4-3 Quadratic Formula with Imaginary Numbers & Graphing

Objective: I can solve quadratic equations that have imaginary roots using the Quadratic Formula.

Objective: I can graph quadratic functions that have real and imaginary roots.

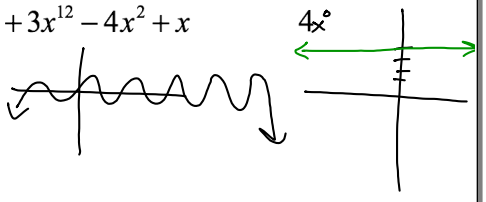
Fundamental Theorem of Algebra

Any polynomial of degree n with real number coefficients has exactly n complex roots.

What is the degree of the following:

x^2+5x-6 $\qquad$ $3x+2$

$15x^4+3x^{12}-4x^2+x$ $\qquad$ $4x^6$



Quadratic Formula Review

Get the equation in standard form, then plug in a, b, and c.

Standard form: $ax^2+bx+c=0$

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

Solve:

$3x+6=9$ $\qquad$ $3x+7=2$

$-6 \quad -6$

$3x=3$

$\boxed{x=1}$

How many solution(s) did we end up with?

What kind of solution(s) are they?

Solve.

$x^2-4x=-4$ $\qquad$ 4 : $1,4$ $\quad -2,-2$ $\qquad$ $x=-2,-4$

$+4 \quad +4$

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

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

$x(x-2)-2(x-2)=0$

$(x-2)(x-2)=0=(x-2)^2=0$

$\sqrt{(x-2)^2}=\sqrt{0}$

$x-2=0$

$\boxed{x=2}$

$2x^2+12x+16=0$

$\frac{2}{2}(x^2+6x+8)=\frac{0}{2}$

$x^2+6x+8=0$

$(x^2+4x)+(2x+8)=0$

$x(x+4)+2(x+4)=0$

$(x+4)(x+2)=0$

$x+4=0 \quad x+2=0$

$\boxed{x=-4 \quad x=-2}$

How many solution(s) did we end up with?

What kind of solution(s) are they?

What kind of number is it if we get a negative inside the radical?

When we use the Quadratic Formula, we can get numbers that have both real and imaginary parts.

REMEMBER TO SIMPLIFY!

Solve using the Quadratic Formula.

$x^2 - 4x = -13$ $a=1$ $b=-4$ $c=13$

$+13 \quad +13$

$x^2 - 4x + 13 = 0$

$x = \frac{4 \pm \sqrt{16 - 4(1)(13)}}{2(1)}$

$x = \frac{4 \pm \sqrt{-36}}{2}$

$x = \frac{4 \pm 6i}{2} = 2 \pm 3i$

$x^2 + x + 5 = 0$

$x = \frac{-1 \pm \sqrt{1 - 4 \cdot 5}}{2}$

$x = \frac{-1 \pm \sqrt{-19}}{2}$

$x = \frac{-1 \pm i\sqrt{19}}{2}$

How many solution(s) did we end up with?

What kind of solution(s) are they?

Solve using the Quadratic Formula.

$7 + 3x = -2x^2$ 19, 1 19, 2 17

$+2x^2 \quad +2x^2$

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

$x = \frac{-3 \pm \sqrt{9 - 4(2)(7)}}{2(2)}$

$x = \frac{-3 \pm \sqrt{-47}}{4} = \frac{-3 \pm i\sqrt{47}}{4}$

How many solution(s) did we end up with?

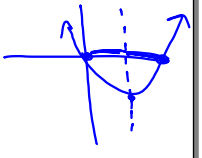
What kind of solution(s) are they?

To graph a quadratic function that's NOT in graphing form, we can use the Quadratic Formula.

x-coordinate of vertex

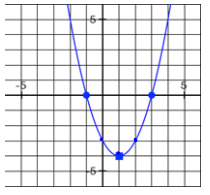
how much to add to and subtract from vertex to find solutions

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



To find the vertex: $(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right))$

Graphing Quadratic Functions



If we solve this equation, what do you notice about the solutions? $x = \frac{-b}{2a}$

$f(x) = x^2 - 2x - 3$

$x = \frac{2}{2(1)} = \frac{2}{2} = 1$

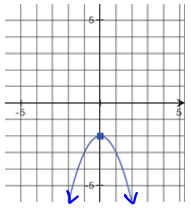
$f(1) = 1 - 2 - 3 = -4$

$f(1) = -4$ V: $(1, -4)$

How many root(s) did we end up with?

What kind of root(s) are they?

Find the zeros using the quadratic formula. $-(x+0)^2 - 2$



$g(x) = -x^2 - 2$

V: $(0, -2)$

Domain: $(-\infty, \infty)$

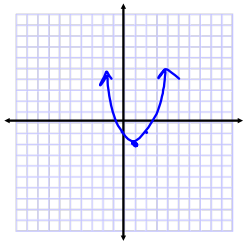
Range: $(-\infty, -2]$

How many root(s) did we end up with?

What kind of root(s) are they?

~~Find the zeros using the quadratic formula.~~ $x = \frac{-b}{2a}$

Graph



$f(x) = x^2 - 2x - 1$

$x = \frac{2}{2} = 1$

$f(1) = 1 - 2 - 1 = -2$

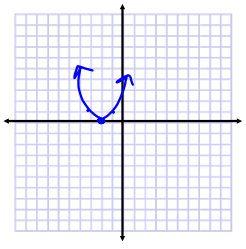
V: $(1, -2)$

How many root(s) did we end up with?

What kind of root(s) are they?

Find the zeros using the quadratic formula.

Graph



$f(x) = x^2 + 4x + 4$

$x = \frac{-4}{2(1)} = \frac{-4}{2} = -2$

$f(-2) = (-2)^2 + 4(-2) + 4$

$= 4 - 8 + 4$

$f(-2) = 0$

$(-2, 0)$

How many root(s) did we end up with?

What kind of root(s) are they?