$, the object is moving in a positive direction.

c. For $t = 1$, the object is moving in a negative direction.
For $t = 4$, the object is moving in a positive direction.

7. **a.** $v(t) = 2t - 6$

b. $t = 3$ s

8. **a.** $t = 4$ s

b. $s(4) = 80$ m

9. **a.** $v(5) = 3$ m/s

b. $a(5) = 2$ m/s^2

10. **a.** $v(t) = \frac{35}{2}t^{\frac{3}{2}} - \frac{7}{2}t^{\frac{5}{2}}$,

$a(t) = \frac{105}{2}t^{\frac{1}{2}} - \frac{35}{4}t^{\frac{3}{2}}$

b. 5 s

c. 5 s

d. $0 < t < 6$ s

e. after 7 s

11. **a.** 25 m/s

b. 31.25 m

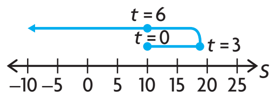
c. -25 m/s

12. **a.** $v(8) = 98$ m/s, $a(8) = 12$ m/s^2

b. 38 m/s

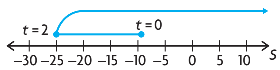
13. **a.** $s = 10 + 6t - t^2$
$v = 6 - 2t$
$= 2(3 - t)$
$a = -2$

The object moves to the right from its initial position of 10 m from the origin, 0, to the 19 m mark, slowing down at a rate of 2 m/s^2. It stops at the 19 m mark, then moves to the left, accelerating at 2 m/s^2 as it goes on its journey into the universe. It passes the origin after $(3 + \sqrt{19})$ s.



b. $s = t^3 - 12t - 9$
$v = 3t^2 - 12$
$= 3(t^2 - 4)$
$= 3(t - 2)(t + 2)$
$a = 6t$

The object begins at 9 m to the left of the origin, 0, and slows down to a stop after 2 s when it is 25 m to the left of the origin. Then, the object moves to the right, accelerating at faster rates as time increases. It passes the origin just before 4 s (approximately 3.7915) and continues to accelerate as time goes by on its journey into space.



14. $t = 1$ s; away

15. **a.** $s(t) = kt^2 + (6k^2 - 10k)t + 2k$

$v(t) = 2kt + (6k^2 - 10k)$

$a(t) = 2k + 0$

$= 2k$

Since $k \neq 0$ and $k \in \mathbf{R}$, then $a(t) = 2k \neq 0$ and an element of the real numbers. Therefore, the acceleration is constant.

b. $t = 5 - 3k$, $-9k^3 + 30k^2 - 23k$.

16. **a.** The acceleration is continuous at $t = 0$ if $\lim_{t \to 0} a(t) = a(0)$.

For $t \geq 0$,

$$s(t) = \frac{t^3}{t^2 + 1}$$

and
$$v(t) = \frac{3t^2(t^2 + 1) - 2t(t^3)}{(t^2 + 1)^2} = \frac{t^4 + 3t^2}{(t^2 + 1)^2}$$

and
$$a(t) = \frac{(4t^3 + 6t)(t^2 + 1)^2}{(t^2 + 1)^2} - \frac{2(t^2 + 1)(2t)(t^4 + 3t^2)}{(t^2 + 1)^2}$$
$$= \frac{(4t^3 + 6t)(t^2 + 1)}{(t^2 + 1)^3} - \frac{4t(t^4 + 3t^2)}{(t^2 + 1)^3}$$
$$= \frac{4t^5 + 6t^3 + 4t^3}{(t^2 + 1)^3} + \frac{6t - 4t^5 - 12t^3}{(t^2 + 1)^3}$$
$$= \frac{-2t^3 + 6t}{(t^2 + 1)^3}$$

Therefore,

$$a(t) = \begin{cases} 0, & \text{if } t < 0 \\ \dfrac{-2t^3 + 6t}{(t^2 + 1)^3}, & \text{if } t \geq 0 \end{cases}$$

and

$$v(t) = \begin{cases} 0, & \text{if } t < 0 \\ \dfrac{t^4 + 3t^2}{(t^2 + 1)^2}, & \text{if } t \geq 0 \end{cases}$$

$$\lim_{t \to 0^-} a(t) = 0, \quad \lim_{t \to 0^+} a(t) = \frac{0}{1} = 0$$

Thus, $\lim_{t \to 0} a(t) = 0$.

