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

Graph Paper Maker (free): www.mathworksheetsgo.com/paper/

Online Graphing Calculator(free): www.mathworksheetsgo.com/calculator/

Solving Quadratic Equations with the Quadratic Formula: Complex Solutions

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

Complex numbers are written in the form $a+bi$ where $i^2=-1, i=\sqrt{-1}$. Complex numbers include the set of Real and Imaginary numbers.

I. Model Problems

In the following examples you will solve quadratic equations with the quadratic formula over the set complex numbers.

Example 1: **Solve: $x^2-5x+10=0$.**

Write down the equation.
$$x^2-5x+10=0$$

Identify the values of *a*, *b*, and *c*.
$$a=1 \quad b=-5 \quad c=10$$

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

Substitute.
$$x=\frac{-(-5)\pm\sqrt{(-5)^2-4(1)(10)}}{2(1)}$$

Simplify.
$$x=\frac{5\pm\sqrt{25-40}}{2}$$
$$x=\frac{5\pm\sqrt{-15}}{2}$$

Simplify the radical and reduce.
$$x=\frac{5\pm i\sqrt{15}}{2}$$

The solution is:
$$x=\frac{5\pm i\sqrt{15}}{2}$$

You can also write the answer as two separate expressions.
$$x=\frac{5-i\sqrt{15}}{2}, \frac{5+i\sqrt{15}}{2}$$

Example 2: **Solve: $-2x^2+4x+6=15$. Write your solutions as an exact answer(s).**

Write down the equation.
$$-2x^2+4x+6=15$$

Rearrange so the equation is equal to zero.
$$-2x^2+4x-9=0$$

Identify the values of *a*, *b*, and *c*.
$$a=-2 \quad b=4 \quad c=-9$$

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

Substitute.
$$x=\frac{-(4)\pm\sqrt{(4)^2-4(-2)(-9)}}{2(-2)}$$

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

Simplify the radical and reduce. The solution is: $\emptyset$
$$x=\frac{2\pm i\sqrt{14}}{2}$$

II. Practice solving quadratics with the quadratic formula over the set of Complex numbers.

1. $x^2 - 4x + 5 = 0$
2. $x^2 + 6x + 13 = 0$
3. $x^2 + 6x + 12 = 0$
4. $x^2 + 4x + 2 = 0$
5. $a^2 - 5a + 8 = 0$
6. $x^2 - 3x + 10 = 0$
7. $b^2 - 7b - 3 = 0$
8. $-x^2 + 5x - 6 = 0$
9. $-c^2 - 6c + 8 = 0$
10. $2a^2 - 6a - 3 = 0$
11. $3d^2 - 5d + 6 = 0$
12. $4x^2 + 11x = 3x - 10$
13. $14 - 3a^2 = 2a$
14. $7 - 8z^2 = 6z + 16$
15. $3d - 2 = 5d^2$
16. $5x^2 - 5x + 2 = 3x^2 - 3x$
17. $10x^2 - 11x + 9 = 13x - 6x^2$
18. $3t^2 + 8t + 5 = -2t^2$

III. Challenge Problems

19. $x^4 + 13x^2 + 36 = 0$
20. $x^4 + 16x^2 - 225 = 0$
21. $\frac{1}{4}x^2 - \frac{1}{3}x + 1 = 0$
22. $\frac{2}{7}c^2 - \frac{1}{2}c - \frac{3}{14} = 0$

From the quadratic formula $b^2 - 4ac$ is called the discriminant. The values of the discriminant tell us the nature of the solutions or roots of a quadratic equation,

$ax^2 + bx + c = 0$

23. What value(s) of the discriminant result in two unique real solutions?

24. What value(s) of the discriminant result in one unique real solution?

25. What value(s) of the discriminant result in two unique imaginary solutions?

IV. Answer Key

1. $x = 2 \pm i$
2. $x = -3 \pm 2i$
3. $x = -3 \pm i\sqrt{3}$
4. $x = -2 \pm \sqrt{2}$
5. $a = \frac{5 \pm i\sqrt{7}}{2}$
6. $x = \frac{3 \pm i\sqrt{31}}{2}$
7. $b = \frac{7 \pm \sqrt{61}}{2}$
8. $x = 2, 3$
9. $c = -3 \pm \sqrt{17}$
10. $a = \frac{3 \pm \sqrt{15}}{2}$
11. $d = \frac{5 \pm i\sqrt{47}}{6}$
12. $x = \frac{-2 \pm i\sqrt{6}}{2}$
13. $a = \frac{1 \pm \sqrt{43}}{3}$
14. $z = \frac{-3 \pm 3\sqrt{7}}{8}$
15. $d = \frac{3 \pm i\sqrt{31}}{10}$
16. $x = \frac{1 \pm i\sqrt{3}}{2}$
17. $x = \frac{3}{4}$
18. $t = \frac{-4 \pm 3i}{5}$
19. $x = \pm 3i, \pm 2i$
20. $x = \pm 3, \pm 5i$
21. $x = \frac{2 \pm 4i\sqrt{2}}{3}$
22. $c = \frac{7 \pm \sqrt{97}}{8}$
23. The discriminant is positive.
24. The discriminant is zero.
25. The discriminant is negative.