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MED 607 – I2T2
December 8, 2006

Linear vs Non-Linear:
“An exploration of Lines and Parabolas”

6-Day introduction and/or review
Designed for Geometry: 8-9

Tools Used:
TI-83/84 Calculators
TI SmartView Software
A Projector
Student/Teacher Worksheets

Daily Unit Description:

Day 1: Introduction to the Graphing Calculator

Students will be given a worksheet that has multiple graphs, and equations. This lesson will focus on students being able to enter these equations into the "y =" on the calculator, and graphing them. Students will be responsible for drawing these graphs on their worksheets, by using both the graph shown on the calculator its corresponding table.

Day 2: Slope of a Line

Students will use the Day 1 worksheet to explore what slope is. Ultimately the goal is that they should see that the slope of the line is the same as the number before the "x" in the equation.

Day 3: The Y-intercept of a Line

Students will continue to use the Day 1 worksheet to explore what it means to be a y-intercept. Ultimately the goal is that they should see that the y-intercept of the line is the same as the number that is added to the x in the equation.

Day 4: The Equation of a Line

Students will continue to use the Day 1 worksheet to explore how the equation of a line relates to the slope and y-intercept. Using the knowledge from the previous 2 lessons, each student should be able to write the equation of a line, based on looking at a graph, as well as draw a graph by looking at the equation of a line

Day 5: Linear vs. Non-Linear Graphs

Students will use a graphing calculator to graph linear as well as quadratic equations, and explore when a graph is linear or non-linear.

Day 6: Exploring the Quadratic Equation

Students use their graphing calculators to explore how each coefficient manipulates the shape of the given quadratic. Students will be required to complete a 3 page packet and answer the corresponding questions.

Daily Unit Standards Used:

- ***New York State Standards***

8.A.19 Interpret multiple representations using equation, table of values, and graph

8.R.11 Use mathematics to show and understand mathematical phenomena (e.g., use tables, graphs, and equations to show a pattern underlying a function)

8.A.3 Describe a situation involving relationships that matches a given graph

8.A.4 Create a graph given a description or an expression for a situation involving a linear or nonlinear relationship

8.A.20 Distinguish between linear and nonlinear equations $ax^2 + bx + c$; a=1 (only graphically)

8.A.21 Recognize the characteristics of quadratics in tables, graphs, equations, and situations

8.G.13 Determine the slope of a line from a graph and explain the meaning of slope as a constant rate of change

8.G.14 Determine the y-intercept of a line from a graph and be able to explain the y-intercept

8.G.15 Graph a line using a table of values

8.G.16 Determine the equation of a line given the slope and the y-intercept

8.G.17 Graph a line from an equation in slope-intercept form ($y=mx+b$)

- ***NCTM Standards***

- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and when possible, symbolic rules.
- Identify functions as linear or nonlinear and contrast their properties from tables, graphs, or equations.
- Use graphs to analyze the nature of changes in quantities in non-linear relationships.

Introductions to the Graphing Calculator:

Objective:
Students will understand how to enter an equation onto at TI-83/84 calculator, and graph it. They will also understand how to change the window, and view a table.

Summary:
Students will be given a worksheet that has multiple graphs, and equations. This lesson will focus on students being able to enter these equations into the "y =" on the calculator, and graphing them. Students will be responsible for drawing these graphs ond their worksheets, by using both the graph shown on the calculator and the corresponding table.

Materials:
Students will be required to acquire the attached worksheet that has 8 coordinate graphs, and a list of 8 equations. Students will also be required to pick up a TI-83/84 Graphing calculator. The teacher will need either a copy of TI SmartView or a Graphing calculator with overhead projector.

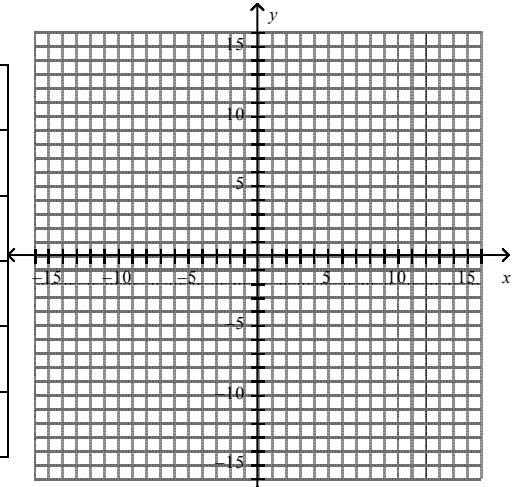
Anticipatory Set:
Students will be asked to define what the term Linear Equation. After all students have been given a few minutes with it, we will lead classroom discussion on the meaning of the word.

Lesson:
This lesson will begin with the teacher going over the equation $y = 2x + 4$, with the class. The students will be asked to turn on their calculators, and then hit the "y =" button. If there is anything in any of the y1 through y0 slots, they should clear them, by hitting clear. The teacher should show the students how to enter the given equation into the y1 slot. Emphasis should be placed on how to enter the variable x, by hitting the "X,T,θ,n" button. Then students should be instructed to hit the "window" button. Teacher should note that the "default window is, both x and y from -10 to 10. After all students have the same window, they should hit the "graph" button. At this point, all students should see what the equation is a line. The teacher should show the students that if you hit "2^{nd}" and "Graph" you can view a table of values. The students will be required to use this table to graph a few points on their worksheet.