Also, $a(0) = \dfrac{0}{1} = 0$

Therefore, $\lim_{t \to 0} a(t) = a(0)$.

Thus, the acceleration is continuous at $t = 0$.

b. velocity approaches 1, acceleration approaches 0

17.
$$v = \sqrt{b^2 + 2gs}$$
$$v = (b^2 + 2gs)^{\frac{1}{2}}$$
$$\frac{dv}{dt} = \frac{1}{2}(b^2 + 2gs)^{\frac{1}{2}} \times \left(0 + 2g\frac{ds}{dt}\right)$$
$$a = \frac{1}{2v} \times 2gv$$
$$a = g$$

Since g is a constant, a is a constant, as required.

Note: $\dfrac{ds}{dt} = v$

$\dfrac{dv}{dt} = a$

18.
$$F = m_0 \frac{d}{dt}\left(\frac{v}{\sqrt{1 - (\frac{v}{c})^2}}\right)$$

Using the quotient rule,

$$= \frac{m_0 \frac{dv}{dt}\left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}}{1 - \frac{v^2}{c^2}} - \frac{\frac{1}{2}\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}\left(-\frac{2v\frac{dv}{dt}}{c^2}\right) \times v}{1 - \frac{v^2}{c^2}}$$

Since $\dfrac{dv}{dt} = a$,

$$= \frac{m_0\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}\left[a\left(1 - \frac{v^2}{c^2}\right) + \frac{v^2 a}{c^2}\right]}{1 - \frac{v^2}{c^2}}$$
$$= \frac{m_0\left[\frac{ac^2 - av^2}{c^2} + \frac{v^2 a}{c^2}\right]}{\left(1 - \frac{v^2}{c^2}\right)^{\frac{3}{2}}}$$
$$= \frac{m_0 ac^2}{c^2(1 - \frac{v^2}{c^2})^{\frac{3}{2}}}$$
$$= \frac{m_0 a}{(1 - \frac{v^2}{c^2})^{\frac{3}{2}}}, \text{ as required.}$$

Section 3.2, pp. 135–138

1. **a.** The algorithm can be used; the function is continuous.

b. The algorithm cannot be used; the function is discontinuous at $x = 2$.

c. The algorithm cannot be used; the function is discontinuous at $x = 2$.

d. The algorithm can be used; the function is continuous on the given domain.

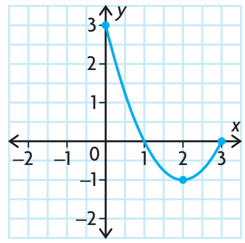
2. **a.** max: 8, min: -12

b. max: 30, min: -5

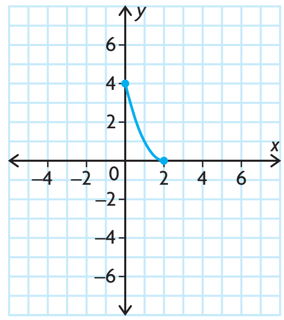
c. max: 100, min: -100

d. max: 30, min: -20

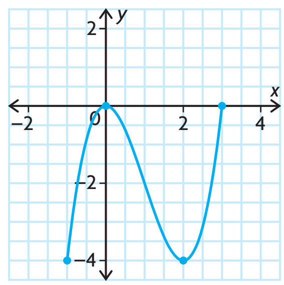
3. **a.** max is 3 at $x = 0$, min is -1 at $x = 2$



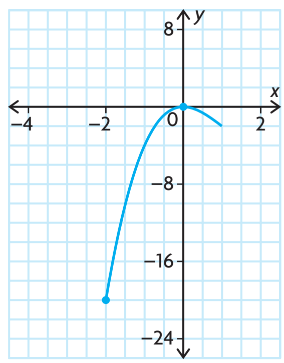
b. max is 4 at $x = 0$, min is 0 at $x = 2$



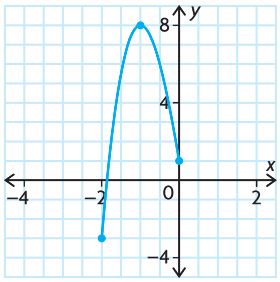
c. min is -4 at $x = -1, 2$, max is 0 at $x = 0, 3$



