10. **a)** $(7x + 2)(x - 3)$ **c)** $(2x - 1)(6x - 5)$
b) $(4a + 3)(a + 5)$ **d)** $(2n - 5y)(3n + 2y)$

11. **a)** 10 and 50 watches **b)** \$800

12. **a)** $4x^2 + 12x + 9 = (2x + 3)^2$
b) $64x^2 - 9 = (8x - 3)(8x + 3)$

13. **a)** $(12x - 5)(12x + 5)$ **d)** $(2x - 9)^2$
b) $(6a + 1)^2$ **e)** $(x + 5 - y)(x + 5 + y)$
c) $2x(3x^2 - 16y)(3x^2 + 16y)$ **f)** $(x - 3 - 2y)(x - 3 + 2y)$

14. No. Answers may vary, e.g., $x^2 + 25$ cannot be factored because it has two terms and no common factors, and it is not a difference of squares.

15. Expanding an algebraic expression is the reverse of factoring it. Answers may vary, e.g., expanding $(x + 2)(x - 4)$ gives $x^2 - 2x - 8$, while factoring $x^2 - 2x - 8$ gives $(x + 2)(x - 4)$.

16. **a)** $(7x + 2)(x - 4)$ **d)** $4y(x - 9)(x - 2)$
b) $(8a^3 - 5)(8a^3 + 5)$ **e)** $(4x + 5)(5x + 9)$
c) $(3c - 2)(6a - 5)$ **f)** $(z^2 - 8)(z^2 - 5)$

17. **a)** $(2s + 5)(s - 1)$ **d)** $(4s - 11r)(4s + 11r)$
b) $(5 + w)(3 - w)$ **e)** $(3 - 5g)^2$
c) $(z^2 - 8)(z^2 + 4)$ **f)** $(x + 8 - 5y)(x + 8 + 5y)$

18. **a)** The three dimensions are $2x + 5$, $3x + 1$, and $3x - 1$.
b) The three dimensions are 9 cm, 7 cm, and 5 cm; the volume is 315 cm^3.

19. **a)** $(5, -1)$ **c)** $(0, 500)$ **e)** $(-2, -16)$
b) $(6, 0)$ **d)** $(1.75, -10.125)$ **f)** $(-5, 0)$

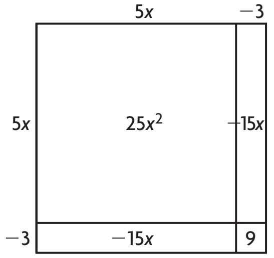
Chapter Self-Test, page 242

1. **a)** ◆ = 1; ■ = 8
b) Answers may vary, e.g., ◆ = 9; ■ = 4; ● = 3
c) ◆ = 3; ■ = 1; ● = 23
d) Answers may vary, e.g., ◆ = 7; ■ = 5; ● = 70

2. **a)** $4x^2 - 10x + 6 = (2x - 3)(2x - 2)$
b) $2x^2 + 7x - 4 = (2x - 1)(x + 4)$

3. **a)** $10x^3(2x^2 - 3)$ **c)** $(3b + 5)(2a + 7)$
b) $-2yc(4c^2 - 2y + 3)$ **d)** $(t + 3)(2s + 5)$

4. **a)** Answers may vary, e.g.,
- **i)** using a perfect square pattern: $(5x - 3)^2$
- **ii)** using an area diagram:



b) Answers may vary, e.g., I prefer the perfect-square method because it is more direct.

5. **a)** $(x + 11)(x - 7)$ **c)** $3(x - 2)^2$
b) $(a - 5)(a + 2)$ **d)** $m(m + 4)(m - 1)$

6. **a)** $(2x + 1)(3x - 2)$ **c)** $(3x + 2)^2$
b) $2(2n - 1)(2n + 3)$ **d)** $a(3x + 4)(2x - 1)$

7. Answers may vary, e.g.,
a) length $= 2x + 3$, width $= x + 4$
b) length $= 2x + 5$, width $= 2x + 8$; expression for area: $4x^2 + 26x + 40$
c) length $= 6x + 9$, width $= 3x + 12$

8. **a)** $(15x - 2)(15x + 2)$ **c)** $(x^3 - 2y)(x^3 + 2y)$
b) $(3a - 8)^2$ **d)** $(3 + n - 5)^2 = (n - 2)^2$

9. Answers may vary, e.g., first, I factor the equation as $y = (2x - 1)(x - 5)$. This gives me zeros at $x = 0.5$ and $x = 5$. I know that the x-value of the vertex is halfway between these values, so it is 2.75. I substitute this value into the equation above to solve for the y-value: $y = (2 \times 2.75 - 1)(2.75 - 5) = -10.125$. Therefore, the vertex is located at $(2.75, -10.125)$.

Chapter 5

Getting Started, page 246

1. **a)** ii **c)** v **e)** i
b) iii **d)** vi **f)** iv

2. **a)** figure C; each square of figure A is translated 6 units left and 6 units down.
b) figure D; each square of figure A is reflected in the x-axis.
c) figure B; each square of figure A is reflected in the y-axis.

3. **a)** 13 **b)** 0

4. **a)** zeros: -5, 3; equation of the axis of symmetry: $x = -1$; vertex: $(-1, -16)$
b) zeros: 4, -1; equation of the axis of symmetry: $x = 1.5$; vertex: $(1.5, -12.5)$
c) zeros: 0, -3; equation of the axis of symmetry: $x = -1.5$; vertex: $(-1.5, 9)$

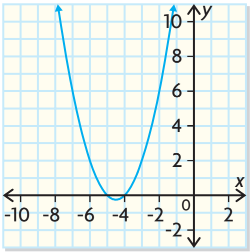
5. **a)** $(1, 9)$ **b)** $(3, -8)$ **c)** $(0, 0)$ **d)** $(3, 5)$

6. **a)** translation 5 units right and 3 units down
b) translation 3 units right and 6 units down
c) translation 2 units left and 3 units down

7. **a)** zeros: -1, 2; equation of the axis of symmetry: $x = 0.5$; vertex: $(0.5, -9)$
b) zeros: -3, 0; equation of the axis of symmetry: $x = -1.5$; vertex: $(-1.5, 2)$

8. **a)** $y = x^2 + 9x + 20$ **c)** $y = -3x^2 - 9x + 84$
b) $y = 2x^2 + x - 6$ **d)** $y = x^2 + 10x + 25$

9. **a)**



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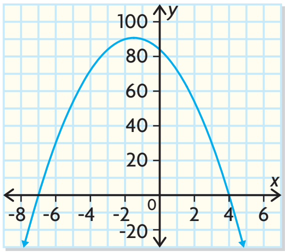

