12. Multiply each of the following, using the method in question 11.

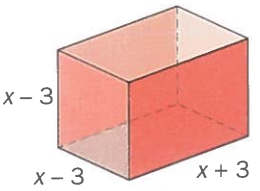
a) $(10 + 2)(10 - 2)$ **b)** $(15 + 3)(15 - 3)$ **c)** $(20 - 2)(20 + 2)$

d) 14×6 **e)** 17×23 **f)** 32×28

13. Use $x = y - 2$ to write each of the following in terms of y. Then, expand and simplify.

a) $x^2 - 2x + 3$ **b)** $3x^2 + 5x - 9$

14. Measurement Write, expand, and simplify an expression that represents the surface area of the rectangular prism.



15. Measurement The length of an edge of a cube is represented by the expression $2x - y$. Write, expand, and simplify an expression that represents the surface area of the cube.

16. Rewrite in the form $(a + b)^2$ or $(a - b)^2$.

a) $x^2 + 14x + 49$ **b)** $x^2 - 16x + 64$ **c)** $4a^2 + 12a + 9$

d) $9b^2 - 24b + 16$ **e)** $64m^2 - 32m + 4$ **f)** $81n^2 + 90n + 25$

17. Change one term in each trinomial, so that it can be written as the square of a binomial.

a) $x^2 + 12x + 18$ **b)** $a^2 + 7a + 16$ **c)** $y^2 - 9y + 9$

d) $m^2 - 4m + 16$ **e)** $4x^2 - 4x + 2$ **f)** $9y^2 + 10y + 4$

18. Expand and simplify.

a) $(x^2 + 1)^2$ **b)** $(y^2 - 1)^2$ **c)** $(x^2 + y^2)^2$ **d)** $(x^2 - y^2)^2$

e) $(2x^2 + 3)^2$ **f)** $(3y^2 - 4)^2$ **g)** $(x^2 - 2y^2)^2$ **h)** $(4x^2 + 3y^2)^2$

19. Expand and simplify.

a) $(x^2 + 1)(x^2 - 1)$ **b)** $(y^2 - 2)(y^2 + 2)$ **c)** $(x^2 + y^2)(x^2 - y^2)$

d) $(8a^2 + 3)(8a^2 - 3)$ **e)** $(3x^2 + 2y^2)(3x^2 - 2y^2)$ **f)** $(4 - 3c^2)(4 + 3c^2)$

20. Measurement The side length of a square is represented by x centimetres. The length of a rectangle is 3 cm greater than the side length of the square. The width of the rectangle is 3 cm less than the side length of the square. Which figure has the greater area and by how much?

21. Communication If a square garden is made into a rectangle by shortening two opposite sides by 5 m each and lengthening the other two sides by 5 m each, how do the areas of the original garden and the new garden compare? Explain.

Example 3 Perfect Square Trinomials

a) Verify that $4x^2 + 20x + 25$ is a perfect square trinomial.

b) Factor it.

Solution

a) $4x^2 = (2x)^2$ and $25 = 5^2$, so the first and last terms are perfect squares.
$20x = 2(2x)(5)$, so the middle term is twice the product of the square roots of the first and last terms.
So, $4x^2 + 20x + 25$ is a perfect square trinomial.

b) Use the appropriate perfect square trinomial pattern.

$$a^2 + 2ab + b^2 = (a + b)^2$$
$$4x^2 + 20x + 25 = (2x)^2 + 2(2x)(5) + 5^2$$
$$= (2x + 5)^2$$

Key Concepts

1 To factor a polynomial in the form $a^2 - b^2$, use the pattern for the difference of squares.
$a^2 - b^2 = (a + b)(a - b)$

2 To factor a perfect square trinomial, use the patterns for squaring binomials.
$a^2 + 2ab + b^2 = (a + b)^2$
$a^2 - 2ab + b^2 = (a - b)^2$

Communicate Your Understanding

1. Describe how you would factor each of the following.

a) $x^2 - 36$ **b)** $2x^2 - 18$ **c)** $x^2 - 6x + 9$

2. Can $4x^2 + 9$ be factored using the pattern for the difference of squares or the patterns for squaring binomials? Explain and justify your reasoning.

3. If the first and last terms of a trinomial are perfect squares, how can you determine the middle term that will make a perfect square trinomial?