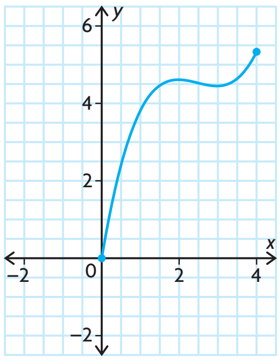
d. max is 0 at $x = 0$, min is -20 at $x = -2$



e. max is 8 at $x = -1$,
min is -3 at $x = -2$

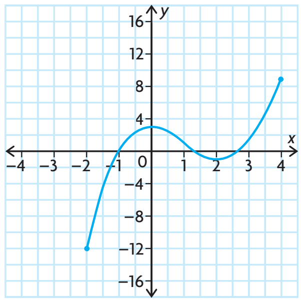


f. max is $\frac{16}{3}$ at $x = 4$,
min is 0 at $x = 0$



4. **a.** min value of 4 when $x = 2$,
max value of 10.4 when $x = 10$
b. min value of 3 when $x = 9$,
max value of 4 when $x = 4$
c. max value of 1 when $x = 1$,
min value of $\frac{1}{2}$ when $x = 0, 2$
d. min value of -169 when $x = 3$,
max value of 47 when $x = -3$
e. max value of 2 when $x = 1$,
min value of -2 when $x = -1$
f. min value of 0.94 when $x = 4$,
max value of 1.6 when $x = 2$
5. **a.** max velocity is $\frac{4}{3}$ m/s,
min velocity is $\frac{4}{5}$ m/s
b. min velocity is 0 m/s, no maximum velocity, but $v(t) \to 4$ as $t \to \infty$
6. 20 bacteria/cm^3
7. **a.** 80 km/h
b. 50 km/h
c. $0 \le v < 80$
d. $80 < v \le 100$
8. min concentration is at $t = 1$
max concentration is at $t = 3$
9. 0.05 years or approximately 18 days
10. 70 km/h; \$31.50
11. absolute max value = 42,
absolute min value = 10

12. **a.**



b. $-2 \le x \le 4$
c. increasing: $-2 \le x < 0$
$2 < x \le 4$
decreasing: $0 < x < 2$
13. Absolute max: Compare all local maxima and values of $f(a)$ and $f(b)$ when the domain of $f(x)$ is $a \le x \le b$. The one with the highest value is the absolute maximum.
Absolute min: We need to consider all local minima and the value of $f(a)$ and $f(b)$ when the domain of $f(x)$ is $a \le x \le b$. Compare them, and the one with the lowest value is the absolute minimum.
You need to check the endpoints because they are not necessarily critical points.
14. 245 units
15. 300 units

Mid-Chapter Review, pp. 139–140

1. **a.** $h''(x) = 36x^2 - 24x - 6$
b. $f''(x) = 48x - 120$
c. $y'' = \dfrac{30}{(x+3)^3}$
d. $g''(x) = -\dfrac{x^2}{(x^2+1)^{\frac{3}{2}}} + \dfrac{1}{(x^2+1)^{\frac{1}{2}}}$
2. **a.** 108 m
b. -45 m/s
c. -18 m/s^2
3. **a.** 6 m/s
b. $t \doteq 0.61$ s
c. $t = 1.50$ s
d. -8.67 m/s
e. -9.8 m/s^2, -9.8 m/s^2
4. **a.** Velocity is 0 m/s
Acceleration is 10 m/s
b. Object is stationary at time $t = \frac{1}{3}$ s and $t = 2$ s.
Before $t = \frac{1}{3}$, $v(t)$ is positive and therefore the object is moving to the right.
Between $t = \frac{1}{3}$ and $t = 2$, $v(t)$ is negative and therefore the object is moving to the left.
After $t = 2$, $v(t)$ is positive and therefore the object is moving to the right.
c. $t \doteq 1.2$ s; At that time, the object is neither accelerating nor decelerating.
5. **a.** min value is 1 when $x = 0$,
max value is 21 when $x = 2$
b. min value is 0 when $x = -2$,
max value is 25 when $x = 3$
c. min value is 0 when $x = 1$,
max value is 0.38 when $x = \sqrt{3}$
6. 3.96 °C
7. **a.** 105
b. 3
c. -6
d. -78
e. 3
f. 1448
g. $-\dfrac{202}{27}$
h. $-\dfrac{185}{6}$
8. -1.7 m/s^2
9. **a.** 189 m/s
b. 27 s
c. 2916 m
d. 6.2 m/s^2
10. 16 m; 4 s
11. **a.** $0 \le t \le 4.31$
b. 2.14 s
c. 22.95 m