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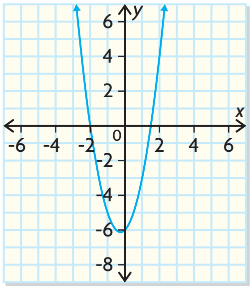

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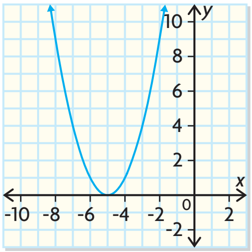


10. $y = 2(x + 4)(x - 6)$; -50

11. Answers may vary, e.g.,

Definition: A relation that can be described by an equation with a polynomial whose highest degree is 2	Special Properties: The graph has a vertical line of symmetry. The graph also has a single minimum or maximum value.
Examples: $y = x^2 + 9x + 2$ $y = 2(x + 4)(x - 6)$ $y = 4(x + 2)^2 - 3$	Non-examples: $y = x + 9$ $y = x^3 + 9x + 3$ $y = \sqrt{x}$

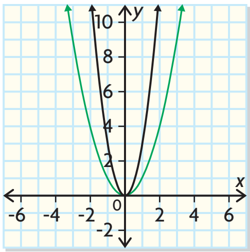
Quadratic Relation

Lesson 5.1, page 256

1.	**a)** iv	**b)** iii	**c)** i	**d)** ii
2.	**a)** (1, 5)	**b)** (−2, −12)	**c)** (5, −15)	**d)** (−4, 8)

3. **a)** Answers may vary, e.g., $y = 4x^2$; $y = 1.01x^2$
b) Answers may vary, e.g., $y = 0.5x^2$; $y = -0.1x^2$
c) Answers may vary, e.g., $y = -3.1x^2$; $y = -6x^2$

4. **a)**



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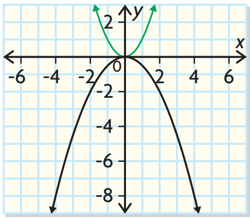

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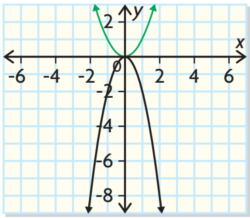

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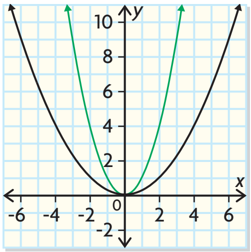

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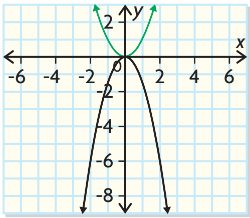

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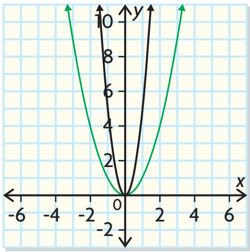


5. **a)** vertical stretch by a factor of 4; $y = 4x^2$
b) vertical compression by a factor of $\frac{1}{2}$, reflected in the x-axis; $y = -\frac{1}{2}x^2$
c) vertical stretch by a factor of 2.5, reflected in the x-axis; $y = -2.5x^2$
d) vertical compression by a factor of $\frac{1}{4}$; $y = \frac{1}{4}x^2$

6. Choose the point (2, −0.5), and substitute this point into $y = ax^2$; solve for a; Answers may vary, e.g., $y = -0.125x^2$.

7. **a)** Answers may vary, e.g., $y = -\frac{5}{9}x^2$
b) Answers may vary, e.g., $y = -\frac{3}{16}x^2$

8. **a)** vertical stretch by a factor of 4; (2, 16)
b) reflection in the x-axis, vertical compression by a factor of $\frac{2}{3}$; $\left(2, -\frac{8}{3}\right)$
c) vertical compression by a factor of 0.25; (2, 1)
d) reflection in the x-axis, vertical stretch by a factor of 5; (2, −20)
e) reflection in the x-axis; (2, −4)
f) vertical compression by a factor of $\frac{1}{5}$; $\left(2, \frac{4}{5}\right)$

9. Answers may vary, e.g., $y = -\frac{1}{9}x^2$

10. Disagree. Changing the value of a to 1 or −1 will make $y = ax^2$ congruent to $y = x^2$.

11.

Equation	Direction of Opening (upward/ downward)	Description of Transformation (stretch/compress)	Shape of Graph Compared with Graph of $y = x^2$ (wider/narrower)
$y = 5x^2$	upward	stretch	narrower
$y = 0.25x^2$	upward	compress	wider
$y = -\frac{1}{3}x^2$	downward	compress	wider
$y = -8x^2$	downward	stretch	narrower

12. **a)** All the y-coordinates are multiplied by a negative number. This means that all the points on the graph $y = ax^2$ are reflected in the x-axis, causing the parabola to open downward.
b) The y-coordinates of the points on the graph are multiplied by a fraction whose magnitude is less than 1, so the points are moved toward the x-axis, making the parabola wider.
c) Since the y-coordinate of the vertex is 0, and multiplying 0 by any number results in a value of 0, the vertex is not affected.

13. It has the same effect on all graphs.

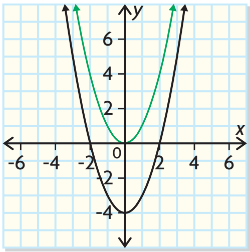
14. **a)** As the value of a increases, the radius of the circle decreases. As the value of a decreases, the radius of the circle increases.
b) The graph of $ax^2 + by^2 = r^2$ is a circle that has been stretched or compressed both horizontally and vertically for all values of a and b, where $a \neq 1$ and $b \neq 1$. The resulting oval shape is called an ellipse. As the value of a increases, the width of the oval shape along the x-axis decreases. As the value of a decreases, the width of the oval shape along the x-axis increases. As the value of b increases, the width of the oval shape along the y-axis decreases. As the value of b decreases, the width of the oval shape along the y-axis increases.