Practice

A

1. Factor, if possible. Check each factored form by substituting 1 for the variable(s) in the expanded form and the factored form.

a) $x^2 - 9$ **b)** $y^2 - 16$ **c)** $z^2 + 81$
d) $25a^2 - 36$ **e)** $1 - 64t^2$ **f)** $36 - 49a^2$
g) $49 + x^2$ **h)** $25x^2 - 64y^2$ **i)** $4t^2 - 9s^2$
j) $100p^2 - 121q^2$ **k)** $16^2 - 81y^2$ **l)** $225b^2 - a^2$

2. State whether each trinomial is a perfect square trinomial. If it is, factor it.

a) $x^2 + 6x + 9$ **b)** $y^2 - 10y + 25$ **c)** $x^2 - 8x + 4$

d) $4t^2 + 4t + 1$ **e)** $16t^2 + 24t + 9$ **f)** $49 + 14x + x^2$

g) $1 - 16t + 64t^2$ **h)** $9x^2 - 24x + 16$ **i)** $4 + 28r + 49r^2$

j) $81x^2 - 72xy + 64y^2$ **k)** $121m^2 - 22m + 1$ **l)** $9a^2 + 12ab + 4b^2$

3. Factor fully, if possible.

a) $y^2 - 144$ **b)** $25x^2 + 5y + 1$ **c)** $9a^2 - 24a + 16$

d) $2x^2 - 32$ **e)** $y^2 + 36$ **f)** $3x^2 + 6x + 3$

g) $m^2 - 14m + 49$ **h)** $4p^2 + 20pq + 25q^2$ **i)** $49x^2 - 121y^2$

j) $80a^2 - 45b^2$ **k)** $100x^2 + 10x + 1$ **l)** $y^3 - 36y$

m) $y^3 - 18y^2 + 81y$ **n)** $36x^2 + 100y^2$ **o)** $3x^3 - 48x$

p) $5m^3 - 40m^2 + 80m$ **q)** $81x^2 - 144$ **r)** $3b^2 - 300$

Applications and Problem Solving

4. Numbers Evaluate by factoring the difference of squares.

a) $53^2 - 47^2$ **b)** $45^2 - 35^2$ **c)** $820^2 - 180^2$

5. Volleyball The area of a volleyball court, excluding the service areas, can be represented by the trinomial $2x^2 - 4x + 2$.

a) Factor the trinomial completely.

b) If the length of the court is twice the width, use the factors from part a) to write expressions that represent the length and the width.

c) If x represents 10 m, what are the length and the width of the court, in metres?

B

6. Factor.

a) $(x + 2)^2 - 9$ **b)** $16 - (y - 3)^2$ **c)** $(m + 1)^2 - (m + 2)^2$ **d)** $x^4 + 22x^2 + 121$

e) $t^6 - 18t^3 + 81$ **f)** $\frac{x^2}{4} - \frac{1}{9}$ **g)** $25x^4 - 81$ **h)** $(2x + y)^2 - (2x - y)^2$

7. Determine the value(s) of k such that each trinomial is a perfect square.

a) $x^2 + kx + 16$ **b)** $9x^2 + kx + 49$ **c)** $x^2 + 4x + k$

d) $4x^2 - 12x + k$ **e)** $kx^2 + 40x + 16$ **f)** $kx^2 - 24xy + 9y^2$

8. Measurement The volume of a rectangular prism is represented by the polynomial $2x^3 - 24x^2 + 72x$.

a) Factor the polynomial completely.

b) If the expression for each dimension of the prism includes x, what are the expressions that represent the possible sets of dimensions?

c) If x represents 8 cm, what are the possible dimensions of the prism?

d) Communication Could x represent 5 cm? Explain.

9. Integers If a and b are integers, find values of a and b such that $a^2 - b^2$ is 21.

C

10. Measurement The area of a square is represented by the expression $49 - 28x + 4x^2$, where x represents a positive integer. What are the possible values for the perimeter of the square?

11. Factor.

a) $(x + 3)^2 - y^2$

b) $x^2 - 4x + 4 - 9y^2$

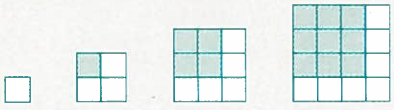
c) $4x^2 + 12xy + 9y^2 - 4z^2$

d) $x^4 - 2x^2y + y^2 - z^2$

12. Measurement A circle has an area of $(9x^2 + 30x + 25)\pi$ square centimetres, where x is a positive integer. Determine the smallest diameter that the circle can have.

Modelling Math Representing Patterns Algebraically

The four grids, which were shown on page 125, have side lengths of 1, 2, 3, and 4 units, respectively.



a) Communication Describe the pattern in the number of shaded grid squares.

b) If s represents the side length of the grid, write an expression in terms of s for finding the number of shaded grid squares. Write your expression in factored form.

c) Use your expression to find the number of shaded grid squares on a 12 by 12 grid; a 91 by 91 grid.

d) If the number of shaded grid squares is 529, what is the side length of the grid?

e) The total number of grid squares on a grid of side length s is s^2. Subtract the expression you found in part b) from s^2 to find an expression that represents the number of unshaded squares in terms of s.

f) Use your expression from part e) to find the number of unshaded squares on a 53 by 53 grid.

