Key Concepts

1 To solve a quadratic equation using the quadratic formula, write the equation in the form $ax^2 + bx + c = 0$, $a \neq 0$.

2 The quadratic formula is $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Communicate Your Understanding

1. Describe the three methods you know for solving quadratic equations. Describe the advantages and disadvantages of each method.

2. State the method you would use to solve each of the following quadratic equations. Explain why you chose each method.

a) $x^2 - 7x + 12 = 0$ **b)** $x^2 + 6x + 9 = 0$ **c)** $x^2 - 5x + 1 = 0$

d) $2x^2 + 7x + 3 = 0$ **e)** $2x^2 - x = -4$

Practice

A

1. Solve using the quadratic formula. Check your solutions.

a) $x^2 + 6x + 5 = 0$ **b)** $x^2 + 2x - 8 = 0$ **c)** $x^2 - 2x - 3 = 0$

d) $x^2 - 12x + 35 = 0$ **e)** $x^2 + 4x + 4 = 0$ **f)** $y^2 - 2y + 1 = 0$

2. Solve using the quadratic formula.

a) $2x^2 - 3x + 1 = 0$ **b)** $5x^2 - 14x - 3 = 0$ **c)** $2x^2 - 5x - 12 = 0$

d) $9x^2 - 6x + 1 = 0$ **e)** $8x^2 + 6x - 9 = 0$ **f)** $6x^2 - x = 2$

g) $4x^2 - 9 = 0$ **h)** $0 = 4x^2 + 16x + 15$ **i)** $2x^2 - 5x = 0$

j) $3w^2 + 11w = -10$

3. Solve using the quadratic formula. Express answers as exact roots and as approximate roots, to the nearest hundredth.

a) $x^2 + 5x + 2 = 0$ **b)** $x^2 - 3x - 1 = 0$ **c)** $x^2 - x - 3 = 0$

d) $x^2 + 7x + 2 = 0$ **e)** $x^2 - 5x - 2 = 0$ **f)** $z^2 - z - 4 = 0$

g) $0 = x^2 + x - 7$ **h)** $a^2 - a = 5$ **i)** $2x^2 + 3x - 7 = 0$

j) $3x^2 - x - 1 = 0$ **k)** $2x^2 + x - 5 = 0$ **l)** $0 = -3x^2 + 3x + 1$

Applications and Problem Solving

4. Peace Tower **a)** Find the width, in metres, of the Canadian flag on the Peace Tower in Ottawa by solving the equation $8w^2 + 18w - 81 = 0$.

b) The height of the Peace Tower is 90 m. If an object is thrown downward from this height at 5 m/s, the approximate time, t seconds, the object takes to reach the ground can be found by solving the equation $-5t^2 - 5t + 90 = 0$. Find the time taken, to the nearest tenth of a second.

5 or –5 **19.** $w = 1$ m, $l = 18$ m **20.** 9 **21.** $w = \frac{8}{3}$ m, $l = 6$ m **22.** 8 cm, 15 cm **23.** 11 **24.** 8 cm
25. a) Outer: 8 cm × 8 cm, Inner: 4 cm × 4 cm
b) Outer: 9 cm × 9 cm, Inner: 3 cm × 3 cm **26.** 0.5 m
27. a) $w = 70$ mm, $l = 135$ mm **b)** The widths are the same but a Canadian $20 bill is longer with length 152 mm. **28. a)** $x = -3$; 1 root **b)** $x = -3$; there are two roots that are equal. **29. a)** $x = -\frac{1}{6}$ or $x = 1$ **b)** $x = -\frac{3}{4}$ or $x = 1$ **30. a)** $x = 0$ or $x = 1$ **b)** $x = -\frac{1}{2}$ or $x = 2$ **c)** $k = -4$ or $k = 2$ **d)** $z = \frac{1}{2}$ **e)** $x = -4$ or $x = 3$ **f)** $g = \frac{8}{3}$ or $g = 6$ **g)** $y = 3$ or $y = -3$ **h)** $n = 1$ or $n = -1$ **i)** $x = 0$ or $x = 7$ **31. a)** $x = -y$ or $x = -4y$ **b)** $x = -\frac{y}{2}$ or $x = 3y$ **c)** $x = \frac{y}{2}$ **d)** $x = \frac{y}{4}$ or $x = -2y$ **e)** $x = 0$ or $x = -\frac{y}{5}$ **f)** $x = 0$ or $x = \frac{7y}{3}$ **32. a)** $x^2 - x - 6 = 0$
b) Yes, any constant multiple of $x^2 - x - 6 = 0$
33. a) $x^2 + (-p - q)x + pq = 0$ **34. a)** 10 **b)** $-\frac{1}{3}$

Career Connection p. 286

1. a) $16x^2 = 144$ m^2 $\Rightarrow x^2 = 9$ m^2 $\Rightarrow x = 3$m **b)** 2 m

Modelling Math p. 286

a) $-5t^2 + 9t + 2 = 0$ **b)** $(5t + 1)(-t + 2) = 0$; 2 s

Section 5.3 p. 287

1. $x = 4$ or $x = -2$ **2.** 4, –2 **4.** $x = 1$ **5.** $y = -9$
7. a) x–intercepts: 2, 6; vertex: (4, –4)
b) x–intercepts: –1, 3; vertex: (1, –4)
c) x–intercepts: –7, –3; vertex: (–5, –4)
d) x–intercepts: –4, 0; vertex: (–2, –4)
e) x–intercepts: 1, 5; vertex: (3, –4)
f) x–intercepts: –1, 7; vertex: (4, –15)
g) x–intercepts: 0, 8; vertex: (4, –16)
h) x–intercepts: –5, 7; vertex: (1, –36) **8.** No, because $ax^2 + bx + c$ is a perfect square, there is only one x – intercept, which is also the vertex. A point on each side of the vertex is needed to complete the sketch.

