Objective 2: Solving Quadratics by the Quadratic Formula.

So far, we have learned to solve quadratic equations by factoring, completing the square, and by extracting square roots. Now we will learn a final method that consistently works to solve any quadratic equations, with the quadratic formula.

QUADRATIC FORMULA: $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ (when equation is $ax^2 + bx + c = 0$ and $a \neq 0$)

EXAMPLES: Solve the following equations.

A) $3x^2 + 5x - 7 = 0$

$a=3 \quad b=5 \quad c=-7$

$5^2-4(3)(-7)$

$25+84$

109

$\frac{-5 \pm \sqrt{5^2-4(3)(-7)}}{2(3)}$

$\boxed{x = \frac{-5 \pm \sqrt{109}}{6}}$

B) $2x^2 + 3 = 2x \Rightarrow 2x^2-2x+3=0$

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

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

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

$4-24$

$x = \frac{2 \pm \sqrt{-20}}{4}$

$\boxed{\text{no real solution}}$

C.) $2x^2 + 4x - 5 = 0$

$a=2 \quad b=4 \quad c=-5$

$4^2-4(2)(-5)$

$16+40$

56

$x = \frac{-4 \pm \sqrt{(4)^2-4(2)(-5)}}{2(2)}$

$x = \frac{-4 \pm \sqrt{56}}{4}$

$x = \frac{-\cancel{4}^{2} \pm \cancel{2}^{1}\sqrt{14}}{\cancel{4}_{2}}$

$\boxed{x = \frac{-2 \pm \sqrt{14}}{2}}$

D.) $4x^2 - 3x + 15$

$x = \frac{-(-3) \pm \sqrt{(-3)^2-4(4)(15)}}{2(4)}$

-231

$\boxed{\text{no real solution}}$

So now we know 4 ways to solve quadratic equations.

METHOD	CAN BE USED	WHEN TO USE
FACTORING	Sometimes	If c = 0 or factors are easy to find.
SQUARE ROOT PROPERTY	Sometimes	When equation is a perfect square.
COMPLETING THE SQUARE	Always	When b is an even number.
QUADRATIC FORMULA	Always	When other methods fail or are too tedious.

Algebra 2 Worksheet **Name:** _____

AII.4b – The Quadratic Formula and Discriminant

The Discriminant:

1) What is the formula for the discriminant?

b^2-4ac

2) What does the discriminant tell us about an equation?

the # of solutions

3) Based on the given discriminants, what do you know about the equation related to it?

a. 8

2 solutions

b. -10

no real solutions

c. 9

2 Real solutions

d. 1

2 solutions

e. 0

1 solution

f. -4

no Real solutions

Quadratic Formula:

4) What is the quadratic formula?

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

5) Why do we use the quadratic formula? What are the benefits of solving a quadratic equation by the quadratic formula over the other methods we have?

You can <u>Always</u> use the formula to find solutions.

p.4-5 (evens) p.5

For each equation below A) find the discriminant and determine the type of solutions and B) solving each equation using the quadratic formula.

6. $x^2 - 2x + 9 = 0$

$X = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(9)}}{2(1)}$

$X = \frac{-2 \pm \sqrt{-32}}{2}$ $\boxed{\text{NRS}}$

7. $3x^2 - 3x + 12 = 0$

$X = \frac{3 \pm \sqrt{(-3)^2 - 4(3)(12)}}{2(3)}$

$X = \frac{3 \pm \sqrt{-135}}{6}$ $\boxed{\text{NRS}}$

8. $8x^2 - 4 = 0$

$X = \frac{-0 \pm \sqrt{0^2 - 4(8)(-4)}}{2(8)}$

$X = \frac{\pm\sqrt{128}}{16} = \frac{8\sqrt{2}}{2 \cdot 16} = \boxed{\frac{\pm\sqrt{2}}{2}}$

9. $-4x^2 - 4x + 15 = 0$

$X = \frac{4 \pm \sqrt{(-4)^2 - 4(-4)(15)}}{2(-4)}$

$X = \frac{4 \pm \sqrt{256}}{-8} = \frac{4 \pm 16}{-8}$ $\boxed{X = \frac{5}{-2}, \frac{3}{2}}$

10. $12x = -18x - 2x^2$

$2x^2 + 18x + 12x = 0$

$X = \frac{-18 \pm \sqrt{18^2 - 4(2)(12)}}{2(2)}$

$\frac{-18 \pm \sqrt{228}}{4} = \frac{-\cancel{18}^{9} \pm \cancel{2}^{1}\sqrt{57}}{\cancel{4}2} = \frac{-9 \pm \sqrt{57}}{2}$

11. $-10x^2 = 45x$

$-10x^2 + 45x + 0 = 0$

$X = \frac{-45 \pm \sqrt{(45)^2 - 4(-10)(0)}}{2(-10)}$

$X = \frac{-45 \pm \sqrt{2025}}{-20} = \frac{-45 \pm 45}{-20} =$

$\frac{-45+45}{20}$ AND $\frac{-45-45}{20}$

$\boxed{0, -4.5}$

12. $2 = -10x + 25x^2 + 20$

$25x^2 - 10x + 18 = 0$

$X = \frac{10 \pm \sqrt{(-10)^2 - 4(25)(18)}}{2(25)}$

$\boxed{\text{NRS}}$

13. $3x^2 = -4x + 10$

$3x^2 + 4x - 10 = 0$

$X = \frac{-4 \pm \sqrt{4^2 - 4(3)(-10)}}{2(3)}$

$X = \frac{-4 \pm \sqrt{136}}{6} = \frac{-\cancel{4}^{2} \pm \cancel{2}^{1}\sqrt{34}}{3\ \cancel{6}}$

$X = \frac{-2 \pm \sqrt{34}}{3}$

14. $1 = -10x + 7x^2$

$7x^2 - 10x - 1 = 0$

$X = \frac{10 \pm \sqrt{(-10)^2 - 4(7)(-1)}}{2(7)}$

$X = \frac{10 \pm \sqrt{128}}{14} = \frac{\cancel{10}^{5} \pm \cancel{8}^{4}\sqrt{2}}{7\ \cancel{14}} = \boxed{\frac{5 \pm 4\sqrt{2}}{7}}$

15. $3x^2 - 10x + 22 = 0$

$X = \frac{10 \pm \sqrt{(-10)^2 - 4(3)(22)}}{2(3)}$

$\frac{10 \pm \sqrt{-164}}{}$

$\boxed{\text{NRS}}$

5