Lesson 5.2, page 262

1. **a)** $h = 3, k = 0; y = (x - 3)^2$
b) $h = 0, k = -4; y = x^2 - 4$
c) $h = -2, k = 0; y = (x + 2)^2$
d) $h = 0, k = 5; y = x^2 + 5$
e) $h = -6, k = -7; y = (x + 6)^2 - 7$
f) $h = 2, k = 5; y = (x - 2)^2 + 5$

2.	**a)** iii	**b)** v	**c)** ii	**d)** iv

3. **a)**



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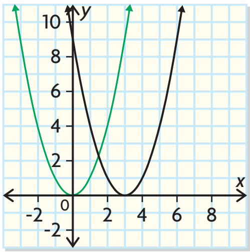

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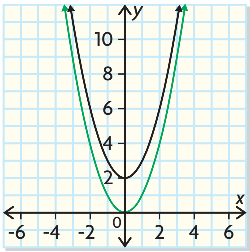

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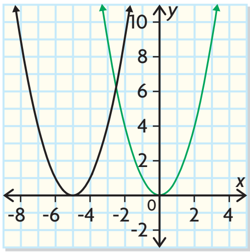

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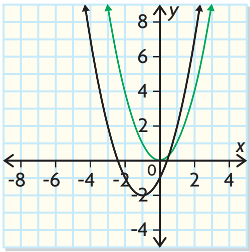

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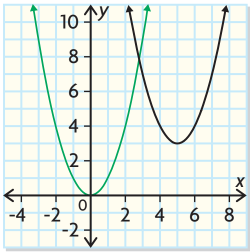


4. **a)** The parabola moves 5 units up.
b) The parabola moves 3 units right.
c) The parabola is reflected in the *x*-axis and vertically stretched by a factor of 3.
d) The parabola moves 7 units left.
e) The parabola is vertically compressed by a factor of $\frac{1}{2}$.
f) The parabola moves 6 units left and 12 units up.

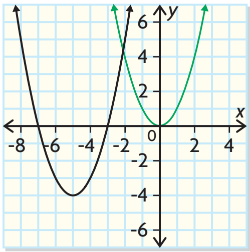
5. **a)** vertex: (0, 5); equation of the axis of symmetry: $x = 0$
b) vertex: (3, 0); equation of the axis of symmetry: $x = 3$
c) vertex: (0, 0); equation of the axis of symmetry: $x = 0$
d) vertex: (−7, 0); equation of the axis of symmetry: $x = -7$
e) vertex: (0, 0); equation of the axis of symmetry: $x = 0$
f) vertex: (−6, 12); equation of the axis of symmetry: $x = -6$

Lesson 5.3, page 269

1. **a)** translation 3 units down
b) translation 5 units left
c) vertical compression by a factor of $\frac{1}{2}$, reflection in the *x*-axis
d) vertical stretch by a factor of 4, translation 2 units left and 16 units down

2. **a) i)** upward **ii)** (0, −3) **iii)** $x = 0$
b) i) upward **ii)** (−5, 0) **iii)** $x = -5$
c) i) downward **ii)** (0, 0) **iii)** $x = 0$
d) i) upward **ii)** (−2, −16) **iii)** $x = -2$

3. **a)**



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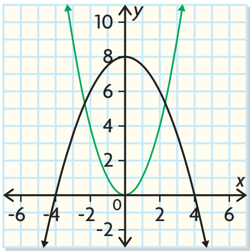

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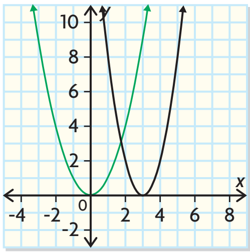

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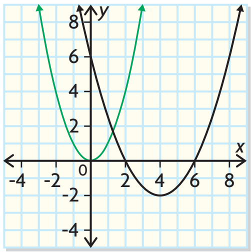
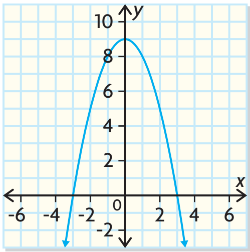


4. **a)** reflection in the *x*-axis, translation 9 units up
b) translation 3 units right
c) translation 2 units left and 1 unit down
d) reflection in the *x*-axis, translation 6 units down
e) vertical stretch by a factor of 2, reflection in the *x*-axis, translation 4 units right and 16 units up
f) vertical compression by a factor of $\frac{1}{2}$, translation 6 units left and 12 units up
g) vertical compression by a factor of $\frac{1}{2}$, reflection in the *x*-axis, translation 4 units left and 7 units down
h) vertical stretch by a factor of 5, translation 4 units right and 12 units down

5. **a)**



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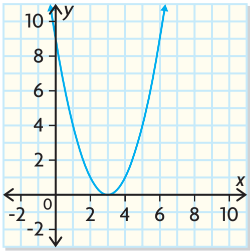

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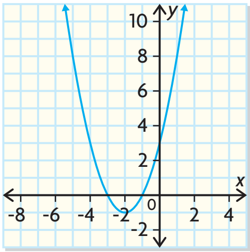

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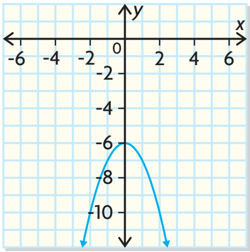

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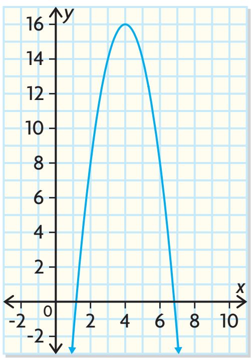

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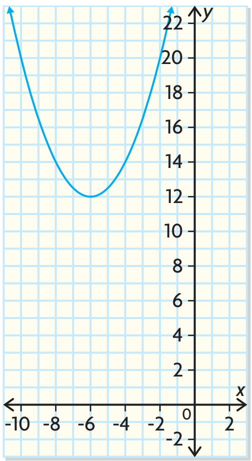

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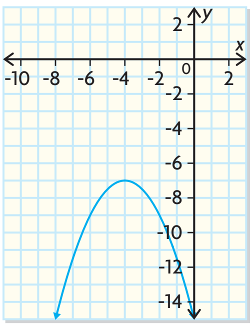

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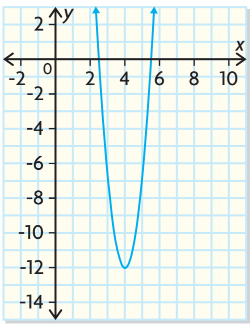
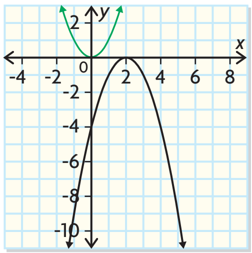


6. **a)** ii
b) v
c) iv
d) vi
e) i
f) iii

7. **a)**



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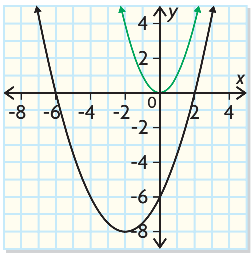

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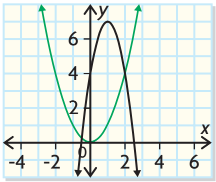

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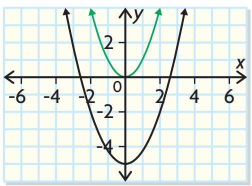

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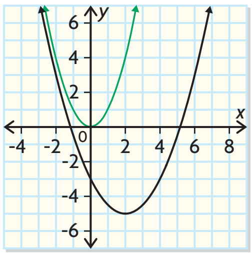

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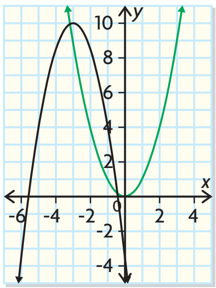
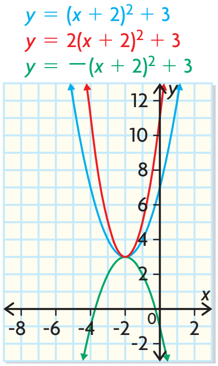


8.