Section 5.4 pp. 292–295

Practice 1. a) $x = -1$ or $x = -5$ **b)** $x = -4$ or $x = 2$
c) $x = -1$ or $x = 3$ **d)** $x = 5$ or $x = 7$ **e)** $x = -2$ **f)** $y = 1$
2. a) $x = \frac{1}{2}$ or $x = 1$ **b)** $x = -\frac{1}{5}$ or $x = 3$ **c)** $x = -\frac{3}{2}$ or $x = 4$ **d)** $x = \frac{1}{3}$ **e)** $x = -\frac{3}{2}$ or $x = \frac{3}{4}$ **f)** $x = -\frac{1}{2}$ or $x = \frac{2}{3}$ **g)** $x = \pm\frac{3}{2}$ **h)** $x = -\frac{3}{2}$ or $x = -\frac{5}{2}$ **i)** $x = 0$ or $x = \frac{5}{2}$ **j)** $x = -\frac{5}{3}$ or $x = -2$ **3. a)** $x = \frac{-5 \pm \sqrt{17}}{2}$; $x = -0.44$ or $x = -4.56$

b) $x = \frac{3 \pm \sqrt{13}}{2}$; $x = 3.30$ or $x = -0.30$ **c)** $x = \frac{1 \pm \sqrt{13}}{2}$; $x = 2.30$ or $x = -1.30$ **d)** $x = \frac{-7 \pm \sqrt{41}}{2}$; $x = -0.30$ or $x = -6.70$ **e)** $x = \frac{5 \pm \sqrt{33}}{2}$; $x = 5.37$ or $x = -0.37$

f) $z = \frac{1 \pm \sqrt{17}}{2}$; $z = 2.56$ or $z = -1.56$

g) $x = \frac{-1 \pm \sqrt{29}}{2}$; $x = 2.19$ or $x = -3.19$

h) $a = \frac{1 \pm \sqrt{21}}{2}$; $a = 2.79$ or $a = -1.79$ **i)** $x = \frac{-3 \pm \sqrt{65}}{4}$; $x = 1.27$ or $x = -2.77$ **j)** $x = \frac{1 \pm \sqrt{13}}{6}$; $x = 0.77$ or $x = -0.43$ **k)** $x = \frac{-1 \pm \sqrt{41}}{4}$; $x = 1.35$ or $x = -1.85$

l) $x = \frac{-3 \pm \sqrt{21}}{-6}$; $x = -0.26$ or $x = 1.26$

Applications and Problem Solving 4. a) 2.25 m **b)** 3.8 s
5. a) $x = 0$ or $x = 1.6$ **b)** $x = 1.3$ or $x = -0.3$ **c)** $x = 3.4$ or $x = -1.4$ **d)** $c = 3.9$ or $c = -0.9$ **e)** $n = 6.6$ or $n = -0.6$ **f)** $x = 2.8$ or $x = -1.3$ **g)** $x = -0.3$ or $x = -2$ **h)** $x = 10.7$ or $x = 1.3$ **i)** $d = 6.2$ or $d = 0.8$ **j)** $g = 0$ or $g = 1.9$
6. a) $x = 0.65$ or $x = -4.65$ **b)** $x = 5.16$ or $x = -1.16$
c) $y = 1.31$ or $y = -0.13$ **d)** $n = 1.67$ or $n = -0.5$
e) $x = -0.04$ or $x = -1.05$ **f)** $a = 9.94$ or $a = -12.44$
7. 82 m **8.** $w = 56$ m, $l = 116$ m **9.** 12 cm, 16 cm
10. a) 7.5 cm **b)** 6562.5 cm^3 **11.** $l = 8.1$ m, $w = 6.1$ m
12. 5.6 m **13.** $b = 7.4$ cm, $h = 5.4$ cm **14.** $h = 23.7$ cm, $w = 29.7$ cm **15.** 13 cm × 8 cm **16. a)** between 17 cm and 18 cm **b)** 17.72 cm **17. a)** $N = 110$ jackets; $P = \$160$ **b)** $N = 130$ jackets; $P = \$120$ **18.** 3.58 units
19. a) 6; 10 **b)** $s = \frac{p(p-1)}{2}$ **c)** $p = 11$ **d)** no
20. $b^2 - 4ac \geq 0$ **21.** $b^2 - 4ac = 0$ **22.** 3.2 cm
23. a) no real solutions **b)** two real, equal roots
c) two real, distinct roots **d)** two real, distinct,