9.5 Quadratic Formula

Bellwork

Homework Quiz #1

Essential Question

Core Concept

Quadratic Formula

The real solutions of the quadratic equation $ax^2 + bx + c = 0$ are

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

where $a \neq 0$ and $b^2 - 4ac \geq 0$.

Core Concept

Solve $2x^2 - 5x + 3 = 0$ using the Quadratic Formula.

$a = 2$

$b = -5$

$c = 3$

$$\frac{5 \pm \sqrt{(-5)^2 - 4 \cdot 2 \cdot 3}}{2 \cdot 2} = \frac{5 \pm 1}{4} = \begin{cases} \frac{5+1}{4} = \frac{6}{4} = 1.5 \\ \frac{5-1}{4} = \frac{4}{4} = 1 \end{cases}$$

Example 1

Solve the equation using the Quadratic Formula. Round your solutions to the nearest tenth, if necessary.

1. $x^2 - 6x + 5 = 0$

$a = 1 \quad b = -6 \quad c = 5$

$$\frac{6 \pm \sqrt{(-6)^2 - 4 \cdot 1 \cdot 5}}{2 \cdot 1}$$

$$\frac{6 \pm 4}{2} \begin{cases} \frac{6+4}{2} = \frac{10}{2} = 5 \\ \frac{6-4}{2} = \frac{2}{2} = 1 \end{cases}$$

2. $\frac{1}{2}x^2 + x - 10 = 0$

$a = \frac{1}{2} \quad b = 1 \quad c = -10$

$$\frac{-1 \pm \sqrt{(1)^2 - 4(\frac{1}{2})(-10)}}{2(\frac{1}{2})} = \frac{-1 \pm 4.6}{1} = \begin{cases} \frac{-1+4.6}{1} = 3.6 \\ \frac{-1-4.6}{1} = -5.6 \end{cases}$$

3. $-3x^2 + 2x + 7 = 0$

$a = -3 \quad b = 2 \quad c = 7$

$$\frac{-2 \pm \sqrt{(2)^2 - 4(-3)(7)}}{2(-3)}$$

$$\frac{-2 \pm 9.4}{-6} \begin{cases} \frac{-2+9.4}{-6} = -1.2 \\ \frac{-2-9.4}{-6} = 1.9 \end{cases}$$

4. $4x^2 - 4x = -1$

$+1 \quad +1$

$4x^2 - 4x + 1 = 0$

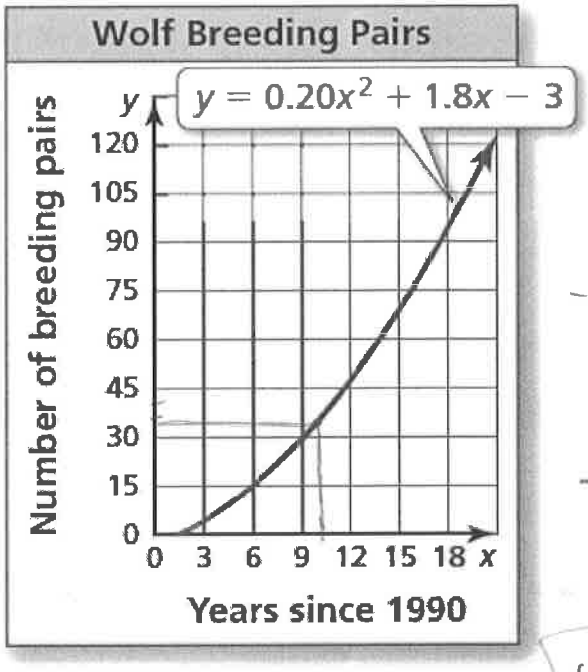
$a = 4 \quad b = -4 \quad c = 1$

$$\frac{4 \pm \sqrt{(-4)^2 - 4(4)(1)}}{2(8)}$$

$$\frac{4 \pm 0}{16} = \begin{cases} \frac{4+0}{16} = \frac{4}{16} = \frac{1}{4} \\ \frac{4-0}{16} = \frac{4}{16} = \frac{1}{4} \end{cases}$$

Monitoring Progress 1-4

The number y of Northern Rocky Mountain wolf breeding pairs x years since 1990 can be modeled by the function $y = 0.20x^2 + 1.8x - 3$. When were there about 35 breeding pairs?



$y = 35$

$35 = 0.20x^2 + 1.8x - 3$

$-35 \quad\quad -35$

$0 = 0.20x^2 + 1.8x - 38$

$\frac{-1.8 \pm \sqrt{(1.8)^2 - 4(0.2)(-38)}}{2(.2)}$

$\frac{-1.8 \pm 5.8}{(0.4)}$

$\frac{-1.8 + 5.8}{(0.4)} = 10$

$\frac{-1.8 - 5.8}{(0.4)} = -19$

10 years later in 2000

Example 2

The number y of bald eagle nesting pairs in a state x years since 2000 can be modeled by the function $y = 0.34x^2 + 13.1x + 51$.

a. When were there about 160 bald eagle nesting pairs?