R.S. = 13 **b)** $x^2 + 8x + 12$ **7. a)** The length of the rectangle is $3x + 2y$. The width is $2x + y$. The area is $(3x + 2y)(2x + y)$. **b)** $6x^2 + 7xy + 2y^2$
8. a) $3x^2 + 13xy + 4y^2$ **b)** $8a^2 - 22ab + 5b^2$
c) $20m^2 - 7mn - 6n^2$ **d)** $20s^2 - 39st + 18t^2$
e) $7a^2 + ab - 8b^2$ **f)** $-6a^2 - ab + 12b^2$
9. a) $(x + 10)(x + 5)$ **b)** 750 m^2 **10. a)** $7x^2 - 72x + 20$
b) 29 280 cm^2; 2.928 m^2 **11. a)** $x^2 + x - 2$
b) $x^2 + 3xy + 2y^2 + 3x - 3y$ **12.** $14x^2 + 17x - 3$
13. a) 42 cm^2 **b)** $(n + 2)(n + 3)$ **c)** $n^2 + 5n + 6$
d) 930 cm^2 **14. a)** $10x^2 + 10x - 10$ **b)** 290 cm^2
15. No, the product of $(x - 1)$ and $(x + 1)$ is $x^2 - 1$, which is a binomial. The product of $(a + b)$ and $(c + d)$ is $ac + ad + bc + cd$, which has four terms. **16. a)** Take four consecutive numbers. Subtract the product of the outer numbers from the product of the inner numbers. **b)** 2, 2, 2, 2 **c)** $(x + 1)(x + 2) - (x)(x + 3) = 2$
d) The expression simplifies to 2.

Modelling Math p. 139

a) The product of three consecutive numbers plus the middle number. **b)** 8, 27, 64, 125 **c)** The answer is the cube of the middle number.
d) $(x - 1)(x)(x + 1) + x = x^3$ **e)** The expression simplifies to x^3.

Section 3.3 pp. 142–145

Practice 1. a) x^2 **b)** a^2 **c)** $4x^2$ **d)** $81t^2$ **e)** $9y^2$ **f)** $49p^2$
g) $16j^2$ **h)** $36q^2$ **2. a)** $-6x$ **b)** $+16y$ **c)** $+2xy$ **d)** $-2ab$
e) $+12x$ **f)** $-40a$ **g)** $+12xy$ **h)** $-84p$ **3. a)** $a + 7$ **b)** $x - 2$
c) $3m + 7$ **d)** $9x - 8$ **e)** $x + y$ **f)** $2a - 3b$
4. a) $x^2 + 10x + 25$ **b)** $y^2 + 2y + 1$ **c)** $x^2 - 12x + 36$
d) $m^2 - 6m + 9$ **e)** $x^2 - 9$ **f)** $y^2 - 36$ **g)** $m^2 - 49$ **h)** $t^2 - 64$
5. a) $9x^2 + 12x + 4$ **b)** $25x^2 - 10x + 1$ **c)** $4x^2 - 9$
d) $4m^2 + 28m + 49$ **e)** $9y^2 - 4$ **f)** $16y^2 - 24y + 9$
g) $1 - 25m^2$ **h)** $4 - 12t + 9t^2$ **6. a)** $4x^2 - 9y^2$
b) $4x^2 + 12xy + 9y^2$ **c)** $9a^2 - b^2$ **d)** $16t^2 - 40ts + 25s^2$
e) $16m^2 - 25n^2$ **f)** $9c^2 + 42cd + 49d^2$ **g)** $y^2 - 36x^2$
h) $a^2 - 16ab + 64b^2$ **7. a)** $2x^2 + 4x + 20$
b) $2y^2 + 14y + 13$ **c)** $-16m + 65$ **d)** $5a^2 + 12a - 6$
e) $-2x^2 + 100x - 94$ **f)** $-19t^2 - 30t + 105$
8. a) $-x^2 - 26x - 107$ **b)** $-8x^2 - 23x + 14$
c) $-7m^2 - 33m + 24$ **d)** $19t^2 + 12t - 14$
e) $-21y^2 + 13y + 28$ **f)** $54t^2 - 12t - 2$
g) $100s^2 - 22t^2 + 6t$ **h)** $12m^2 - 12mn + 2n^2 - 3m + 45$
i) $5x^2 + 4xy - 3y^2$ **j)** $-13a^2 - 28ab + 8b^2$
Applications and Problem Solving 9. a) L.S. = 16, R.S. = 10 **b)** $x^2 + 6x + 9$ **10. a)** $x + 10$ **b)** x^2, $(x + 10)^2 = x^2 + 20x + 100$ **c)** 625 cm^2; 1225 cm^2
11. $(20 + 4)(20 - 4) = 384$; $(50 - 3)(50 + 3) = 2491$; $(60 + 2)(60 - 2) = 3596$ **12. a)** 96 **b)** 216 **c)** 396 **d)** 84
e) 391 **f)** 896 **13. a)** $y^2 - 6y + 11$ **b)** $3y^2 - 7y - 7$
14. $2(x - 3)^2 + 4(x - 3)(x + 3) = 6x^2 - 12x - 18$
15. $6(2x - y)^2 = 24x^2 - 24xy + 6y^2$ **16. a)** $(x + 7)^2$
b) $(x - 8)^2$ **c)** $(2a + 3)^2$ **d)** $(3b - 4)^2$ **e)** $(8m - 2)^2$
f) $(9n + 5)^2$ **17. a)** $x^2 + 12x + 36$ **b)** $a^2 + 8a + 16$
c) $y^2 - 6y + 9$ **d)** $m^2 - 8m + 16$ **e)** $4x^2 - 4x + 1$
f) $9y^2 + 12y + 4$ **18. a)** $x^4 + 2x^2 + 1$ **b)** $y^4 - 2y^2 + 1$
c) $x^4 + 2x^2y^2 + y^4$ **d)** $x^4 - 2x^2y^2 + y^4$ **e)** $4x^4 + 12x^2 + 9$
f) $9y^4 - 24y^2 + 16$ **g)** $x^4 - 4x^2y^2 + 4y^4$
h) $16x^4 + 24x^2y^2 + 9y^4$ **19. a)** $x^4 - 1$ **b)** $y^4 - 4$ **c)** $x^4 - y^4$
d) $64a^4 - 9$ **e)** $9x^4 - 4y^4$ **f)** $16 - 9c^4$ **20.** The square, by 9 cm^2. **21.** The original garden is 25 m^2 larger than the new garden. **22. a)** $a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$
b) $4x^2 + 9y^2 + 1 + 12xy + 4x + 6y$ **23.** 1 term, 5 terms
24. a) {7, 24, 25}; {9, 40, 41}, {9, 12, 15}; {12, 35, 37}, {12, 16, 20}, {9, 12, 15}, {5, 12, 13} **b)** Let a represent the given leg, $c + b$ represent one factor of a^2, and $c - b$ represent the other factor of a^2. Thus $(c + b)(c - b) = a^2$, or $c^2 - b^2 = a^2$, or $c^2 = a^2 + b^2$. So $\{a, b, c\}$ is a Pythagorean triple, and represents the sides of a right triangle.

