**Functions Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Leading Question:** How do we know what the roots of a quadratic will be without solving it?

**The Quadratic Formula**

Consider the quadratic formula given below:

In any quadratic equation $ax^{2}+bx+c=0,$

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

You’ll remember that we use the quadratic formula to calculate the $x$-intercepts of a quadratic function.

Write other words that we use to refer to the $x$-intercepts.

In each of the cases below, the values for$ a$, $b$ and $c$ have already been substituted into the quadratic formula.

Consider each of them and draw a graph of what you think the function will look like. Try and do as few calculations as possible to decide.

a) $x=\frac{-(-3)\pm \sqrt{(-3)^{2}-4(1)(-10)}}{2(1)}$ b) $x=\frac{-(6)\pm \sqrt{(6)^{2}-4(1)(9)}}{2(1)}$



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



Now make a summary of the three general scenarios we get when referring to the $x$-intercepts of quadratic functions.

Can you think of an easy way to predict which one of the three types mentioned above we’ll get from any quadratic function?

**The Discriminant**

The discriminant forms a part of the quadratic formula, as can be seen below:

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

We can write it as a formula which reads:

$$∆=b^{2}-4ac$$

$∆$is…

By simply looking at the discriminant, we can predict how many and which type of $x$-intercepts a quadratic function will have. We say that we comment on the **nature of the roots**.

**Example**

Calculate the discriminant for each of the following quadratic functions and try to comment on the nature of the roots.

a) $y=x^{2}-3x-10$ b) $y=3x^{2}+2x-3$

c) $y=x^{2}-6x+9$ d) $y=-x^{2}-3x-5$

We can summarize the different nature of roots scenarios as follows:

$∆>0$$∆=0$

$∆<0$$∆\geq 0$

**Nature of Roots - Homework**

Calculate the discriminant for each of the following and hence, comment on the nature of the roots.

a) $y=x^{2}+3x+2$ b) $y=x^{2}+14x+49$

c) $y=6x^{2}-6x-1$ d) $y=-4x^{2}+19x+5$

e) $y=x^{2}-3$ f) $y=3x^{2}+5x+8$

g) $y=x^{2}-36$ h) $y=-x^{2}-4x+1$

i) $y=x^{2}-3x+11$ j) $y=x^{2}-x+\frac{1}{4}$

**Challenge Question**

Consider the quadratic equation$ y=x^{2}+3x+k$. For which values of $k$ will this quadratic equation have non-real roots?