$160 = y$

about 2007

$160 = 0.34x^2 + 13.1 + 51$

$-160 \quad\quad -160$

$0 = 0.34x^2 + 13.1 - 109$

$\frac{-13.1 \pm \sqrt{(13.1)^2 - 4(.34)(-109)}}{2(0.34)} = \frac{-13.1 \pm 17.9}{(0.68)}$

$\frac{-13.1 + 17.9}{0.68} = 7.1$

$\frac{-13.1 - 17.9}{0.68} = -45.6$

b. How many bald eagle nesting pairs were there in 2000?

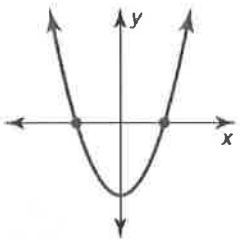
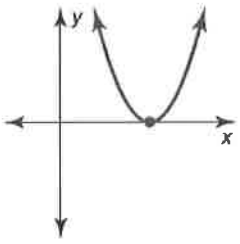
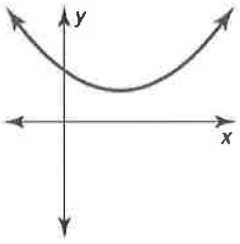
So at 0 years. What is y when x is zero? (0, c)

51 pairs

Monitoring Progress 5-6

Core Concept

Interpreting the Discriminant

$b^2 - 4ac > 0$	$b^2 - 4ac = 0$	$b^2 - 4ac < 0$
		
• two real solutions • two x-intercepts	• one real solution • one x-intercept	• no real solutions • no x-intercepts

Core Concept

$a=1 \quad b=8 \quad c=-3$

a. Determine the number of real solutions of $x^2 + 8x - 3 = 0$.

$b^2-4ac \quad 8^2-4(1)(-3)$

$64+12 = 76 > 0$

2 real solns.

b. Determine the number of real solutions of $9x^2 + 1 = 6x$. Write the equation in standard form: $9x^2 - 6x + 1 = 0$.

$a=9 \quad b=-6 \quad c=1$

$(-6)^2 - 4(9)(1)$

$36-36$

$0 = 0$

1 real solution

Example 3

Determine the number of real solutions of the equation.

7. $-x^2 + 4x - 4 = 0$

$a=-1 \quad b=4 \quad c=-4$

$(4)^2 - 4(-1)(-4)$

$16 - 16$

$0 = 0$

1 real soln & 1 x-int.

8. $6x^2 + 2x = -1$

$6x^2 + 2x + 1 = 0$

$a=6 \quad b=2 \quad c=1$

$(2)^2 - 4(6)1$

$4 - 24$

-20

No real solns.
No x-int.

9. $\frac{1}{2}x^2 = 7x - 1$

$\frac{1}{2}x^2 - 7x + 1 = 0$

$a=\frac{1}{2} \quad b=-7 \quad c=1$

$(-7)^2 - 4(\frac{1}{2})(1)$

$49 - 2 = 47 > 0$

2 real solns.
2 x-int.

Monitoring Progress 7-9

Find the number of x-intercepts of the graph of $y = 2x^2 + 3x + 9$.

$y = 2x^2 + 3x + 9$

$0 = 2x^2 + 3x + 9$

$(3)^2 - 4(2)9$

$9 - 72$

$-63 < 0$

no real solns.
no x-intercepts

Example 4

Solve the equation.

a. $x^2 - 10x = 1$

$x^2 - 10x - 1 = 0$

$\frac{10 \pm \sqrt{(10)^2 - 4(1)(-1)}}{2(1)} = \frac{10 \pm 10.2}{2}$

10.1 and .1

b. $2x^2 - 13x - 24 = 0$

$\frac{-13 \pm \sqrt{(-13)^2 - 4(2)(-24)}}{2 \cdot 2}$

$\frac{-13 \pm 19}{4}$ / $\frac{-13+19}{4} = \frac{6}{4} = 1.5$ \ $\frac{-13-19}{4} = -8$

c. $x^2 + 8x + 12 = 0$

$\frac{-8 \pm \sqrt{64 - 48}}{2}$

$\frac{-8 \pm 4}{2}$ / $\frac{-8+4}{2} = \frac{-4}{2} = -2$ \ $\frac{-8-4}{2} = \frac{-12}{2} = -6$

Example 5

Homework

Pg. 521 #7, 8, 13 - 20, 23 - 25, 27

Closure