Essential Question: What are the roots of a quadratic function?

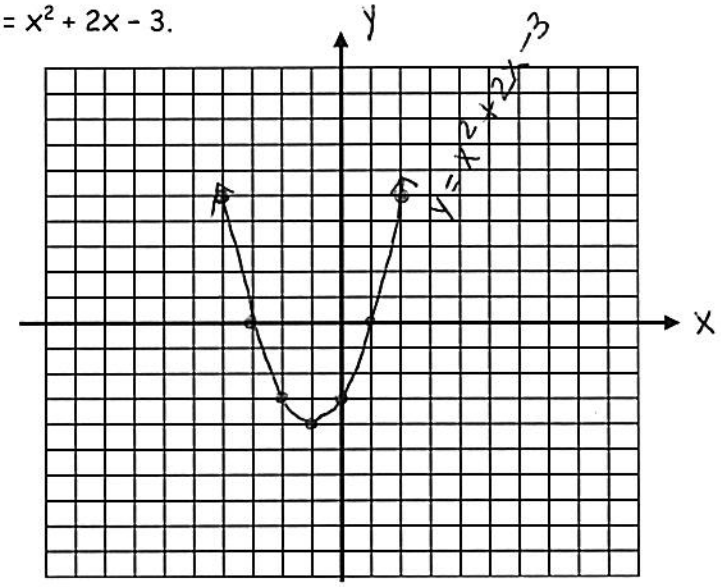
Do Now: Graph the function $y = x^2 + 2x - 3$.

$x = \frac{-b}{2a}$

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

$x = -1$

x	y
-4	5
-3	0
-2	-3
-1	-4
0	-3
1	0
2	5



Where does the graph intercept the x-axis?

x-intercepts: (-3, 0) (1, 0)

Think about this.... What is the solution set to the equation $x^2 + 2x - 3 = 0$?

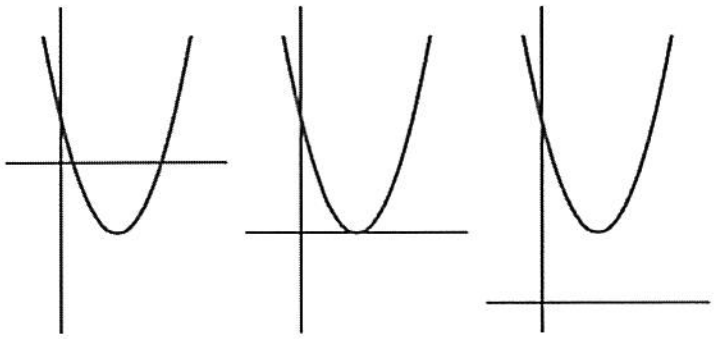
$(x+3)(x-1) = 0$

$x+3=0$	$x-1=0$
$x=-3$	$x=1$

What do you notice about the **solution set** to the equation and the **x-intercepts** of the graph from the Do Now? They are the same.

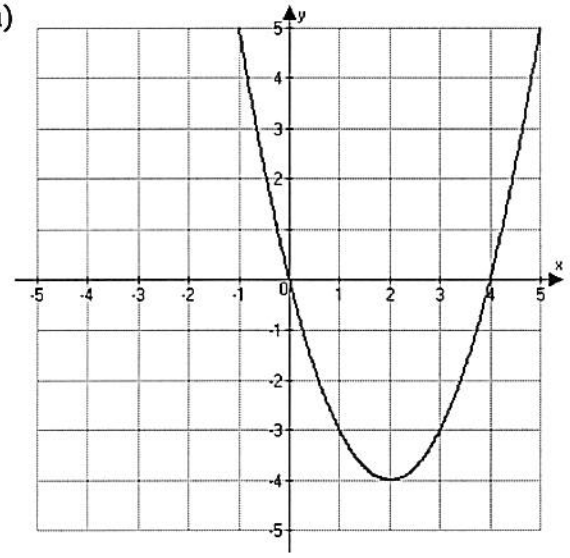
The "roots" of a parabola are the *x*-coordinates of the points where the curve intercepts the x-axis. **These values are also known as the "zeros" of the function.**

- If a parabola intersects the x-axis twice, then the parabola has 2 real roots.
- If it only intersects the x-axis once, then the parabola has 1 real root.
- If the parabola doesn't intersect the x-axis, then the roots are not real. (imaginary)



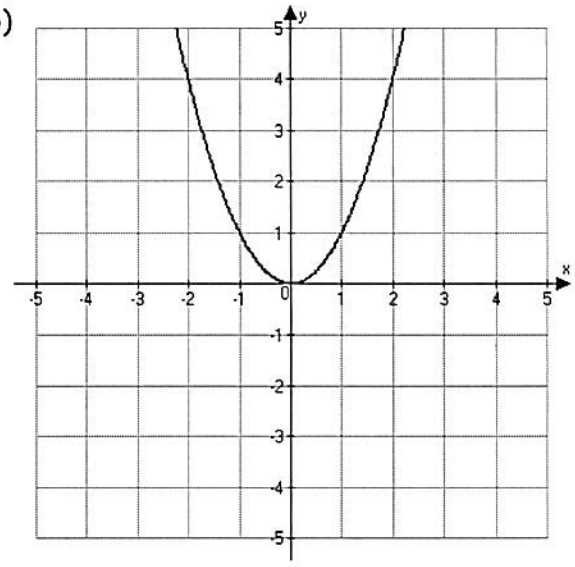
1) Identify the **roots** of the quadratic functions graphed below?