Technology Extension p. 146

1 Multiplying Binomials 1. a) $8x^2 + 42x + 27$
b) $6x^2 - 5x - 25$ **c)** $20y^2 - 52y + 33$
d) $32x^2 - 4xy - 21y^2$ **e)** $20x^2 + 7xy - 6y^2$ **f)** $9x - 14$
g) $7x^2 + 9x - 13$ **h)** $-6y^2 - 26y + 49$ **i)** $22x^2 + 12xy + y^2$
2 Special Products 1. a) $x^2 + 30x + 225$
b) $t^2 - 10t + 25$ **c)** $81 - 18y + y^2$ **d)** $16m^4 + 56m^2 + 49$
e) $36 - 60r + 25r^2$ **f)** $64x^2 + 48xy + 9y^2$
2. a) $4x^2 - 121$ **b)** $16 - 25x^2$ **c)** $9y^2 - 25x^2$ **3. a)** $4x$
b) $-4x - 13$ **c)** $44y^2 + 68y + 26$ **d)** $15 + 48m - 40m^2$

Section 3.4 p. 150–151

Practice 1. a) $5(x + 5)$ **b)** not possible **c)** $9(y - 1)$
d) $3(x - 5y)$ **e)** $5x(5x + 2)$ **f)** $2a(2x + 4y - 3z)$
g) $pq(5r - s - 10t)$ **h)** $2(x^2 - x - 3)$ **i)** not possible
2. a) $9(a^3 + 3b^2)$ **b)** $3x(x^4 - 2x^2 + 3)$ **c)** $4y(3 - 2y + 6y^2)$
d) $6w^3(4w^2 + 1)$ **e)** not possible **f)** $11b(3a + 2c - b)$
g) $8xy(3y + 2x)$ **h)** $5y(7x - 2y)$ **i)** not possible
j) $12xy(2y - 1 + 3x)$ **k)** $9a^2b^2(3b + 1 - 2a)$
l) $6mn^2(m^2 + 3mn - 2)$ **3. a)** $(a + b)(5x + 3)$
b) $(x - 1)(3m + 5)$ **c)** not possible **d)** $(p + q)(4y - x)$
e) $(m + 7)(4t + 1)$ **f)** not possible **4. a)** $(x + y)(w + z)$
b) $(x + 3)(y + 4)$ **c)** $(x + 1)(x - y)$ **d)** $(m + 4)(m - n)$
e) $(x + 2)(2x + 3y)$ **f)** $(t - 2)(5m^2 + t)$

