Three possibilities for a quadratic equation Solutions NAME:

This worksheet investigates an example of each of the three possibilities for a quadratic equation. For any quadratic equation, there could be zero, one, or two real solutions. In the case where there are zero real solutions, there will always be two complex solutions. We will use our calculator program to investigate the three equations below and their corresponding functions.

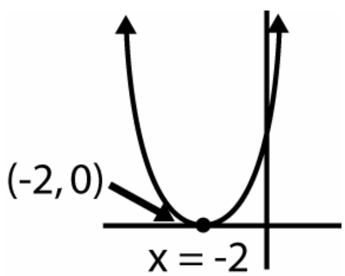
Solve each equation using your QUADRATC (or QUAD2) program. Answer the questions.

1. Solve $0 = x^2 + 4x + 4$ using your program.

a.) What's the solution to $0 = x^2 + 4x + 4$?

One real solution
x = -2

b.) Draw the graph of $y = x^2 + 4x + 4$ that your program provided. Notice it should have just one x-intercept. Label it on your graph. This is the solution to the equation.



c.) The quadratic formula is $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Find the solutions to $0 = x^2 + 4x + 4$ by figuring the quadratic formula by hand to verify the program's solutions.

$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(4)}}{2(1)}$$
$$x = \frac{-4 \pm \sqrt{16 - 16}}{2}$$
$$x = \frac{-4 \pm \sqrt{0}}{2}$$
$$x = \frac{-4}{2} = -2$$

Notice the discriminant is zero. This causes the radical part to drop out and results in only one solution to the equation and one x-intercept for the function.

d.) Your calculator also gives the vertex of the parabola. This is sometimes useful. Label the vertex on your graph above.

Vertex (-2, 0)

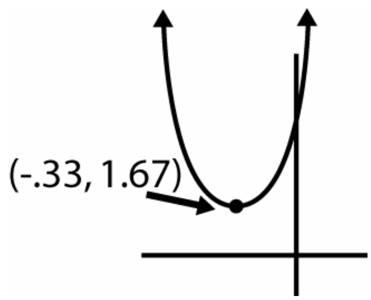
2. Solve $0 = 3x^2 + 2x + 2$ using your program.

a.) What's the solution to $0 = 3x^2 + 2x + 2$?

No real solutions

Two complex solutions: $x = -.33 \pm .75i$

b.) Draw the graph of $y = 3x^2 + 2x + 2$ that your program provided. Notice it should have no x-intercepts. This means that there are no real numbers that make the equation true. We must use complex numbers to make the equation true. These are the numbers you recorded in part a.



c.) The quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Find the solutions to $0 = 3x^2 + 2x + 2$ by figuring the quadratic formula by hand to verify the program's solutions.

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

$$x = \frac{-2 \pm \sqrt{4 - 24}}{6}$$

$$x = \frac{-2 \pm \sqrt{-20}}{6}$$

$$x = \frac{-2}{6} \pm \frac{\sqrt{20}}{6} i$$

$$x = -.33 \pm .75i$$

Since the discriminant is negative, the solution does not exist in the real numbers. We have to introduce complex numbers in order to find numbers that make the equation true. Notice, when this happens, there are no x-intercepts for the corresponding function.

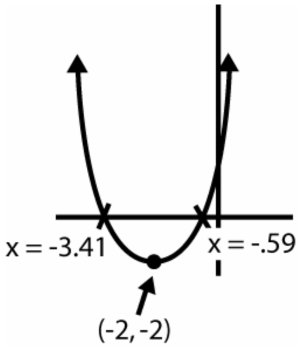
d.) Your calculator also gives the vertex of the parabola. This is sometimes useful. Label the vertex on your graph above.

Vertex: (-.33, 1.67)

3. Solve $0 = x^2 + 4x + 2$ using your program.
a.) What's the solution to $0 = x^2 + 4x + 2$?

Two real solutions
x = -3.41, -.59

b.) Draw the graph of $y = x^2 + 4x + 2$ that your program provided. Notice it should have two x-intercepts. Label them on your graph. These are the solutions to the equation.



c.) The quadratic formula is $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Find the solutions to $0 = x^2 + 4x + 2$ by figuring the quadratic formula by hand to verify the program's solutions.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(2)}}{2(1)}$$
$$x = \frac{-4 \pm \sqrt{16 - 8}}{2}$$
$$x = \frac{-4 \pm \sqrt{8}}{2}$$
$$x = \frac{-4}{2} \pm \frac{\sqrt{8}}{2}$$
$$x = -2 \pm 1.41$$
$$x = -3.41, -.59$$

The discriminant is positive which results in two different solutions to the equation and two x-intercepts for the corresponding function.

d.) Your calculator also gives the vertex of the parabola. This is sometimes useful. Label the vertex on your graph above.

Vertex: (-2, -2)