Section 3.3, pp. 145–147

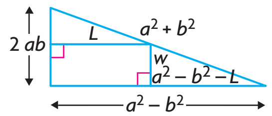
1. 25 cm by 25 cm
2. If the perimeter is fixed, then the figure will be a square.
3. 150 m by 300 m
4. height 8.8 cm, length 8.24 cm, and width 22.4 cm
5. 110 cm by 110 cm
6. 8 m by 8 m
7. 125 m by 166.67 m
8. 4 m by 6 m by 6 m
9. base 10 cm by 10 cm, height 10 cm
10. 100 square units when $5\sqrt{2}$
11. **a.** $r = 5.42$, $h = 10.84$
b. $\dfrac{h}{d} = \dfrac{1}{1}$; yes
12. **a.** 15 cm^2 when $W = 2.5$ cm and $L = 6$ cm
b. 30 cm^2 when $W = 4$ cm and $L = 7.5$ cm
c. The largest area occurs when the length and width are each equal to one-half of the sides adjacent to the right angle.
13. **a.** base is 20 cm and each side is 20 cm
b. approximately 260 000 cm^3

14. **a.** triangle side length 0.96 cm, rectangle 0.96 cm by 1.09 cm
b. Yes. All the wood would be used for the outer frame.

15. 0.36 h after the first train left the station

16. 1:02 p.m.; 3 km

17.



$$\frac{a^2 - b^2 - L}{a^2 - b^2} = \frac{W}{2ab}$$

$$W = \frac{2ab}{a^2 - b^2}(a^2 - b^2 - L)$$

$$A = LW = \frac{2ab}{a^2 - b^2}[a^2L - b^2L - L^2]$$

Let $\frac{dA}{dL} = a^2 - b^2 - 2L = 0,$

$L = \frac{a^2 - b^2}{2}$ and

$$W = \frac{2ab}{a^2 - b^2}\left[a^2 - b^2 - \frac{a^2 - b^2}{2}\right]$$
$$= ab$$

The hypothesis is proven.

18. Let the height be h and the radius r.

Then, $\pi r^2 h = k, h = \frac{k}{\pi r^2}$.

Let M represent the amount of material,

$$M = 2\pi r^2 + 2\pi rh$$
$$= 2\pi r^2 + 2\pi r\left(\frac{k}{\pi r^2}\right)$$
$$= 2\pi r^2 + \frac{2k}{r}, 0 \le r \le \infty$$

Using the max min Algorithm,

$$\frac{dM}{dr} = 4\pi r - \frac{2k}{r^2}$$

Let $\frac{dM}{dr} = 0, r^3 = \frac{k}{2\pi}, r \neq 0$ or

$$r = \left(\frac{k}{2\pi}\right)^{\frac{1}{3}}.$$

When $r \to 0, M \to \infty$

$r \to \infty, M \to \infty$

$$r = \left(\frac{k}{2\pi}\right)^{\frac{1}{3}}$$

$$d = 2\left(\frac{k}{2\pi}\right)^{\frac{1}{3}}$$

$$h = \frac{k}{\pi\left(\frac{k}{2\pi}\right)^{\frac{2}{3}}} = \frac{k}{\pi}\cdot\frac{(2\pi)^{\frac{2}{3}}}{k^{\frac{2}{3}}} = \frac{k^{\frac{1}{3}}}{\pi^{\frac{1}{3}}} \times 2^{\frac{2}{3}}$$

Min amount of material is

$$M = 2\pi\left(\frac{k}{2\pi}\right)^{\frac{2}{3}} + 2k\left(\frac{2\pi}{k}\right)^{\frac{1}{3}}.$$

Ratio $\frac{h}{d} = \frac{\left(\frac{k}{\pi}\right)^{\frac{1}{3}} \times 2^{\frac{2}{3}}}{2\left(\frac{k}{2\pi}\right)^{\frac{1}{3}}} = \frac{\left(\frac{k}{\pi}\right)^{\frac{1}{3}} \times 2^{\frac{2}{3}}}{2^{\frac{2}{3}}\left(\frac{k}{\pi}\right)^{\frac{1}{3}}} = \frac{1}{1}$

