Check Your Understanding

Practise

1. Use the discriminant to determine the nature of the roots for each equation. Do not solve the equations. Check your answers graphically.

a) $x^2 - 7x + 4 = 0$

b) $s^2 + 3s - 2 = 0$

c) $r^2 + 9r + 6 = 0$

d) $n^2 - 2n + 1 = 0$

e) $7y^2 + 3y + 2 = 0$

f) $4t^2 + 12t + 9 = 0$

2. Without graphing, determine the number of zeros for each function.

a) $f(x) = x^2 - 2x - 14$

b) $g(x) = -3x^2 + 0.06x + 4$

c) $f(x) = \frac{1}{4}x^2 - 3x + 9$

d) $f(v) = -v^2 + 2v - 1$

e) $f(x) = \frac{1}{2}x^2 - x + \frac{5}{2}$

f) $g(y) = -6y^2 + 5y - 1$

3. Use the quadratic formula to solve each quadratic equation. Express your answers as exact roots.

a) $7x^2 + 24x + 9 = 0$

b) $4p^2 - 12p - 9 = 0$

c) $3q^2 + 5q = 1$

d) $2m^2 + 4m - 7 = 0$

e) $2j^2 - 7j = -4$

f) $16g^2 + 24g = -9$

4. Use the quadratic formula to solve each equation. Express your answers to the nearest hundredth.

a) $3z^2 + 14z + 5 = 0$

b) $4c^2 - 7c - 1 = 0$

c) $-5u^2 + 16u - 2 = 0$

d) $8b^2 + 12b = -1$

e) $10w^2 - 45w = 7$

f) $-6k^2 + 17k + 5 = 0$

5. Determine the roots of each quadratic equation. Express your answers as exact values and to the nearest hundredth.

a) $3x^2 + 6x + 1 = 0$

b) $h^2 + \frac{h}{6} - \frac{1}{2} = 0$

c) $0.2m^2 = -0.3m + 0.1$

d) $4y^2 + 7 - 12y = 0$

e) $\frac{x}{2} + 1 = \frac{7x^2}{2}$

f) $2z^2 = 6z - 1$

6. Marge claims that the most efficient way to solve all quadratic equations is to use the quadratic formula. Do you agree with her? Explain with examples.

7. Solve using an appropriate method. Justify your choice of method.

a) $n^2 + 2n - 2 = 0$

b) $-y^2 + 6y - 9 = 0$

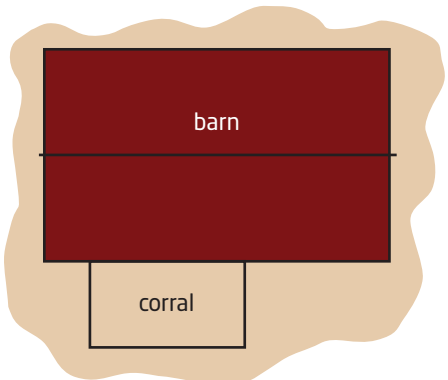
c) $-2u^2 + 16 = 0$

d) $\frac{x^2}{2} - \frac{x}{3} = 1$

e) $x^2 - 4x + 8 = 0$

Apply

8. To save materials, Choma decides to build a horse corral using the barn for one side. He has 30 m of fencing materials and wants the corral to have an area of 100 m^2. What are the dimensions of the corral?



9. A mural is being painted on an outside wall that is 15 m wide and 12 m tall. A border of uniform width surrounds the mural. The mural covers 75% of the area of the wall. How wide is the border? Express your answer to the nearest hundredth of a metre.

10. Subtracting a number from half its square gives a result of 11. What is the number? Express your answers as exact values and to the nearest hundredth.

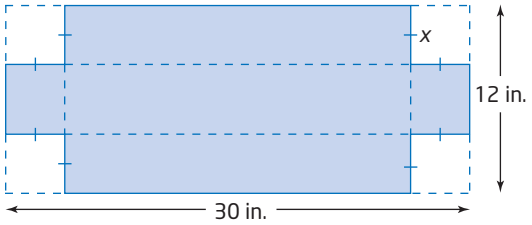
11. The mural *Northern Tradition and Transition*, located in the Saskatchewan Legislature, was painted by Métis artist Roger Jerome to honour the province of Saskatchewan's 100th anniversary in 2005. The mural includes a parabolic arch. The approximate shape of the arch can be modelled by the function $h(d) = -0.4(d - 2.5)^2 + 2.5$, where h is the height of the arch, in metres, and d is the distance, in metres, from one end of the arch. How wide is the arch at its base?

Did You Know?

Roger Jerome included the arch shape to symbolize the unity of northern and southern Saskatchewan.

Northern Tradition and Transition by Roger Jerome

12. An open-topped box is being made from a piece of cardboard measuring 12 in. by 30 in. The sides of the box are formed when four congruent squares are cut from the corners, as shown in the diagram. The base of the box has an area of 208 sq. in..



a) What equation represents the surface area of the base of the box?

b) What is the side length, x, of the square cut from each corner?

c) What are the dimensions of the box?