Quadratic Relation	Stretch/ Compression Factor	Reflection in the *x*-axis	Horizontal/ Vertical Translation	Vertex	Axis of Symmetry
$y = 3(x - 2)^2 - 5$	3	no	2 right, 5 down	(2, −5)	$x = 2$
$y = 4(x + 2)^2 - 3$	4	no	2 left, 3 down	(−2, −3)	$x = -2$
$y = -(x - 1)^2 + 4$	1	yes	1 right, 4 up	(1, 4)	$x = 1$
$y = 0.8(x - 6)^2$	0.8	no	6 right	(6, 0)	$x = 6$
$y = 2x^2 - 5$	2	no	5 down	(0, −5)	$x = 0$

9. Answers may vary, e.g.,
$y = (x + 2)^2 + 3$,
$y = 2(x + 2)^2 + 3$,
$y = -(x + 2)^2 + 3$. The second graph is a vertical stretch of the first graph by a factor of 2. The third graph is a reflection of the first graph in the *x*-axis.



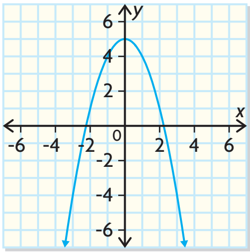
10. **a)** The graph for the bedsheet will be the narrowest parabola. The graph for the car tarp will be wider than the graph for the bedsheet. The graph for the parachute will be the widest parabola of all three. An object dropped from 100 m will hit the ground at about 4.5 s with a bedsheet, at about 5 s with a car tarp, and at about 15 s with a regular parachute.

b) Yes. If the object with the bedsheet is dropped from a much higher altitude than the object with the parachute is dropped, or at an earlier time, it is possible for them to hit the ground at the same time. The graph for the bedsheet would be narrower than the graph for the parachute, and it would have a much higher vertex. The positive zeros would be equal.

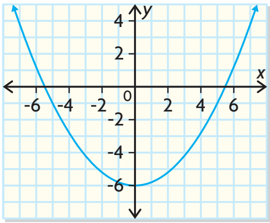
11. **a)** $y = -x^2 + 5$ **c)** $y = \frac{1}{5}x^2 - 6$

b) $y = 5(x + 2)^2$ **d)** $y = -6(x - 3)^2 + 4$

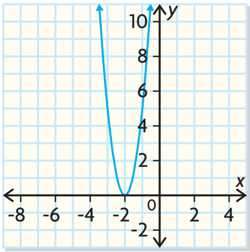
12. **a)**



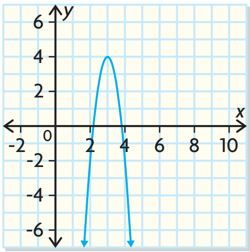
c)



b)



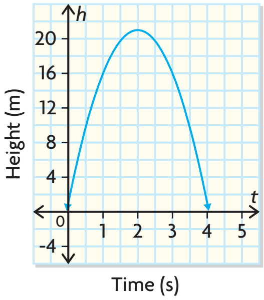
d)



13. The equation in part **c)** is $y = -\frac{2}{3}(x - 3)^2 + 5$. The vertex is at (3, 5), so the equation is of the form $y = a(x - 3)^2 + 5$. The parabola opens downward, so a is negative. Substituting for point $(0, -1)$ in the equation gives $-1 = a(-3)^2 + 5$. Solving for a gives $a = -\frac{2}{3}$.

14. **a)** 4 s **b)** 2500 m

15. **a)**



b) 21 m
c) 2 s
d) about 0.5 s and 3.5 s
e) about 4 s

16. Answers may vary, e.g., translation 5 units right and 8 units up: $y = (x - 5)^2 + 8$; reflection in the x-axis, translation 5 units right and 26 units up: $y = -(x - 5)^2 + 26$; vertical stretch by a factor of $\frac{17}{9}$ and shift 5 units right: $y = \frac{17}{9}(x - 5)^2$.

17. standard form: $y = 2x^2 + 12x - 80$;
vertex form: $y = 2(x + 3)^2 - 98$

18. Answers may vary, e.g.,

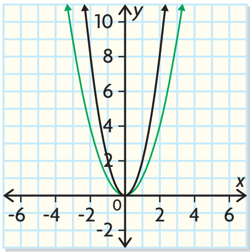
$y = -2(x + 3)^2 + 4$

Translation: 3 units left, 4 units up	Reflection: reflected in the x-axis
Stretch/Compression: stretch by a factor of 2	Vertex: (−3, 4)

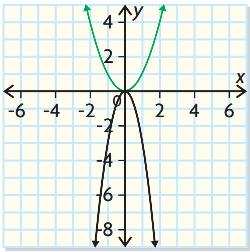
19. zero: $k - 1$ or 1

Mid-Chapter Review, page 274

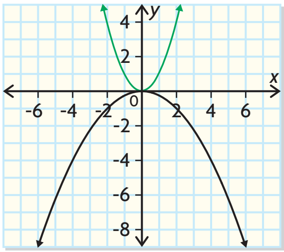
1. **a)**



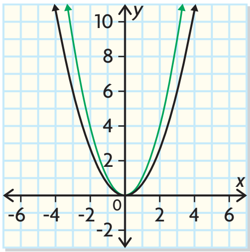
c)



b)

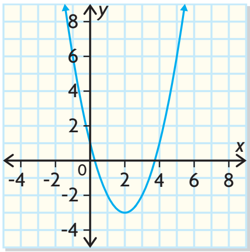


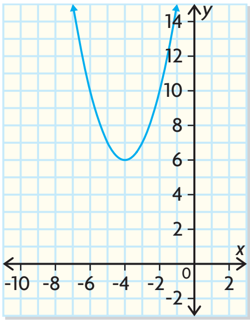
d)



2. **a)** vertical stretch by a factor of 4; $y = 4x^2$
b) reflection in the x-axis; $y = -x^2$

3. **a)** $h = 2$, $k = -3$; $y = (x - 2)^2 - 3$ **b)** $h = -4$, $k = 6$; $y = (x + 4)^2 + 6$