19. **a.** no cut
b. 44 cm for circle; 56 cm for square

20. $\sqrt{17}$

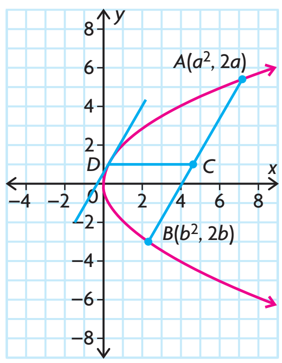
21. Let point A have coordinates $(a^2, 2a)$. (Note that the x-coordinate of any point on the curve is positive, but that the y-coordinate can be positive or negative. By letting the x-coordinate be a^2, we eliminate this concern.)
Similarly, let B have coordinates $(b^2, 2b)$. The slope of AB is $\frac{2a - 2b}{a^2 - b^2} = \frac{2}{a + b}$.
Using the mid-point property, C has coordinates $\left(\frac{a^2 + b^2}{2}, a + b\right)$.
Since CD is parallel to the x-axis, the y-coordinate of D is also $a + b$. The slope of the tangent at D is given by $\frac{dy}{dx}$ for the expression $y^2 = 4x$.
Differentiating,

$$2y\frac{dy}{dx} = 4$$
$$\frac{dy}{dx} = \frac{2}{y}$$

And since at point D, $y = a + b$,

$$\frac{dy}{dx} = \frac{2}{a + b}$$

But this is the same as the slope of AB. Then, the tangent at D is parallel to the chord AB.



22. when P is at the point (5, 2.5)

23. $\frac{2k}{\sqrt{3}}$ by $\frac{2}{3}k^2$

Section 3.4, pp. 151–154

1. **a.** \$1.80
b. \$1.07
c. 5625 L

2. **a.** 15 terms
b. 16 terms/h
c. 20 terms/h

3. **a.** $t = 1$
b. 1.5
c.

d. The level will be a maximum.
e. The level is decreasing.

4. \$6000/h when plane is flying at 15 000 m

5. 250 m by 375 m

6. \$1100 or \$1125

7. \$22.50

8. 6 nautical miles/h

9. 20.4 m by 40.8 m by 24.0 m

10. $r = 4.3$ cm, $h = 17.2$ cm

11. **a.** \$15
b. \$12.50, \$825
c. If you increase the price, the number sold will decrease. Profit in situations like this will increase for several price increases and then it will decrease because too many customers stop buying.

12. 12.1 cm by 18.2 cm by 18.2 cm

13. \$50

14. \$81.25

15. 19 704 units

16. $P(x) = R(x) - C(x)$
Marginal Revenue $= R'(x)$.
Marginal Cost $= C'(x)$.
Now $P'(x) = R'(x) - C'(x)$.
The critical point occurs when $P'(x) = 0$.
If $R'(x) = C'(x)$, then
$P'(x) = R'(x) - C'(x)$
$= 0$
Therefore, the instantaneous rate of change in profit is 0 when the marginal revenue equals the marginal cost.

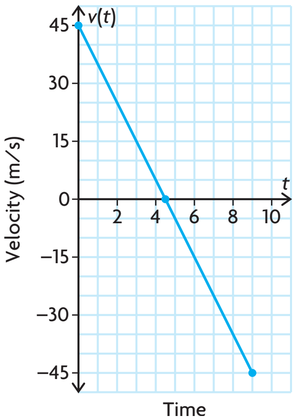
17. $r = 230$ cm and h is about 900 cm

18. 128.4 km/h

19. maximum velocity: $\frac{4}{27}r_0A$, radius: $\frac{2r_0}{3}$.

Review Exercise, pp. 156–159

1. $f'(x) = 4x^3 + 4x^{-5}$,
$f''(x) = 12x^2 - 20x^{-6}$
2. $\frac{d^2y}{dx^2} = 72x^7 - 42x$
3. $v = 2t + (2t - 3)^{\frac{1}{2}}$,
$a = 2 - (2t - 3)^{\frac{3}{2}}$
4. $v(t) = 1 - 5t^{-2}$,
$a(t) = 10t^{-3}$
5. The upward velocity is positive for $0 \le t \le 4.5$ s, zero for $t = 4.5$ s, and negative for $t > 4.5$ s.