13. A car travelling at a speed of v kilometres per hour needs a stopping distance of d metres to stop without skidding. This relationship can be modelled by the function $d(v) = 0.0067v^2 + 0.15v$. At what speed can a car be travelling to be able to stop in each distance? Express your answer to the nearest tenth of a kilometre per hour.

a) 42 m

b) 75 m

c) 135 m

14. A study of the air quality in a particular city suggests that t years from now, the level of carbon monoxide in the air, A, in parts per million, can be modelled by the function $A(t) = 0.3t^2 + 0.1t + 4.2$.

a) What is the level, in parts per million, of carbon monoxide in the air now, at $t = 0$?

b) In how many years from now will the carbon monoxide level be 8 parts per million? Express your answer to the nearest tenth of a year.

b) Examples:

$144 - 25 = (12 - 5)(12 + 5)$
$= (7)(17)$
$= 119$

$256 - 49 = (16 - 7)(16 + 7)$
$= (9)(23)$
$= 207$

4.3 Solving Quadratic Equations by Completing the Square, pages 240 to 243

1. a) $c = \frac{1}{4}$ **b)** $c = \frac{25}{4}$
c) $c = 0.0625$ **d)** $c = 0.01$
e) $c = \frac{225}{4}$ **f)** $c = \frac{81}{4}$

2. a) $(x + 2)^2 = 2$ **b)** $(x + 2)^2 = \frac{17}{3}$
c) $(x - 3)^2 = -1$

3. a) $(x - 6)^2 - 27 = 0$ **b)** $5(x - 2)^2 - 21 = 0$
c) $-2\left(x - \frac{1}{4}\right)^2 - \frac{7}{8} = 0$
d) $0.5(x + 2.1)^2 + 1.395 = 0$
e) $-1.2(x + 2.125)^2 - 1.981\,25 = 0$
f) $\frac{1}{2}(x + 3)^2 - \frac{21}{2} = 0$

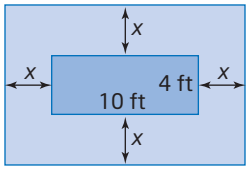
4. a) $x = \pm 8$ **b)** $s = \pm 2$
c) $t = \pm 6$ **d)** $y = \pm\sqrt{11}$

5. a) $x = 1, x = 5$ **b)** $x = -5, x = 1$
c) $d = -\frac{3}{2}, d = \frac{1}{2}$ **d)** $h = \frac{3 \pm \sqrt{7}}{4}$
e) $s = \frac{-12 \pm \sqrt{3}}{2}$ **f)** $x = -4 \pm 3\sqrt{2}$

6. a) $x = -5 \pm \sqrt{21}$ **b)** $x = 4 \pm \sqrt{3}$
c) $x = -1 \pm \sqrt{\frac{2}{3}}$ or $\frac{-3 \pm \sqrt{6}}{3}$
d) $x = 1 \pm \sqrt{\frac{5}{2}}$ or $\frac{2 \pm \sqrt{10}}{2}$
e) $x = -3 \pm \sqrt{13}$ **f)** $x = 4 \pm 2\sqrt{7}$

7. a) $x = 8.5, x = -0.5$ **b)** $x = -0.8, x = 2.1$
c) $x = 12.8, x = -0.8$ **d)** $x = -7.7, x = 7.1$
e) $x = -2.6, x = 1.1$ **f)** $x = -7.8, x = -0.2$

8. a)



b) $4x^2 + 28x - 40 = 0$
c) 12.4 ft by 6.4 ft

9. a) $-0.02d^2 + 0.4d + 1 = 0$
b) 22.2 m

10. 200.5 m

11. 6 in. by 9 in.

12. 53.7 m

13. a) $x^2 - 7 = 0$ **b)** $x^2 - 2x - 2 = 0$
c) $4x^2 - 20x + 14 = 0$ or $2x^2 - 10x + 7 = 0$

14. a) $x = -1 \pm \sqrt{k + 1}$ **b)** $x = \frac{1 \pm \sqrt{k^2 + 1}}{k}$
c) $x = \frac{k \pm \sqrt{k^2 + 4}}{2}$

15. $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ No. Some will result in a negative in the radical, which means the solution(s) are not real.

16. a) $n = 43$ **b)** $n = 39$

17. a) $12^2 = 4^2 + x^2 - 2(4)(x)\cos(60°)$
b) 13.5 m

18. Example: In the first equation, you must take the square root to isolate or solve for x. This creates the $\pm$ situation. In the second equation, $\sqrt{9}$ is already present, which means the principle or positive square root only.

19. Example: Allison did all of her work on one side of the equation; Riley worked on both sides. Both end up at the same solution but by different paths.

20. Example:
- Completing the square requires operations with rational numbers, which could lead to arithmetic errors.
- Graphing the corresponding function using technology is very easy. Without technology, the manual graph could take a longer amount of time.
- Factoring should be the quickest of the methods.

All of the methods lead to the same answers.

21. a) Example: $y = 2(x - 1)^2 - 3$, $0 = 2x^2 - 4x - 1$
b) Example: $y = 2(x + 2)^2$, $0 = 2x^2 + 8x + 8$
c) Example: $y = 3(x - 2)^2 + 1$, $0 = 3x^2 - 12x + 13$

4.4 The Quadratic Formula, pages 254 to 257

1. a) two distinct real roots
b) two distinct real roots
c) two distinct real roots
d) one distinct real root
e) no real roots
f) one distinct real root

2. a) 2 **b)** 2 **c)** 1
d) 1 **e)** 0 **f)** 2

3. a) $x = -3, x = -\frac{3}{7}$ **b)** $p = \frac{3 \pm 3\sqrt{2}}{2}$
c) $q = \frac{-5 \pm \sqrt{37}}{6}$ **d)** $m = \frac{-2 \pm 3\sqrt{2}}{2}$
e) $j = \frac{7 \pm \sqrt{17}}{4}$ **f)** $g = -\frac{3}{4}$

4. a) $z = -4.28, z = -0.39$
b) $c = -0.13, c = 1.88$
c) $u = 0.13, u = 3.07$
d) $b = -1.41, b = -0.09$
e) $w = -0.15, w = 4.65$
f) $k = -0.27, k = 3.10$

5. a) $x = \frac{-3 \pm \sqrt{6}}{3}$, -0.18 and -1.82