Solve Quadratics by the Quadratic Formula:

Teacher WED

Negative under radical is creating an imaginary number "i"

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

We use the Quadratic Formula when we cannot solve by Factoring.

Example 1: Solve $x^2 + x = -6$

6, 1

$x^2+x+6=0$

$a=1$, $b=1$, $c=6$

$x = \frac{-1 \pm \sqrt{1^2-4(1)(6)}}{2(1)} = \frac{-1 \pm \sqrt{1-24}}{2} = \frac{-1 \pm \sqrt{-23}}{2} = \frac{-1 \pm i\sqrt{23}}{2}$

Example 2: $x^2 + 6x + 9$

9; 3, 3; 6

$a=1$, $b=6$, $c=9$

$(x+3)=0$ — $x=-3$ → $x = \frac{-6 \pm \sqrt{6^2-4(1)(9)}}{2(1)} = \frac{-6 \pm \sqrt{36-36}}{2} = -6/2 = -3$

Example 3: $5x^2 = 13x + 6$

36, 15, 2; -30; -15, 2; -13

$a=5$, $b=-13$, $c=-6$

$(5x-15)(5x+2)$ →

$(x-3)(5x+2)$

$= 3, -2/5$

Example 4: $4a^2 - 12a + 9 = 0$

36, 2, 18, 2, 12, 3, 9, 4; 36; -6, -6; -12

$a=4$, $b=-12$, $c=9$

$\frac{(4a-6)(4a-6)}{2 \quad 2}$

$2a-3=0$

$a = 3/2$

An important part of the quadratic formula is what is under the radical, called the discriminant

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The Discriminant is: $\boxed{b^2-4ac}$

Why is the Discriminant important? It tells you the number and (roots) types of answers. The discriminant can be +, -, 0 which actually tells you a lot! Since the discriminant is under a radical, think about what it means if you have a positive or negative number or 0 under the radical.

What the Discriminant Tells You:

Value of the Discriminant	Nature of the Solutions
Negative	2 imaginary
Zero	1 real
Positive - perfect square	2 real → rational
Positive - non-perfect square	2 real → irr.

cannot be expressed as ratio (decimal keeps going)

Example: Find the value of the discriminant and describe the nature of the roots (real, imaginary, rational, irrational) of each quadratic equation. Then solve the equation using the quadratic formula.

$2x^2 + 7x - 11 = 0$

$a=2$, $b=7$, $c=-11$

b^2-4ac

$7^2-4(2)(-11)$

$49-8(-11)$

$49+88$ $=137$

2 Reals Irr.

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Solve each equation with the quadratic formula.

1) $m^2 - 5m - 14 = 0$ a=1 b=-5 c=-14 ← can Factor → 2) $b^2 - 4b + 4 = 0$

(7, -2) (2)

$x = \frac{-(-5) \pm \sqrt{-5^2 - 4(1)(-14)}}{2(1)}$

$= \frac{5 \pm \sqrt{25+56}}{2}$

$= \frac{5 \pm \sqrt{81}}{2}$

$= \frac{5+9}{2}$ or $\frac{5-9}{2}$

$14/2$ or $-4/2$

3) $2k^2 + 9k = -7$ 4) $5r^2 = 80$

$5r^2 - 80 = 0$

-1, -7/2 4, -4

$\frac{-9 \pm \sqrt{9^2 - 4(2)(7)}}{2(2)}$

$\frac{-9 \pm \sqrt{81-56}}{4}$

$\frac{-9 \pm \sqrt{25}}{4}$ $\frac{-9+5}{4} = -4/4$

5) $2x^2 - 36 = x$ 6) $5x^2 + 9x = -4$

9/2, -4 -4/5, -1

7) $k^2 - 31 - 2k = -6 - 3k^2 - 2k$ 8) $9n^2 = 4 + 7n$

5/2, -5/2 $\frac{7 \pm \sqrt{193}}{18}$

9) $8n^2 + 4n - 16 = -n^2$ 10) $8n^2 + 7n - 15 = -7$

$\cancel{\frac{-2 \pm 2\sqrt{37}}{9}}$ $\frac{-4 \pm \sqrt{592}}{18}$ $\cancel{\frac{-7 \pm \sqrt{305}}{16}}$

Discriminant Practice:

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Which equation has imaginary roots?

- $x^2 - 9 = 0$ $0-4(1)(-9)$
- $x^2 - x + 1 = 0$
- $x^2 + 2x + 1 = 0$
- $x^2 - 1 = 0$

$b^2 - 4ac$

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

$1 - 4$

$= -3$

What is the nature of the roots of $4x^2 - 4x + 1 = 0$?

- real, rational, unequal
- real, rational, equal
- not real, complex
- real, irrational, unequal

$b^2 - 4ac$

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

$16 - 16$

$= 0$

$-1.8^2 - 4(4)(.2)$

$3.24 - 3.2$

Find the value of the below discriminants and tell how many real and distinct roots the equation has:

a). $x^2 - 6x + 5 = 0$ 16 / Two Rational Real # Roots

b). $n^2 - 18n + 81 = 0$ 0/1 real

c). $4y^2 - 12y + 9 = 0$ 0/1 real

d). $9m^2 + 24m + 16 = 0$ 0/1 real

e). $-7q^2 + 8q + 2 = 0$ 120/2 real irr.

f). $4p^2 - 1.8p + 0.2 = 0$ .04/2 real rat.