4. Answers may vary, e.g., $y = (x + 3)^2 - 3$, $y = (x + 2)^2 - 2$, $y = (x + 1)^2 - 1$, $y = x^2$, $y = (x - 1)^2 + 1$, $y = (x - 2)^2 + 2$, $y = (x - 3)^2 + 3$

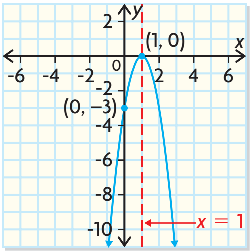
5. **a)** vertical stretch by a factor of 3, reflection in the x-axis, translation 1 unit right

b) vertical compression by a factor of 0.5, translation 3 units left and 8 units down

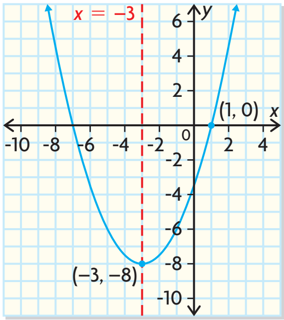
c) vertical stretch by a factor of 4, translation 2 units right and 5 units down

d) vertical compression by a factor of $\frac{2}{3}$, translation 1 unit down

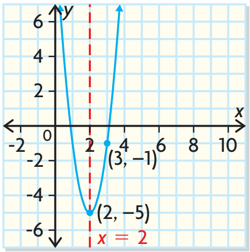
6. **a)** Answers may vary for points labelled, e.g.,



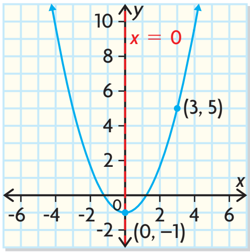
b) Answers may vary for points labelled, e.g.,



c) Answers may vary for points labelled, e.g.,



d) Answers may vary for points labelled, e.g.,

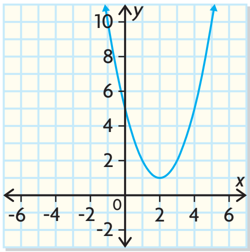


7. **a)** **i)** stretch by a factor of 1, translation 2 units right and 1 unit up

ii) no reflection

iii) $(2, 1)$, $x = 2$

iv)

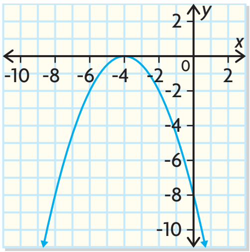


b) **i)** compression by a factor of 0.5, translation 4 units left

ii) reflection

iii) $(-4, 0)$, $x = -4$

iv)

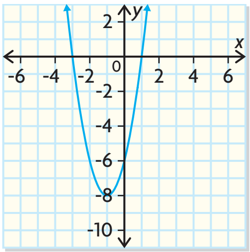


c) **i)** stretch by a factor of 2, translation 1 unit left and 8 units down

ii) no reflection

iii) $(-1, -8)$, $x = -1$

iv)

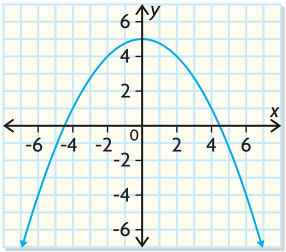


d) **i)** compression by a factor of 0.25, translation 5 units up

ii) reflection

iii) $(0, 5)$, $x = 0$

iv)



8. If $a > 0$, then $k > 0$; the vertex is above the x-axis and opens upward. Answers may vary, e.g., $y = 3x^2 + 2$
If $a < 0$, then $k < 0$; the vertex is below the x-axis and opens downward. Answers may vary, e.g., $y = -3x^2 - 2$

Lesson 5.4, page 280

1. **a)** iii **b)** iv **c)** i **d)** ii

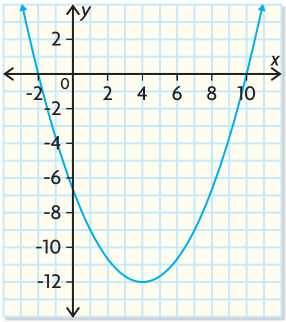
2. **a)** $y = a(x - 4)^2 - 12$, $a \neq 0$

b) $a = \frac{1}{3}$

c) $y = \frac{1}{3}(x - 4)^2 - 12$

d) vertical compression by a factor of $\frac{1}{3}$, translation 4 units right and 12 units down

e)



3. **a)** $y = 0.25x^2$
b) $y = 2(x + 1)^2$
c) $y = -x^2 + 4$
d) $y = -(x - 1)^2 + 2$
e) $y = -3(x - 2)^2 + 4$
f) $y = 5(x + 2)^2 - 3$

4. **a)** $y = 4x^2$
b) $y = (x + 3)^2$
c) $y = -x^2 + 2$
d) $y = \frac{1}{2}x^2$
e) $y = (x - 5)^2 - 4$
f) $y = -2(x + 1)^2$

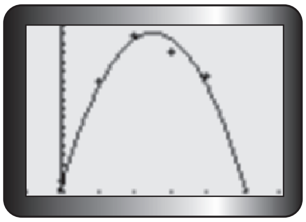
5. **a)** $y = x^2 + 4$
b) $y = -(x - 5)^2$
c) Answers may vary, e.g., $y = 2(x - 2)^2 - 3$
d) Answers may vary, e.g., $y = -0.5(x + 3)^2 + 5$
e) Answers may vary, e.g., $y = 2(x - 4)^2 - 8$
f) Answers may vary, e.g., $y = -0.5(x - 3)^2 - 4$

6. **a)** $y = -0.5(x + 2)^2 + 3$ **c)** $y = (x + 2)^2 - 3$
b) $y = 2(x + 1)^2 - 1$ **d)** $y = -(x + 2)^2 + 5$

7. **a)** $x = 5, y = -4(x - 5)^2 + 3$
b) $x = 1.5, y = 4(x - 1.5)^2 + 3$

8. Answers may vary, e.g., $y = -\frac{2}{9}(x - 3)^2 + 2$

9. **a)**



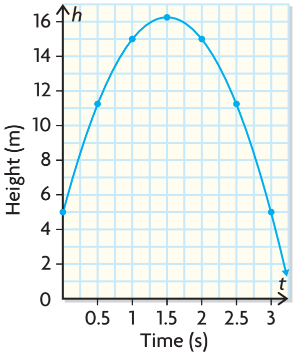
b) Answers may vary, e.g., vertex: about (2.5, 4625); $y = -509(x - 2.5)^2 + 4625$

c) Zero DVDs were sold. This shows limits of making predictions into the future. The prediction assumes that the decreasing trend in sales continues indefinitely, which may or may not be the case.

