Algebra 1R – Mr. Bo
Unit 11 – Day 1 Notes

Name:______________________________
Date:___________________

Parabolas – Graphs of Quadratic Functions

Vocabulary:

Standard form.

1. **Quadratic Function** – A function of the form: $y = ax^2 + bx + c$.
2. **Coefficients** – The "a", "b" and "c" in a quadratic expression. They are typically real number values.
3. **Parabola** – The name given to the graph of a quadratic function.

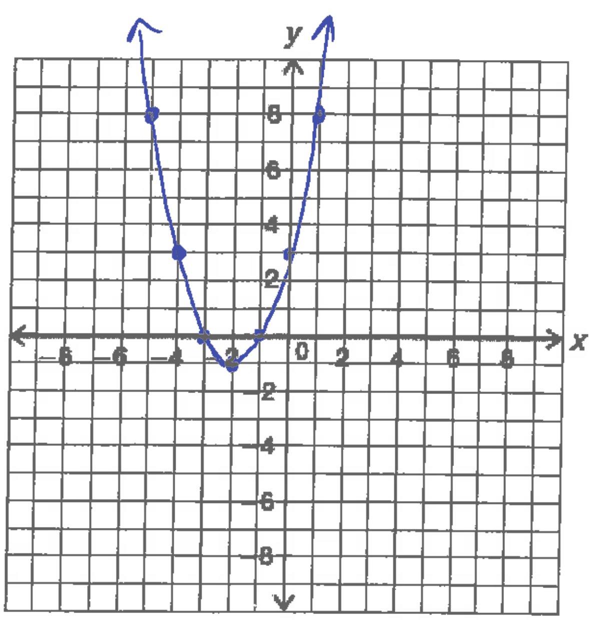
Problem 1 – "What U Talkin Bout?"

Consider the quadratic function: $y = x^2 + 4x + 3$.

1. Determine the values of the coefficients.

a = 1 b = 4 c = 3

2. Graph the quadratic using your calculator. Use a standard window [-10, 10]x[-10, 10]. Sketch the graph on the grid below.



a. Describe the characteristic shape of the graph.

the graph is a "U" shape.

b. What is the y-intercept of the graph?

(0,3)

c. What are the x–intercepts of the graph?

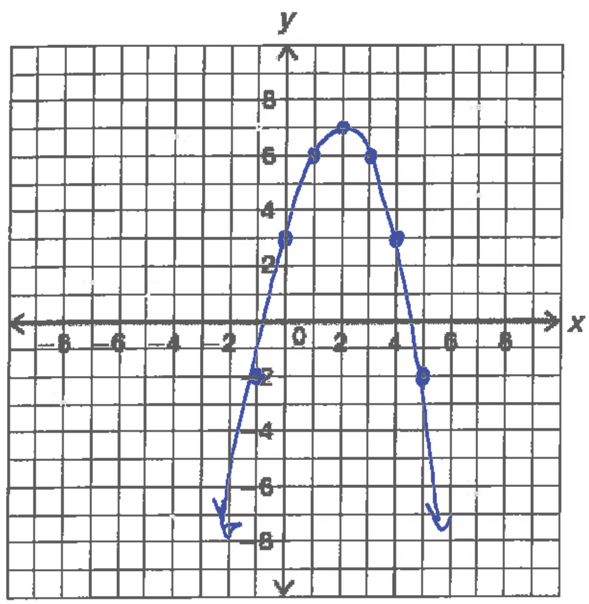
(-3,0), (-1,0)

Problem 2 – "Leading the Way"

The value "a" in a quadratic expression is referred to as the **Leading Coefficient**.

Changing the sign of the leading coefficient will alter the graph of the quadratic.

1. Change the sign of the leading coefficient of $y = x^2 + 4x + 3$. Sketch the resulting graph below.



a. What change to the graph did you observe?

graph is opening down rather that opening up.

b. Describe the characteristic shape of the graph of a quadratic that has a **positive leading coefficient.**

Opens up.

C. Describe the characteristic shape of the graph of a quadratic that has a **negative leading coefficient.**

Opens down.

2. Determine if the graph of the quadric is opening up or down by analyzing the leading coefficient.

a. $y = 4x^2 - 3x + 1$

up.

b. $y = -2x^2 + 7$

down

c. $y = -5x^2 - 2x$

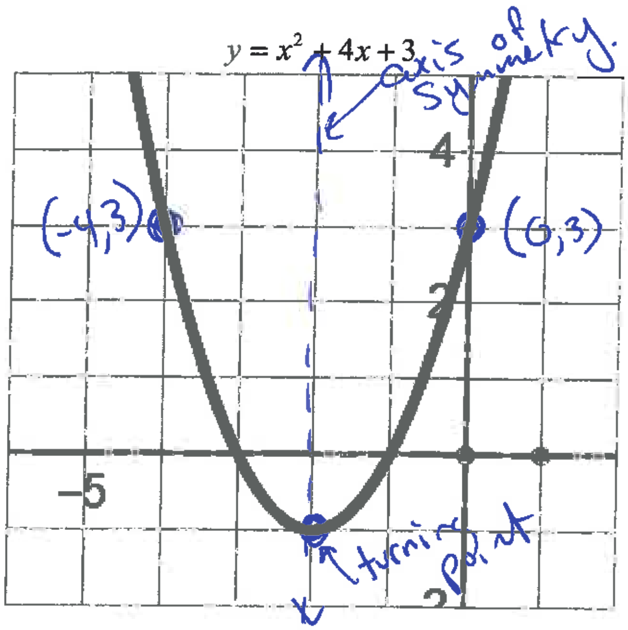
down.

