Practice

A

1. Factor, if possible. Check each factored form by substituting $x = 1$ into the expanded form and the factored form.

a) $2y^2 + 9y + 9$ **b)** $3m^2 + 10m + 3$ **c)** $5t^2 + 7t + 2$

d) $4r^2 + 12r + 3$ **e)** $2x^2 + 11x + 14$ **f)** $6x^2 + 11x + 3$

2. Factor, if possible.

a) $2x^2 - 5x + 3$ **b)** $3x^2 - 5x + 2$ **c)** $3t^2 - 10t + 8$

d) $5m^2 - 11m + 2$ **e)** $6m^2 - 13m + 6$ **f)** $4y^2 - 11y + 9$

3. Factor, if possible.

a) $2x^2 - x - 6$ **b)** $6x^2 - 5x - 4$ **c)** $2t^2 + 9t - 5$

d) $15n^2 - n - 2$ **e)** $3x^2 + x - 4$ **f)** $5y^2 - 14y - 3$

g) $8x^2 - 10x - 3$ **h)** $9x^2 - 15x - 4$ **i)** $10t^2 + 11t - 6$

4. Factor, if possible.

a) $4t^2 + 8t + 3$ **b)** $10x^2 - 17x + 3$ **c)** $5t^2 + 2t - 2$

d) $2y^2 + 11y + 15$ **e)** $8y^2 - 22y + 12$ **f)** $6x^2 + x - 4$

g) $6r^2 + 15r + 9$ **h)** $12y^2 - 11y + 2$ **i)** $4x^2 - 18x - 10$

j) $2m^3 + 7m^2 - 30m$ **k)** $2t^3 + 9t^2 + 4t$ **l)** $18s^2 - 7s - 1$

m) $12r^2 + 27r + 15$ **n)** $5r^2s - 7rs + 2s$ **o)** $6 + 5y - 4y^2$

p) $2 - 7m + 3m^2$ **q)** $12 + 18t + 8t^2$ **r)** $6 + 5y - 6y^2$

5. Factor.

a) $6m^2 + mn - 2n^2$ **b)** $3x^2 + 7xy + 2y^2$ **c)** $10a^2 - 3ab - b^2$

d) $2x^2 - 11xy + 5y^2$ **e)** $6c^2 + 13cd + 2d^2$ **f)** $6x^2 - 9xy + 3y^2$

g) $2m^2 - 4mn - 6n^2$ **h)** $4y^2 + 4xy - 8x^2$ **i)** $6a^2 + 14ab - 12b^2$

Applications and Problem Solving

6. **Transportation** Sydney Harbour Bridge in Australia is unusually wide for a long-span bridge. It carries two rail lines, eight road lanes, a cycle lane, and a walkway.

a) Factor the expression $10x^2 - 7x - 3$ to find binomials that represent the length and the width of the bridge.

b) If x represents 50 m, what are the length and the width of the bridge, in metres?

B

7. Famous Canadians The letters shown in the table each represent a different integer. The letter Y represents −7, as shown.

Letter	A	C	D	E	H	I	J	L	M
Integer									
Letter	N	O	R	S	T	U	W	Y	
Integer								−7	

a) Factor the following 5 trinomials. In each case, write the factored form with the smaller coefficient of x first. For example, the factored form of $6x^2 + 11x + 4$ would be written as $(2x + 1)(3x + 4)$, because $2 < 3$. Use the factored forms to find the integer represented by each capital letter. Then, copy and complete the table.

$10x^2 - 29x + 10 = (Ax + U)(Cx + D)$
$4x^2 - 27x + 18 = (Wx + L)(Ex + H)$
$18x^2 - 27x + 4 = (Jx + I)(Mx + N)$
$56x^2 + 15x + 1 = (Ox + W)(Rx + W)$
$10x^2 - 91x + 9 = (Wx + S)(Tx + N)$

b) Replace each of the following integers with its corresponding letter from part a) to find the names of four famous Canadians. Find out what each of them is famous for.

Name 1: 3 7 −1 −4
6 −4 10 5 −3 4 −6 −6

Name 2: −1 4 −2
−3 2 −1 −6 2 −1

Name 3: 6 2 8 −9 −3 2 −6 −6
6 5 −6 −5 −3 2 −1

Name 4: 4 6 −4 −6 −7
−9 10 7 1 4

C

8. List all values of k such that each trinomial can be factored over the integers.

a) $3x^2 + kx + 5$
b) $5x^2 + kx + 8$
c) $3x^2 + kx - 2$
d) $4x^2 + kx - 9$

9. Factor.

a) $2x^4 + 3x^2 + 1$
b) $2x^4 + 5x^2 - 3$
c) $3x^4 - x^2 - 4$
d) $6x^4 - 13x^2 + 6$
e) $2x^4 + 5x^2y + 2y^2$
f) $3x^4 + 11x^2y - 4y^2$

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)** $-9x^2 + 18xy - 11y^2$