Applications and Problem Solving **5. a)** $20t - 5t^2$ **b)** 0 m, 15 m, 20 m, 15 m, 0 m, −25 m **c)** 20 m **d)** The height is negative. Distance cannot be negative. **e)** 0 s and 4 s **f)** $5t(4 - t)$ **g)** The height of the ball is 0 m when $5t = 0$ and when $4 - t = 0$. **6. a) i)** $4\pi x^2 - x^2$ **ii)** $x^2(4\pi - 1)$ **b) i)** $6xy - 3xz$ **ii)** $3x(2y - z)$ **c) i)** $\pi r^2 = 2r^2$ **ii)** $r^2(\pi - 2)$ **d) i)** $10x + 10y + 100$ **ii)** $10(x + y + 10)$ **e) i)** $6a + 3b + 3c + 6d + 36$ **ii)** $3(2a + b + c + 2d + 12)$ **f) i)** $4a + 4b - 16$ **ii)** $4(a + b - 4)$ **7.** k must be divisible by 2, since the only common factor of $2x^2$ and 4 is 2. **8.** Answers may vary. **a)** $s^3t^2 + s^2t^2 + st^2$ **b)** $st^2(s^2 + s + 1)$ **9.** Answers may vary. **a)** $12x^3y^2 + 9x^2y^3 + 6x^2y^2 + 3xy$ **b)** $3xy(4x^2y + 3xy^2 + 2xy + 1)$

Modelling Math p. 152

a) Number of Squares: 8, 14, 20, 26, 32; Perimeter: 18, 30, 42, 54, 66 **b)** $6n + 2$ **c)** $2(3n + 1)$ **d)** 452; 620 **e)** 28 **f)** $12n + 6$ **g)** $6(2n + 1)$ **h)** 822; 1254 **i)** 22 **j)** $2s + 2$ **k)** $2(s + 1)$ **l)** 186; 630 **m)** 152; 428

Section 3.5 pp. 156–158

Practice **1. a)** 3, 5 **b)** 2, 9 **c)** −3, 10 **d)** 2, −10 **e)** 2, 5 **f)** −5, −2 **g)** −9, −4 **h)** −12, −3 **2. a)** $(x + 4)(x + 1)$ **b)** $(x + 5)(x + 3)$ **c)** not possible **d)** $(r - 6)(r - 7)$ **e)** $(n + 6)(n + 5)$ **f)** $(r - 2)(r - 5)$ **g)** $(w - 2)(w - 8)$ **h)** not possible **i)** $(m - 4)(m - 6)$ **3. a)** $(y + 4)(y - 5)$ **b)** $(x + 9)(x - 2)$ **c)** not possible **d)** $(n - 12)(n + 2)$ **e)** not possible **f)** $(x + 2)(x - 10)$ **4. a)** $(m + 10)(m + 8)$ **b)** $(m + 4)(m - 3)$ **c)** not possible **d)** $(r - 3)(r - 14)$ **e)** $(y - 9)(y - 8)$ **f)** $(x + 2)(x - 8)$ **g)** not possible **h)** not possible **i)** $(x - 3)(x - 7)$ **j)** $(w + 2)(w + 10)$ **k)** $(r + 5)(r - 6)$ **l)** $(y - 2)(y - 18)$ **m)** not possible **n)** $(1 + y)(8 - y)$ **o)** $(8 + x)(2 - x)$ **5. a)** $(x + 7y)(x + 5y)$ **b)** $(a - 11b)(a + 7b)$ **c)** $(c - 2d)(c + d)$ **d)** $(x - 4y)(x + 9y)$ **e)** not possible **f)** $(p - 2q)(p + 16q)$ **6. a)** $3(x + 1)(x + 3)$ **b)** $5(y + 6)(y + 2)$ **c)** $4(t - 5)(t + 3)$ **d)** $6(x + 4)(x - 1)$ **e)** $a(x + 12)(x - 2)$ **f)** $x(x + 12)(x + 6)$ **g)** $2(x - 7)(x - 4)$ **h)** $5(w + 6)(w - 2)$ **i)** $x(3 + x)(1 - x)$