6. **a.** min: −52,
max: 0
b. min: −65,
max: 16
c. min: 12,
max: 20
7. **a.** 62 m
b. Yes, 2 m beyond the stop sign
c. Stop signs are located two or more metres from an intersection. Since the car only went 2 m beyond the stop sign, it is unlikely the car would hit another vehicle travelling perpendicular.
8. min is 2, max is $2 + 3\sqrt{3}$
9. 250
10. **a.** **i.** \$2200
ii. \$5.50
iii. \$3.00; \$3.00
b. **i.** \$24 640
ii. \$61.60
iii. \$43.20; \$43.21
c. **i.** \$5020
ii. \$12.55
iii. \$0.03; \$0.03
d. **i.** \$2705
ii. \$6.88
iii. \$5.01; \$5.01
11. 2000
12. **a.** moving away from its starting point
b. moving away from the origin and towards its starting position
13. **a.** $t = \frac{2}{3}$ **b.** yes
14. 27.14 cm by 27.14 cm for the base and height 13.57 cm
15. length 190 m, width approximately 63 m
16. 31.6 cm by 11.6 cm by 4.2 cm
17. radius 4.3 cm, height 8.6 cm
18. Run the pipe 7.2 km along the river shore and then cross diagonally to the refinery.
19. 10:35 p.m.
20. \$204 or \$206
21. The pipeline meets the shore at a point *C*, 5.7 km from point *A*, directly across from *P*.
22. 11.35 cm by 17.02 cm
23. 34.4 m by 29.1 m
24. 2:23 p.m.
25. 3.2 km from point *C*
26. **a.** absolute maximum: $f(7) = 41$,
absolute minimum: $f(1) = 5$
b. absolute maximum: $f(3) = 36$,
absolute minimum: $f(-3) = -18$
c. absolute maximum: $f(5) = 67$,
absolute minimum: $f(-5) = -63$
d. absolute maximum: $f(4) = 2752$,
absolute minimum: $f(-2) = -56$
27. **a.** 62.9 m **c.** 3.6 m/s^2
b. 4.7 s
28. **a.** $f''(2) = 60$ **d.** $f''(1) = -\frac{5}{16}$
b. $f''(-1) = 26$ **e.** $f''(4) = -\frac{1}{108}$
c. $f''(0) = 192$ **f.** $f''(8) = -\frac{1}{72}$
29. **a.** position: 1, velocity: $\frac{1}{6}$,
acceleration: $-\left(\frac{1}{18}\right)$, speed: $\frac{1}{6}$
b. position: $\frac{8}{3}$, velocity: $\frac{4}{9}$,
acceleration: $\frac{10}{27}$, speed: $\frac{4}{9}$
30. **a.** $v(t) = \frac{2}{3}(t^2 + t)^{-\frac{1}{3}}(2t + 1)$,
$a(t) = \frac{2}{9}(t^2 + t)^{-\frac{4}{3}}(2t^2 + 2t - 1)$
b. 1.931 m/s
c. 2.36 m/s
d. undefined
e. 0.141 m/s^2

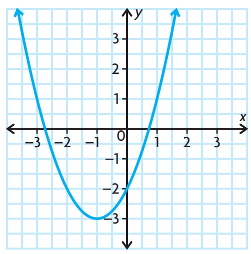
Chapter 3 Test, p. 160

1. **a.** $y'' = 14$
b. $f''(x) = -180x^3 - 24x$
c. $y'' = 60x^{-5} + 60x$
d. $f''(x) = 96(4x - 8)$
2. **a.** $v(3) = -57$,
$a(3) = -44$
b. $v(2) = 6$,
$a(2) = -24$
3. **a.** $v(t) = 2t - 3$,
$a(t) = 2$
b. −0.25 m
c. 1 m/s, 1 m/s
d. between $t = 0$ s and $t = 1.5$ s
e. 2 m/s^2
4. **a.** min: −63, max: 67
b. min: 7.5, max: 10
5. **a.** 2.1 s
b. about 22.9
6. 250 m by 166.7 m
7. 162 mm by 324 mm by 190 mm
8. \$850/month

Chapter 4

Review of Prerequisite Skills, pp. 162–163

1. **a.** $y = -\frac{3}{2}$ or $y = 1$
b. $x = 7$ or $x = -2$
c. $x = -\frac{5}{2}$
d. $y = 1$ or $y = -3$ or $y = -2$
2. **a.** $x < -\frac{7}{3}$
b. $x \le 2$
c. $-1 < t < 3$
d. $x < -4$ or $x > 1$
3. **a.**



b.