a)



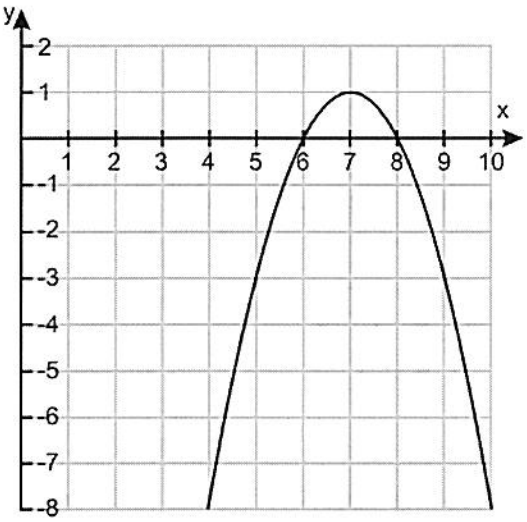
Roots: 0 , 4

b)



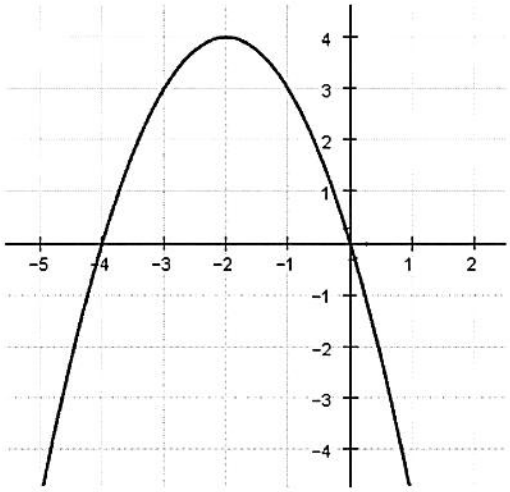
Roots: 0

c)



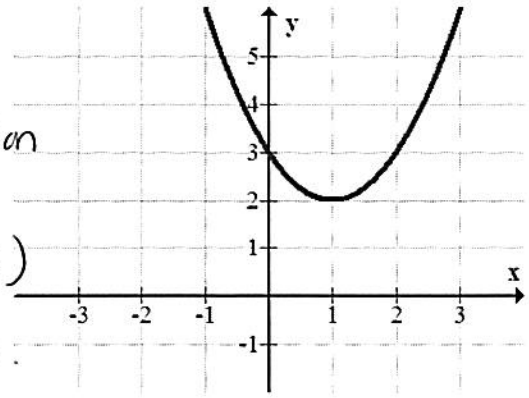
Roots: 6 , 8

d)



Roots: -4 , 0

2) Jeremy says that the parabola shown here has one root, x = 3.
Do you agree or disagree? Explain.



I disagree.
A root of a quadratic function is where the graph crosses the x-axis (not the y-axis)
This graph has no real roots.

3) Without graphing, how can we find the roots of the quadratic function $y = 3x^2 + 18x + 24$?

Factor!

$$\frac{0}{3} = \frac{3x^2}{3} + \frac{18x}{3} + \frac{24}{3}$$

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

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

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

check roots of $-4, -2$

$0 = 3(-4)^2 + 18(-4) + 24$

$0 = 0$ ✓

$0 = 3(-2)^2 + 18(-2) + 24$

$0 = 0$ ✓

4) Find the roots of the function $y = x^2 + 3x - 18$ in two ways.

Algebraically

$$0 = x^2 + 3x - 18$$

$$0 = (x+6)(x-3)$$

$x+6=0$	$x-3=0$
$x=-6$	$x=3$

Graphically (*use calculator*)

2nd Trace (Calc)
Option 2: Zero
Move cursor left of the x-intercept (left bound)
Enter
Move cursor right of the x-intercept (right bound)
Enter
(Guess) Enter

Table of Values
Look for (x, 0)

The **roots** of a quadratic function can be found graphically

by identifying the **x-value** of the **x-intercepts** and algebraically

by replacing **y** in $y = ax^2 + bx + c$ with 0 and solving for x.

JUST ONE more THING!

The **discriminant** is a numerical value that provides information about the roots of a quadratic function. It is calculated using the formula $b^2 - 4ac$.

- If $b^2 - 4ac$ is **positive**, then the **roots are real** numbers.
- If $b^2 - 4ac$ is **negative**, then the **roots are *not real*** (*the graph does not intersect the x-axis*).

Examples: Determine if the roots of the functions are real or not real.

$y = x^2 - 2x + 5$
$b^2 - 4ac$
$(-2)^2 - 4(1)(5)$
-16 ←This value tells me that the graph will *not* intersect the x-axis (*no real roots*)

$y = x^2 + 9x + 14$
$b^2 - 4ac$
$(9)^2 - 4(1)(14)$
25 ←This value tells me that the graph will intersect the x-axis (real roots)

See graphs on calculator.