Applications and Problem Solving **7. a)** $(x - 4)(x + 1)$ **b)** 18 m by 13 m **8. a)** $(x + 4)(x + 5)$ **b)** $(x + 3)(x + 4)$ **c)** $x^2 + 7x + 12$ **d)** $2x + 8$ **9. a)** $(x + 24)(x - 4)$; $(x - 3)(x - 24)$; $(x + 4)(x - 20)$; $(x + 3)(x - 28)$; $(x + 15)(x - 6)$; A = −4, C = −24, E = 4, K = −28, M = 24, N = −3, O = −6, P = 15, S = 3, T = −20, Y = 5 **b)** Mack Sennett, Keystone Kops **10. a)** $x^2 + 6x + 5 = (x + 5)(x + 1)$, $x^2 + 6x + 8 = (x + 4)(x + 2)$, $x^2 + 6x + 9 = (x + 3)(x + 3)$; $x^2 - 5x + 4 = (x - 1)(x - 4)$, $x^2 - 5x + 6 = (x - 2)(x - 3)$; $x^2 + 7x + 12 = (x + 3)(x + 4)$, $x^2 + 8x + 12 = (x + 2)(x + 6)$, $x^2 + 13x + 12 = (x + 1)(x + 12)$; $x^2 - 6x + 5 = (x - 1)(x - 5)$; $x^2 - 11x - 12 = (x - 12)(x + 1)$, $x^2 - 4x - 12 = (x - 6)(x + 2)$, $x^2 - x - 12 = (x - 4)(x + 3)$ **b)** All have more than one except $x^2 - \blacksquare x + 5 = (x - \blacksquare)(x + \blacksquare)$. Because 5 is a prime number, there is only one pair of negative integers with a product of 5. **11.** Answers may vary. **a)** $k = -8, -3, 1$ **b)** $k = 12, 6, 10$ **12. a)** $(x^2 + 1)^2$ **b)** $(x^2 + 3)(x^2 - 2)$ **c)** $(x^2 - 5)(x^2 + 2)$ **d)** $(x^2 + 9y)(x^2 + y)$ **13. a)** $(x + a + 1)(x + a + 2)$ **b)** $(x - b + 5)(x - b - 1)$ **14. a)** $x^2 - 2x - 35 = (x - 7)(x + 5)$, $t^2 + 3t - 40 = (t + 8)(t - 5)$ **b)** The trinomial has the value zero when either factor is zero, or both factors are zero.

Section 3.6 pp. 163–164

Practice **1. a)** $(2y + 3)(y + 3)$ **b)** $(3m + 1)(m + 3)$ **c)** $(5t + 2)(t + 1)$ **d)** not possible **e)** $(x + 2)(2x + 7)$ **f)** $(3x + 1)(2x + 3)$ **2. a)** $(2x - 3)(x - 1)$ **b)** $(x - 1)(3x - 2)$ **c)** $(t - 2)(3t - 4)$ **d)** $(m - 2)(5m - 1)$ **e)** $(2m - 3)(3m - 2)$ **f)** not possible **3. a)** $(x - 2)(2x + 3)$ **b)** $(3x - 4)(2x + 1)$ **c)** $(2t - 1)(t + 5)$ **d)** $(5n - 2)(3n + 1)$ **e)** $(x - 1)(3x + 4)$ **f)** $(y - 3)(5y + 1)$ **g)** $(2x - 3)(4x + 1)$ **h)** not possible **i)** $(5t - 2)(2t + 3)$ **4. a)** $(2t + 1)(2t + 3)$ **b)** $(2x - 3)(5x - 1)$ **c)** not possible **d)** $(2y + 5)(y + 3)$ **e)** $2(4y - 3)(y - 2)$ **f)** not possible **g)** $3(2r + 3)(r + 1)$ **h)** $(3y - 2)(4y - 1)$ **i)** $2(x - 5)(2x + 1)$ **j)** $m(2m - 5)(m + 6)$ **k)** $t(2t + 1)(t + 4)$ **l)** $(2s - 1)(9s + 1)$ **m)** $3(r + 1)(4r + 5)$ **n)** $s(r - 1)(5r - 2)$ **o)** $(2 - y)(3 + 4y)$ **p)** $(2 - m)(1 - 3m)$ **q)** $2(6 + 9t + 4t^2)$ **r)** $(3 - 2y)(2 + 3y)$ **5. a)** $(2m - n)(3m + 2n)$ **b)** $(3x + y)(x + 2y)$ **c)** $(2a - b)(5a + b)$ **d)** $(x - 5y)(2x - y)$ **e)** $(6c + d)(c + 2d)$ **f)** $3(x - y)(2x - y)$ **g)** $2(m - 3n)(m + n)$ **h)** $4(y - x)(y + 2x)$ **i)** $2(3a - 2b)(a + 3b)$

Applications and Problem Solving

6. a) $(10x + 3)(x - 1)$ **b)** 503 m by 49 m **7. a)** $10x^2 - 29x + 10 = (2x - 5)(5x - 2)$; $4x^2 - 27x + 18 = (x - 6)(4x - 3)$; $18x^2 - 27x + 4 = (3x - 4)(6x - 1)$; $56x^2 + 15x + 1 = (7x + 1)(8x + 1)$; $10x^2 - 91x + 9 = (x - 9)(10x - 1)$; A = 2, C = 5, D = −2, E = 4, H = −3, I = −4, J = 3, L = −6, M = 6, N = −1, O = 7, R = 8, S = −9, T = 10, U = −5, W = 1, Y = −7 **b)** Joni Mitchell: folk singer; Ned Hanlan: world champion rower; Marshall McLuhan: author, communication theorist; Emily Stowe: first Canadian woman to practise medicine in Canada **8. a)** ±8, ±16

b) ±13, ±14, ±22, ±41 **c)** ±5, ±1 **d)** ±35, ±16, ±9, ±5, 0
9. a) $(2x^2 + 1)(x^2 + 1)$ **b)** $(2x^2 - 1)(x^2 + 3)$
c) $(3x^2 - 4)(x^2 + 1)$ **d)** $(2x^2 - 3)(3x^2 - 2)$
e) $(2x^2 + y)(x^2 + 2y)$ **f)** $(3x^2 - y)(x^2 + 4y)$