Problem 3 – "The Middle of the Road"

The value "b" in a quadratic expression is referred to as the **Middle Term**.

vertex

1. The middle term (in conjunction with the leading coefficient) affects the **Turning Point** and the **Axis of Symmetry** of a parabola.



a. Identify the **Turning Point** of the parabola.

(−2, −1)

b. Identify the **Axis of symmetry** of the parabola.

X = -2.

2. Use the TRACE feature of a graphing calculator to complete the table:

$y = x^2 + 4x + 3$	a = 1 b = 4	Axis of Symmetry X = −2	Turning Point (−2, −1)	Max or Min? min.
$y = 2x^2 + 4x + 3$	a = 2 b = 4	Axis of Symmetry X = −1	Turning Point (−1, 1)	Max or Min? min
$y = 4x^2 + 4x + 3$	a = 4 b = 4	Axis of Symmetry X = $-\frac{1}{2}$	Turning Point ($-\frac{1}{2}$, 2)	Max or Min? min
$y = -x^2 + 4x + 3$	a = −1 b = 4	Axis of Symmetry X = 2	Turning Point (2, 7)	Max or Min? max
$y = -2x^2 + 4x + 3$	a = −2 b = 4	Axis of Symmetry X = 1	Turning Point (1, 5)	Max or Min? max

3. Describe how the Axis of Symmetry can be found using the "a" and "b" values.

Divide b by −2 times a.

ie) $X = \frac{b}{(-2a)}$

4. Explain how the x-coordinate of the Turning Point is related to the Axis of Symmetry.

X-coord of turning pt is the same as the axis of symmetry.

5. Explain how the y-coordinate of the Turning Point is related to the Axis of Symmetry.

the y-coordinate is found by plugging the x-coordinate into the function.

for example: $y = 2x^2 + 4x + 3$

T.P = $(-1, 1)$

$y = 2(-1)^2 + 4(-1) + 3$

$y = 2 - 4 + 3$

$y = -2 + 3 = 1$

6. What part of a quadratic expression determines if the Turning Point is a Maximum or Minimum? Explain. the leading coefficient, a.

if a is positive, then the T.P. is a min.

if a is negative, then the T.P. is a max

7. Determine the Axis of Symmetry and Turning Point for each quadratic by analyzing the coefficients. State whether the Turning Point is a Maximum or Minimum.

a. $y = 3x^2 - 12x + 1$ $a = 3$, $b = -12$

Axis: $x = \frac{-12}{(-2)(3)}$

$= \frac{-12}{-6}$

$\boxed{x = 2}$

$y = 3(2)^2 - 12(2) + 1$

$= -11$

Turning point = $(2, -11)$

minimum since $a > 0$

b. $y = -2x^2 + 7$ $a = -2$, $b = 0$

axis: $x = \frac{0}{(-2)(-2)}$

$= \frac{0}{4}$

$\boxed{x = 0}$

$y = -2(0)^2 + 7$

$= 7$

Turning Point: $(0, 7)$

maximum since $a < 0$.

c. $y = -5x^2 - 25x$ $a = -5$, $b = -25$

axis: $x = \frac{-25}{(-2)(-5)}$

$= \frac{-25}{10}$

$\boxed{x = -2.5}$

$y = -5(-2.5)^2 - 25(2.5)$

$= 31.25$

Turning pt: $(-2.5, 31.25)$

maximum because $a < 0$.

Problem 4 – It's "The End of the Line", So Let's "Lay Down Some Roots"

The value "c" in a quadratic expression is referred to as the **Constant Coefficient**.

The constant coefficient determines the y-intercept of the graph of a quadratic.

The x-coordinate of the x-intercepts are referred to as the **Roots** of the quadratic.

The values of "a", "b" and "c" all affect the roots of a quadratic. You will learn a method for calculating the roots algebraically in the near future. For now, we can use a calculator to estimate the roots of a quadratic.

c c c

1. Determine the y-intercept of each quadratic by analyzing the coefficients.

a. $y = x^2 - 4x - 5$

(0, -5)

b. $y = -3x^2 + 12x + 0$

(0, 0)

c. $y = x^2 + 2$

(0, 2)

2. Estimate the x-intercepts of the quadratic using the TRACE or INTERSECT feature of a graphing calculator and state the value of the roots.

a. $y = x^2 - 4x - 5$

(-1, 0)

(5, 0)

b. $y = -3x^2 + 12x$

(0, 0)

(4, 0)

c. $y = x^2 + 2$

no x-intercepts.