d) regression: $y = -484x^2 + 2440x + 1553$; standard form of relation in part b): $y = -509x^2 + 2545x + 1443.75$; reasonably accurate

10. **a)** quadratic; the height values increase and then decrease.

b)



c) Answers may vary, e.g., about (1.5, 16.25)

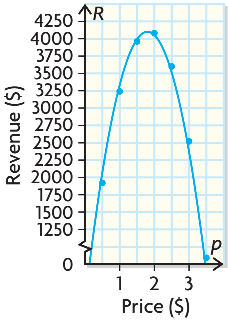
d) $h = -5(t - 1.5)^2 + 16.25$

e) 8.4375 m, 15.9375 m

f) not effective; the height is negative, which would mean that the ball is under ground level.

g) regression: $h = -5t^2 + 15t + 5$; standard form of relation in part b): $h = -5t^2 + 15t + 5$; highly accurate

11. **a)**



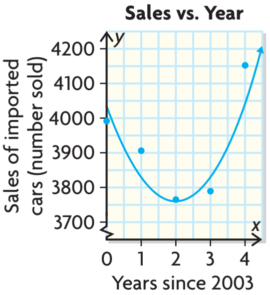
b) Answers may vary, e.g., $R = -1200(p - 1.8)^2 + 4100$

c) Answers may vary, e.g., about $4000

d) Answers may vary, e.g., $1.80

e) regression: $R = -1200p^2 + 4440p$; standard form of relation in part b): $R = -1200p^2 + 4320p + 212$; reasonably accurate

12. **a)** Answers may vary, e.g., in this model, x is the number of years since 2003 and y is the number of imported cars sold.



b) Answers may vary, e.g., $y = 70(x - 2)^2 + 3760$

c) Answers may vary, e.g., about 4390

d) Answers may vary, e.g., about 3830. This is reasonably accurate since it is about 1.5% higher than the actual value.

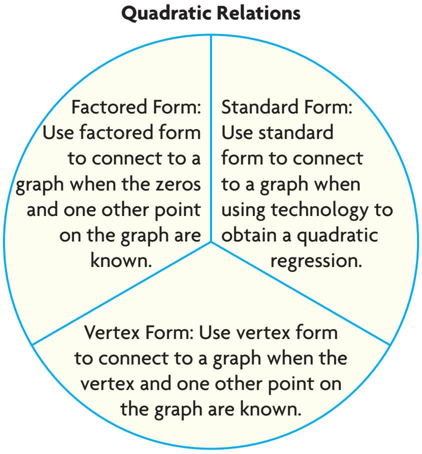
e) regression: $y = 77x^2 - 288x + 4036$; standard form of relation in part b): $y = 70x^2 - 280x + 4040$; reasonably accurate

13. $h = 0.000\,083\,5(x - 758)^2 + 2$, where h represents the height of the cable from the road and x represents the horizontal distance from one of the towers

14. Strategy 1: The vertex is (20, 2000). Substitute (40, 0) in $h = a(t - 20)^2 + 2000$ to determine the value of a.
Strategy 2: The two zeros are (0, 0) and (40, 0). Substitute the vertex (20, 2000) in $h = at(t - 40)$ to determine the value of a.

15. $p = -0.6(d - 75)^2 + 1600$

16. Answers may vary, e.g.,



Quadratic Relations

Factored Form: Use factored form to connect to a graph when the zeros and one other point on the graph are known.

Standard Form: Use standard form to connect to a graph when using technology to obtain a quadratic regression.

Vertex Form: Use vertex form to connect to a graph when the vertex and one other point on the graph are known.

17. **a)** $y = 2(x - 1)^2 - 1$ **d)** $y = 12(x + 3)^2 - 1$
b) $y = -2(x + 3)^2 - 1$ **e)** $y = 0.5(x - 3)^2 - 6$
c) $y = -2(x + 3)^2 - 4$

18. $b = 6, c = 7$

19. $x = h \pm \sqrt{-\frac{k}{a}}$

Lesson 5.5, page 293

1. **a)** $y = 2x^2 + 3$ **c)** $y = -(x - 3)^2 - 2$
b) $y = -3(x - 2)^2$ **d)** $y = 0.5(x + 3.5)^2 + 18.3$

2. **a)** minimum value: 3 **c)** maximum value: −2
b) maximum value: 0 **d)** minimum value: 18.3

3. **a)** $y = -0.0625x^2$
b) The value of a is the same in each of these equations since the parabolas are congruent.

4. **a)** $y = -2x^2 + 3$

b) $y = (x - 2)^2$

c) $y = 3(x + 3)^2 + 2$

d) $y = -\frac{5}{16}(x - 5)^2 - 3$

5. **a)** $y = (x + 1)^2 - 4$

b) $y = 2(x - 4)^2 - 2$

c) $y = -(x - 4)^2 + 4$

d) $y = -\frac{1}{2}x^2 + 4$

6. **a)** standard form: $y = x^2 + 2x - 3$;
factored form: $y = (x - 1)(x + 3)$

b) standard form: $y = 2x^2 - 16x + 30$;
factored form: $y = 2(x - 5)(x - 3)$

c) standard form: $y = -x^2 + 8x - 12$;
factored form: $y = -(x - 2)(x - 6)$

d) standard form: $y = -\frac{1}{2}x^2 + 4$;
factored form: $y = -\frac{1}{2}(x^2 - 8)$

7. $y = -0.5(x - 3)^2 + 12.5$

8. minimum value: -10; $y = 2(x - 1)^2 - 10$

9. **a)** standard form: $y = x^2 - 8x + 15$;
factored form: $y = (x - 5)(x - 3)$

b) standard form: $y = 2x^2 + 4x - 16$;
factored form: $y = 2(x + 4)(x - 2)$

c) standard form: $y = -x^2 - 10x - 24$;
factored form: $y = -(x + 4)(x + 6)$

d) standard form: $y = -3x^2 - 18x + 48$;
factored form: $y = -3(x + 8)(x - 2)$

10. **a)** factored form: $y = 2x(x - 6)$;
vertex form: $y = 2(x - 3)^2 - 18$

b) factored form: $y = -2(x - 8)(x - 4)$;
vertex form: $y = -2(x - 6)^2 + 8$

c) factored form: $y = (2x + 3)(x - 2)$;
vertex form: $y = 2(x - 0.25)^2 - 6.125$

d) factored form: $y = (2x + 5)^2$;
vertex form: $y = 4(x + 2.5)^2$

11. \$5.00

12. translation 4 units right and 10 units up

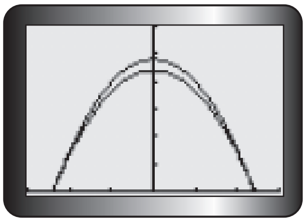
13. **a)** 1997

b) \$5.09

c) \$14.81

d) $C = 0.06(t - 2.25)^2 + 5.056\,25$

14. Answers may vary, e.g., $y = -\frac{11}{72}x^2 + 22$; $y = -\frac{1}{6}x^2 + 24$



15. **a)** $P = -20(x - 2)^2 + 3380$

b) A ticket price of \$13 gives a maximum profit of \$3380; about 260 tickets sold.