Section 3.7 pp. 167–169

Practice **1. a)** $(x + 3)(x - 3)$ **b)** $(y + 4)(y - 4)$ **c)** not possible **d)** $(5a + 6)(5a - 6)$ **e)** $(1 + 8t)(1 - 8t)$
f) $(6 + 7a)(6 - 7a)$ **g)** not possible **h)** $(5x + 8y)(5x - 8y)$
i) $(2t + 3s)(2t - 3s)$ **j)** $(10p + 11q)(10p - 11q)$
k) $(16 + 9y)(16 - 9y)$ **l)** $(15b + a)(15b - a)$
2. a) yes, $(x + 3)^2$ **b)** yes, $(y - 5)^2$ **c)** no **d)** yes, $(2t + 1)^2$
e) yes, $(4t + 3)^2$ **f)** yes, $(7 + x)^2$ **g)** yes, $(1 - 8t)^2$ **h)** yes, $(3x - 4)^2$ **i)** yes, $(2 + 7r)^2$ **j)** no **k)** yes, $(11m - 1)^2$ **l)** yes, $(3a + 2b)^2$ **3. a)** $(y + 12)(y - 12)$ **b)** not possible
c) $(3a - 4)^2$ **d)** $2(x + 4)(x - 4)$ **e)** not possible
f) $3(x + 1)^2$ **g)** $(m - 7)^2$ **h)** $(2p + 5q)^2$
i) $(7x + 11y)(7x - 11y)$ **j)** $5(4a + 3b)(4a - 3b)$ **k)** not possible **l)** $y(y + 6)(y - 6)$ **m)** $y(y - 9)^2$ **n)** $4(9x^2 + 25y^2)$
o) $3x(x + 4)(x - 4)$ **p)** $5m(m - 4)^2$ **q)** $(9x + 12)(9x - 12)$
r) $3(b + 10)(b - 10)$
Applications and Problem Solving **4. a)** 600 **b)** 800
c) 640 000 **5. a)** $2(x - 1)^2$ **b)** $2(x - 1)$, $x - 1$ **c)** 18 m by 9 m **6. a)** $(x - 1)(x + 5)$ **b)** $(1 + y)(7 - y)$ **c)** $-(2m + 3)$
d) $(x^2 + 11)^2$ **e)** $(t^3 - 9)^2$ **f)** $\left(\frac{x}{2} + \frac{1}{3}\right)\left(\frac{x}{2} - \frac{1}{3}\right)$
g) $(5x^2 + 9)(5x^2 - 9)$ **h)** $8xy$ **7. a)** ±8 **b)** ±42 **c)** 4 **d)** 9
e) 25 **f)** 16 **8. a)** $2x(x - 6)^2$ **b)** x, $(x - 6)$, $2(x - 6)$; $2x$, $(x - 6)$, $(x - 6)$ **c)** 8 cm by 2 cm by 4 cm or 16 cm by 2 cm by 2 cm **d)** No, then two of the dimensions would be negative. **9.** 5, 2; −5, 2; 5, −2; −5, −2; 11, 10; −11, 10; 11, −10; −11, −10 **10.** 20, 12, 4
11. a) $(x + 3 + y)(x + 3 - y)$ **b)** $(x - 2 + 3y)(x - 2 - 3y)$
c) $(2x + 3y + 2z)(2x + 3y - 2z)$ **d)** $(x^2 - y + z)(x^2 - y - z)$
12. 16 cm

Modelling Math p. 169

a) side length minus one all squared **b)** $(s - 1)^2$ **c)** 121; 8100 **d)** 24

Career Connection p. 170

1. a) $10\pi[(1.2)^2 - 10\pi(1)^2]$ **b)** $10\pi(1.2 + 1)(1.2 - 1)$; 4.4π **c)** The inner cylinder contains no concrete.
d) 13.8 m^3 **2.** Evaluate the expression in question 1a) without factoring.

