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I. Model Problems.
II. Practice
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IV. Answer Key

Web Resources
Different Methods for Solving Quadratic Equations
Quadratic Equation Grapher
Quadratic Formula Solver

Solving Quadratic Equations with the Quadratic Formula: Real Solutions

For any quadratic equation $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

I. Model Problems

In the following examples you will solve quadratic equations with the quadratic formula.

Example 1: **Solve: $x^2 - 4x - 6 = 0$.**

Write down the equation.
$$x^2 - 4x - 6 = 0$$

Identify the values of *a*, *b*, and *c*.
$$a = 1 \quad b = -4 \quad c = -6$$

Write down Quadratic Formula.
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substitute.
$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(-6)}}{2(1)}$$

Simplify.
$$x = \frac{4 \pm \sqrt{16 + 24}}{2}$$
$$x = \frac{4 \pm \sqrt{40}}{2}$$

Simplify the radical.
$$x = \frac{4 \pm 2\sqrt{10}}{2}$$

Reduce. The solution is:
$$x = 2 \pm \sqrt{10}$$

You can also write the answer as two separate expressions or as a decimal approximation.
$$x = 2 - \sqrt{10}, 2 + \sqrt{10}$$
$$x = -1.16, 5.16$$

Example 2: **Solve: $3x^2 + 7x + 15 = 7$. Write your solutions as an exact answer(s).**

Write down the equation.
$$3x^2 + 7x + 15 = 7$$

Rearrange so the equation is equal to zero ($ax^2 + bx + c = 0$).
$$3x^2 + 7x + 8 = 0$$

Identify the values of *a*, *b*, and *c*.
$$a = 3 \quad b = 7 \quad c = 8$$

Write down Quadratic Formula
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substitute.
$$x = \frac{-(7) \pm \sqrt{(7)^2 - 4(3)(8)}}{2(3)}$$

Simplify.
$$x = \frac{-7 \pm \sqrt{49 - 96}}{6}$$

In this class there is a negative number in the radical so there is no solution over the set of Reals.
$$x = \frac{-7 \pm \sqrt{-47}}{2}$$

The solution is: $\emptyset$

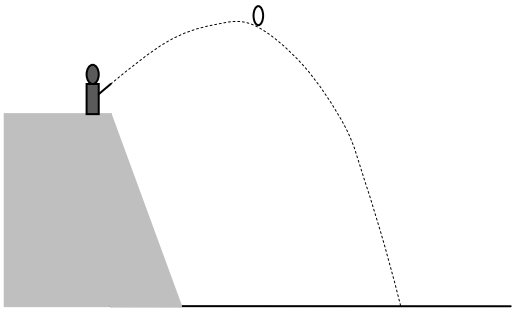
II. Practice solving quadratics with the quadratic formula. Give solutions as exact answers in less directed otherwise.

1. $x^2 - 4x - 7 = 0$
2. $x^2 + 3x - 18 = 0$
3. $a^2 - 7a - 10 = 0$
4. $-x^2 + 3x + 8 = 0$
5. $-b^2 + 4b + 10 = 0$
6. $2x^2 - 4x - 3 = 0$
7. $c^2 + 7c + 16 = 0$
8. $3a^2 - 4a - 4 = 0$
9. $3d^2 + 5d - 6 = 0$
10. $4x^2 - 5x - 11 = 0$
11. $-6a^2 + 3a - 13 = 0$
12. $-9z^2 + 10z + 5 = 0$
13. $16d^2 - 40d + 25 = 0$
14. $-8x^2 - 7x + 3 = 0$
15. $3x^2 - 11x = 8 - 14x$
16. $2t^2 + 15 = 6t^2 - 5t$
17. Find the solution(s) for *x* as a decimal approximation rounded to the nearest hundredth.
    $2.3x^2 - 0.1x - 1.2 = 0$
18. Find the solution(s) for *x* as a decimal approximation rounded to the nearest hundredth.
    $-0.6x^2 + x + 3 = 0$

III. Challenge Problems

19. $\frac{2}{3}x^2 - \frac{1}{6}x - 4 = 0$
20. $-\frac{1}{5}c^2 - \frac{2}{3}c + 1 = 0$
21. The height of a ball in feet can be found by the function $h(t) = -16t^2 + 80t + 5$ where *t* is the elapsed time in seconds. Find the time or times that the ball is 34 feet high to the nearest tenth of a second.
22. The height of a rocket in meters can be found by the function $h(t) = -4.9t^2 + 540t + 25$ where *t* is the elapsed time in seconds. Find the time or times that the rocket is 750 meters high to the nearest tenth of a second.
23. The projectile motion of an object can be found by $h(t) = -16t^2 + v_0t + h_0$ where v_0 is the initial velocity of the object in feet per second, h_0 is the initial height of the object in feet, and *h(t)* is the height in feet of the object at *t* seconds. A stone is shot from a slingshot with an initial velocity of 124 feet per second from a height of 6 feet. How long until the stone hits the ground?
24. The projectile motion of an object can be found by $h(t) = -4.9t^2 + v_0t + h_0$ where v_0 is the initial velocity of the object in meters per second, h_0 is the initial height of the object in meters, and *h(t)* is the height in meters of the object at *t* seconds. A rocket is launched with an initial velocity of 150 meters per second from an initial height of 150 meters. How long until the rocket hits the ground?

25. The projectile motion of an object can be found by $h(t) = -16t^2 + v_0 t + h_0$ where v_0 is the initial velocity of the object in feet per second, h_0 is the initial height of the object in feet, and *h(t)* is the height in feet of the object at *t* seconds. A pitcher is standing at the edge of a cliff. He throws a ball with an initial velocity of 96 feet per second and releases the ball 4 feet above the ground he is standing on. How long will it take the ball to reach the ground 200 feet below the cliff? (Hint: set the height of the ball where it is released equal to 0.)



IV. Answer Key

1. $x = 2 \pm \sqrt{11}$
2. $x = 3, -6$
3. $a = \frac{7 \pm \sqrt{89}}{2}$
4. $x = \frac{3 \pm \sqrt{41}}{2}$
5. $b = 2 \pm \sqrt{14}$
6. $x = \frac{1 \pm \sqrt{37}}{2}$
7. $\emptyset$
8. $x \frac{2 \pm \sqrt{10}}{2}$
9. $d = \frac{-5 \pm 4\sqrt{6}}{6}$
10. $x = \frac{5 \pm \sqrt{201}}{8}$
11. $\emptyset$
12. $z = \frac{5 \pm \sqrt{70}}{9}$
13. $d = \frac{5}{4}$
14. $x = -\frac{7 \pm \sqrt{145}}{16}$
15. $x = \frac{-3 \pm \sqrt{105}}{6}$
16. $t = \frac{5 \pm \sqrt{265}}{8}$
17. $x \approx -0.70, 0.74$
18. $x \approx -1.55, 3.22$
19. $x = \frac{1 \pm \sqrt{385}}{8}$
20. $x = \frac{-5 \pm 2\sqrt{70}}{3}$
21. 0.39 sec and 4.61 sec
22. 1.36 sec and 108.84 sec
23. 7.80 sec
24. 24.71 sec
25. 7.66 sec