16. No. Clearance 8 m from the axis of symmetry is only 26.928 m.

17. $(0, -4)$

18. Answers may vary, e.g., disagree. Vertex form is best for determining maximum and minimum values, because they equal the y-coordinate of the vertex. Factored form, or standard form with technology when the quadratic relation is not factorable, is best for determining zeros.

19. maximum value: 1

20. **a)** left: $y = -\frac{1}{5}x(x - 8)$; right: $y = -\frac{1}{5}(x - 2)(x - 10)$ **b)** 3.2 m

Lesson 5.6, page 301

1. $x = -2$

2. Answers may vary, e.g., $(0.5, 0)$, $(2.5, 0)$

3. $y = 2(x - 2.5)^2 - 1.5$

4. **a)** $x = 5$

b) vertex: $(5, 8)$; $y = -2(x - 5)^2 + 8$

c) $y = -2x^2 + 20x - 42$

5. **a)** **i)** Answers may vary, e.g., $(-7, 0)$, $(1, 0)$
ii) $x = -3$
iii) $(-3, -16)$
iv) $y = (x + 3)^2 - 16$

b) **i)** Answers may vary, e.g., $(0, -8)$, $(6, -8)$
ii) $x = 3$
iii) $(3, -17)$
iv) $y = (x - 3)^2 - 17$

c) **i)** Answers may vary, e.g., $(-3, 0)$, $(7, 0)$
ii) $x = 2$
iii) $(2, 50)$
iv) $y = -2(x - 2)^2 + 50$

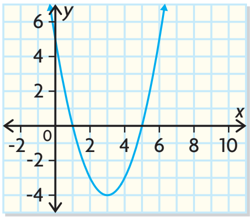
d) **i)** $(0, 2)$, $(-4, 2)$
ii) $x = -2$
iii) $(-2, -10)$
iv) $y = 3(x + 2)^2 - 10$

e) **i)** Answers may vary, e.g., $(-5, 0)$, $(0, 0)$
ii) $x = -2.5$
iii) $(-2.5, -6.25)$
iv) $y = (x + 2.5)^2 - 6.25$

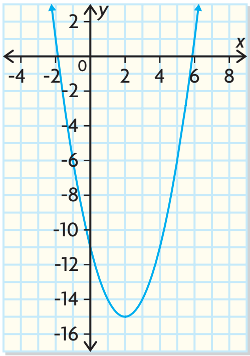
f) **i)** Answers may vary, e.g., $(0, 21)$, $(11, 21)$
ii) $x = 5.5$
iii) $(5.5, -9.25)$
iv) $y = (x - 5.5)^2 - 9.25$

6. $y = -(x - 4)^2 + 2$

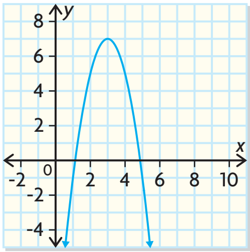
7. **a)** **i)** Answers may vary, e.g., $(0, 5)$, $(6, 5)$
ii) $(3, -4)$
iii) $y = (x - 3)^2 - 4$
iv)



b) **i)** Answers may vary, e.g., $(0, -11)$, $(4, -11)$
ii) $(2, -15)$
iii) $y = (x - 2)^2 - 15$
iv)



c) **i)** Answers may vary, e.g., $(0, -11)$, $(6, -11)$
ii) $(3, 7)$
iii) $y = -2(x - 3)^2 + 7$
iv)

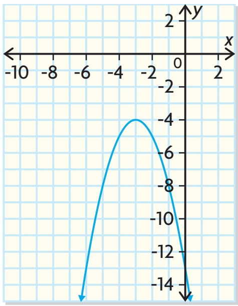


d) i) Answers may vary, e.g., $(0, -13)$, $(-6, -13)$

ii) $(-3, -4)$

iii) $y = -(x + 3)^2 - 4$

iv)

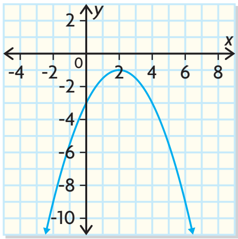


e) i) Answers may vary, e.g., $(0, -3)$, $(4, -3)$

ii) $(2, -1)$

iii) $y = -0.5(x - 2)^2 - 1$

iv)

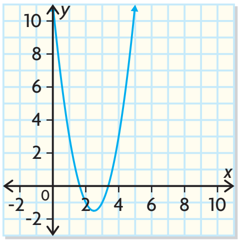


f) i) Answers may vary, e.g., $(0, 11)$, $(5, 11)$

ii) $(2.5, -1.5)$

iii) $y = 2(x - 2.5)^2 - 1.5$

iv)



8. Answers may vary, e.g., strategy 1: factor directly; strategy 2: use partial factoring to write the relation in vertex form; $x = 4$; writing the relation in vertex form requires less calculation.

9. $a = \frac{3}{4}$, $b = -6$

10. $a = 1$, $b = -2$

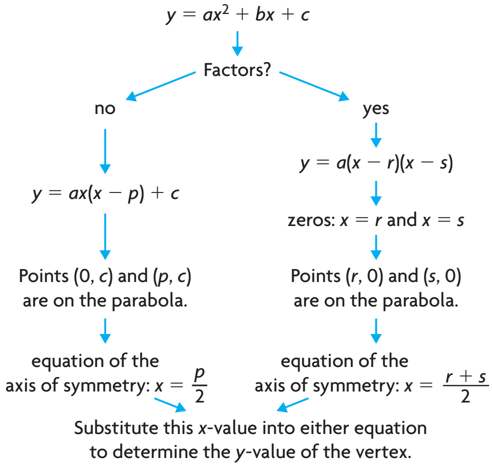
11. 1125 m

12. 5.05 m

13. \$7.50

14. **a)** 1977 **b)** about 1215 t **c)** about 1522 t

15. Answers may vary, e.g.,



16. 15 000 m^2

17. \$2.00; 1050

Chapter Review, page 304

1. **a)** Answers may vary, e.g., $y = 4x^2$, $y = 10x^2$
b) Answers may vary, e.g., $y = 0.1x^2$, $y = -0.4x^2$
c) Answers may vary, e.g., $y = -6x^2$, $y = -10x^2$

2. Substitute the value of p into $y = x^2$. If the y-value is less than q, then the parabola is wider than $y = x^2$. If the y-value is greater than q, then the parabola is narrower than $y = x^2$.