Technology Extension pp. 171

1 Factoring Polynomials **1. a)** $3(2x^2 + 5x - 4)$
b) $7(2y^2 - 6y + 3)$ **c)** $5(4x - 3x^2 + 2)$
d) $2xy(2x + 3 - 4y)$ **e)** $3pq(p^2 + 6pq + 2q^2)$
f) $2b^2(6a^3 + 2a^2b + 4ab^2 - 3b^3)$ **2. a)** $(x + 2)(x + 17)$
b) $(x - 12)(x + 6)$ **c)** not possible **d)** $(5 - t)(3 - t)$
e) $(n + 1)(4n + 9)$ **f)** not possible **g)** $(x - 4)(5x + 3)$
h) $(3y - 2)(5y + 7)$ **i)** $(x + 2y)(x + 5y)$ **j)** $(x - 4y)(3x - 2y)$
k) $(3a - 2b)(5a + 3b)$ **l)** $(2x + 9y)(7x - 4y)$
m) $(x + a + 2)(x + a + 4)$ **n)** $(x - y - 2)(x - y - 3)$
o) $(x^2 + 5)(x^2 - 3)$ **3. a)** $3(x - 1)(x - 9)$
b) $2(2x - 3)(x + 4)$ **c)** $5(5y + 1)(3y + 8)$
d) $2(u - 2v)(u - v)$ **e)** $6(3x - y)(2x + 3y)$
f) $x(x + 1)(x + 2)$ **g)** $2t(t - 7)(2t + 1)$
h) $3(5x^2 + 2)(2x^2 + 5)$ **i)** $8(x + 1)(x - 1)(3x^2 + 1)$
2 Factoring Special Products **1. a)** $(5x + 6)^2$
b) $(3y - 5)^2$ **c)** $(3n + 8)(3n - 8)$ **d)** $(5 + 13x)(5 - 13x)$
e) $(2x + 3y)(2x - 3y)$ **f)** $(7a - 4b)^2$
2. a) $16(m + 2)(m - 2)$ **b)** $4(3 + 2x)(3 - 2x)$
c) $5(5x^2 + 4)(5x^2 - 4)$ **d)** $2(6x + 7y^2)(6x - 7y^2)$
e) $2(x - 7)^2$ **f)** $3(2x + 5)^2$ **g)** $8w(2w - 5)^2$
h) $12(5 + 2x^2)(5 - 2x^2)$ **i)** $4(3y^2 + 5x^2)^2$

Rich Problem pp. 172–173

1 Writing Expressions for Areas **1.** πr^2 **2.** r; $r + 1$
3. a) $\pi(r + 1)^2 - \pi r^2$ **b)** $\pi(2r + 1)$
4. a) $\pi(r + 2)^2 - \pi(r + 1)^2$; $\pi(2r + 3)$
b) $\pi(r + 3)^2 - \pi(r + 2)^2$; $\pi(2r + 5)$
c) $\pi(r + 4)^2 - \pi(r + 3)^2$; $\pi(2r + 7)$
d) $\pi(r + 5)^2 - \pi(r + 4)^2$; $\pi(2r + 9)$ **5. a)** The area is π times the sum of twice the radius and one less than twice the ring number. **b)** $\pi(2r + 2n - 1)$ **c)** $\pi(2r + 15)$
6. a) 44 m^2 **b)** 57 m^2 **c)** 75 m^2 **d)** 88 m^2
7. a) $13\pi(2r + 13)$ **b)** 740 m^2
2 Writing Expressions for Circumferences **1.** $2\pi r$
2. a) $2\pi(r + 1)$ **b)** $2\pi(r + 2)$ **c)** $2\pi(r + 5)$ **d)** $2\pi(r + 12)$
3. a) $26\pi(r + 6)$ **b)** 690 m
3 Estimating Seating Capacities **1.** Answers may vary. Assume each person needs about 1 m of inner circumference. **a)** 22 **b)** 41 **c)** 60 **d)** 690 **2.** 785 000

Review of Key Concepts pp. 174–179

1. a) $5x - 3y$ **b)** $8x^2 - 4x + 3$ **c)** $-a^2 - 6a - 8$
d) $m^2 + 3mn + n^2$ **2. a)** $-12x^4y^4$ **b)** $24r^2s^4t^6$ **3. a)** $-4a$
b) $4n^3p$ **4. a)** $8x + 18$ **b)** $4a + 28$ **c)** $8t^2 - 3t$ **d)** $y^2 - 7$
5. a) $x^2 + 2x - 8$ **b)** $a^2 - a - 30$ **c)** $6y^2 - y - 12$
d) $3x^2 - 11xy - 4y^2$ **6. a)** $2x^2 - 4x - 6$ **b)** $-2y^2 - 6y + 8$
c) $12m^2 - 28m + 8$ **d)** $12x^2 - 12x - 9$ **7. a)** $2y^2 - 4y - 6$
b) $-7x^2 - 12x + 6$ **c)** $8a^2 + 12a + 19$ **d)** $17x^2 - 10x + 12$
8. a) $x^2 + 8x + 16$ **b)** $y^2 - 16$ **c)** $a^2 - 10a + 25$ **d)** $9t^2 - 1$
e) $4x^2 - 12xy + 9y^2$ **f)** $25a^2 - 9b^2$ **g)** $18m^2 + 12m + 2$
h) $1 - 4x + 4x^2$ **i)** $48x^2 - 27$ **9. a)** $2m^2 - 8m + 7$
b) $-12x + 61$ **c)** $30t^2 + 12t + 1$ **d)** $-9x^2 + 18xy - 11y^2$