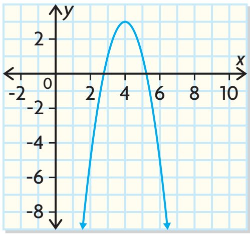
3. **a)** ii **b)** iii **c)** iv **d)** i

4. d); vertical compression by a factor of 2, reflection in the x-axis, translation 3 units to the right and 8 units up; therefore, $a = -2$, $(h, k) = (3, 8)$

5. Same; Both include vertical stretches by a factor of 2. Different: One includes a translation 4 units right and 5 units up; the other includes a translation 5 units right and 4 units up.

6. $y = -(x - 6)^2 - 8$

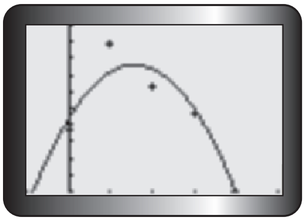
7. **a)** He needed to stretch the graph vertically before translating it.
b) Start by reflecting the graph of $y = x^2$ in the x-axis. Then stretch the graph vertically by a factor of 2. Finally, translate the graph so that its vertex moves to $(4, 3)$.
c)



8. **a)** $y = \frac{2}{3}(x + 5)^2 + 1$
b) $y = 4(x + 1)^2 - 7$
c) $y = 2(x - 7)^2$
d) $y = \frac{1}{2}(x - 4)^2 + 5$

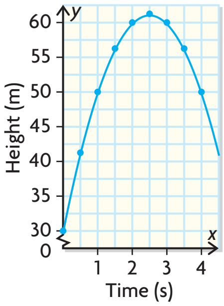
9. **a)** $y = \frac{1}{2}(x + 3)^2 + 2$
b) $y = -2(x - 1)^2 + 5$

10. **a)** Answers may vary, e.g., in this model, x is the number of years since 2002 and E is residential energy used.



b) Answers may vary, e.g., about $(1.57, 1326)$; $E = -13(x - 1.57)^2 + 1326$
c) about July 27, 2003

11. **a)**



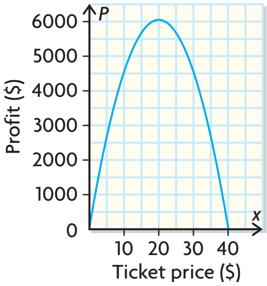
b) Answers may vary, e.g., about (2.5, 61)

c) Answers may vary, e.g., $-5(x - 2.5)^2 + 61$

d) regression: $y = -5x^2 + 25x + 30$; standard form of relation in part c): $y = -5x^2 + 25x + 29.75$; very accurate

12. 1.4 kg/ha

13. **a)**



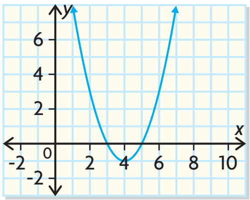
b) maximum profit of $6050 at a ticket price of $20

14. **a)** **i)** $y = (x - 3)(x - 5)$

ii) $(4, -1)$

iii) $y = (x - 4)^2 - 1$

iv)

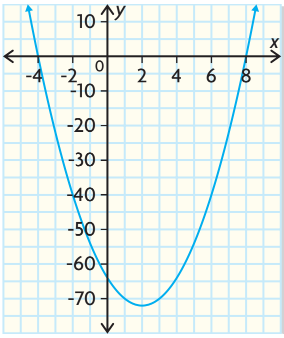


b) **i)** $y = 2(x + 4)(x - 8)$

ii) $(2, -72)$

iii) $y = 2(x - 2)^2 - 72$

iv)

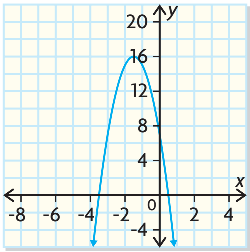


c) **i)** $y = -(2x + 7)(2x - 1)$

ii) $(-1.5, 16)$

iii) $y = -4(x + 1.5)^2 + 16$

iv)



15. **a)** Answers may vary, e.g., (0, 5), (−2, 5); $y = (x + 1)^2 + 4$

b) Answers may vary, e.g., (0, −3), (6, −3); $y = -(x - 3)^2 + 6$

c) Answers may vary, e.g., (0, −147), (14, −147); $y = -3(x - 7)^2$

d) Answers may vary, e.g., (0, 41), (10, 41); $y = 2(x - 5)^2 - 9$

16. **a)** $y = (x - 3)^2 - 17$ **c)** $y = 3(x + 2)^2 - 10$

b) $y = -2(x - 2)^2 + 50$ **d)** $y = -2(x - 3)^2 + 7$

17. **a)** 1.1 m

b) maximum height: 27.0 m at time 2.3 s

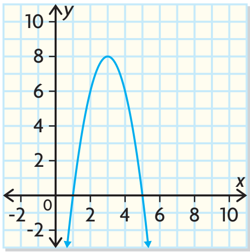
Chapter Self-Test, page 306

1. **a)** $y = \frac{1}{2}(x - 1)^2 - 9$

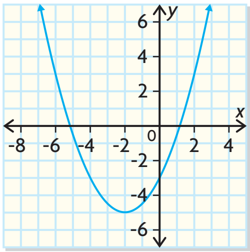
b) vertical compression by a factor of $\frac{1}{2}$, translation 1 unit right and 9 units down

2. **a)** $y = -4(x - 7)^2 + 5$ **b)** $y = 3(x - 3)^2 - 12$

3. **a)**



b)



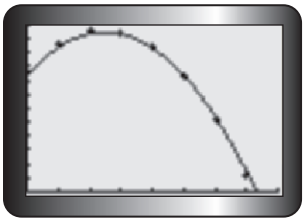
4. Answers may vary, e.g., $y = 2(x - 4)^2 - 10$

5. **a)** $P = -2(x - 3)(x - 9)$

b) zeros: 3, 9; break-even values (in $100 000s)

c) number of shoes sold: 600 000; maximum profit: $1 800 000

6. **a)**



b) vertex: (2.5, 115); $h = -5(t - 2.5)^2 + 115$; $h = -5t^2 + 25t + 83.75$

c) regression: $h = -5t^2 + 24t + 88$; very close to model for part b)

d) maximum height: 116.8 m 2.4 s after it is launched

e) about 7.23 s

Chapter 6

Getting Started, page 310

1. vertex: (−1, 8);
equation of the axis of symmetry: $x = -1$;
zeros: −3, 1

2. **a)** iii **b)** i **c)** ii