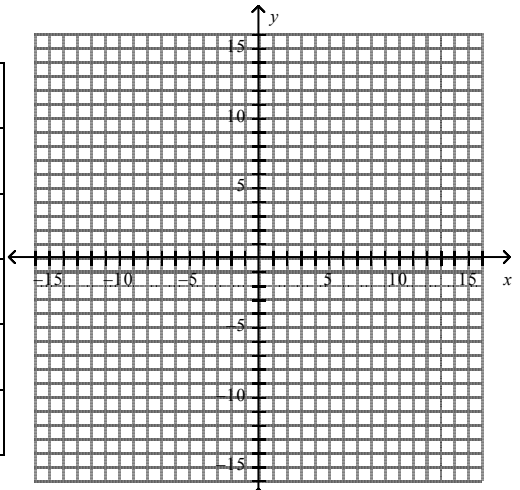
Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

Closure:
At the end of class I am going to take a few minutes to go over the steps of how to graph an equation.

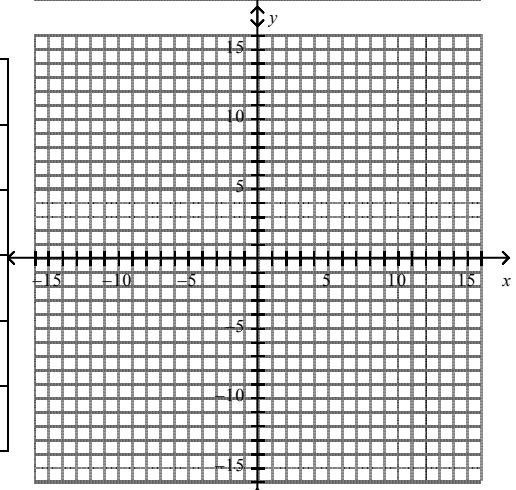
X	$Y = \frac{1}{2}x - 3$	Y	(X,Y)



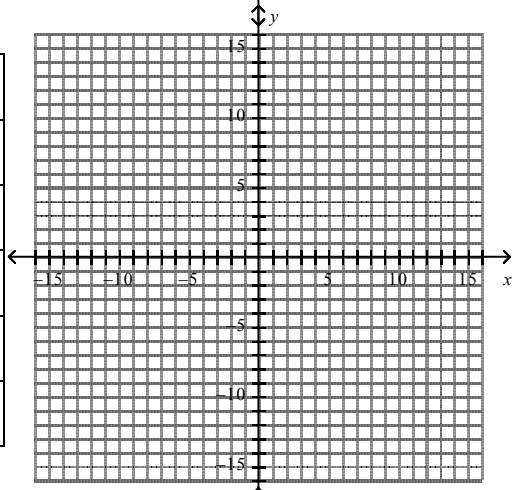
X	Y = 8 – 4x	Y	(X,Y)



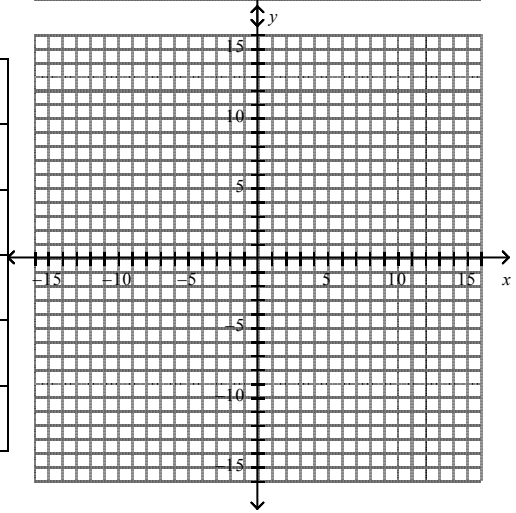
X	Y = 5 +2x	Y	(X,Y)



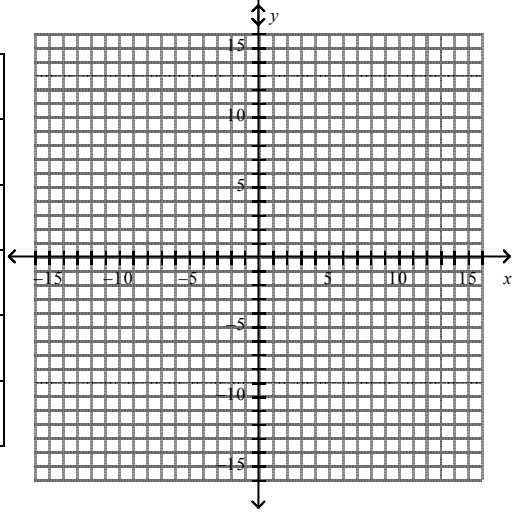
X	$Y = \frac{1}{3}x + 5$	Y	(X,Y)



X	Y = -7 – 2x	Y	(X,Y)



X	Y = 2x - 3	Y	(X,Y)



Slope of a Line:

Objective:
Students will understand what the slope of a line is by looking at a graph, and by calculating it by using 2 points, in a table.

Summary:
Students will use the Day 1 worksheet to explore what slope is. Ultimately the goal is that they should see that the slope of the line is the same as the number before the x in the equation.

Materials:
Students will be required to use their worksheets from the other day. Teachers will need to use a white board/chalkboard, as well as have transparencies of the worksheet from the day before, with the answers listed.

Anticipatory Set:
Students will be asked what the term slope means, and we will try to give it a math context. That is to say, what is slope when looking at a given line graph.

Lesson:
The students will be asked to look at the slope of each of the lines they graphed yesterday, and instructed, how do you get from one point to the next, when they are instructed to move up or down first, and then left or right. This will stem into a formal definition of what slope is, i.e. change in y divided by change in x. Once that has been introduced, students will be asked to look at my example from Day 1, $y = 2x + 4$. Starting at the point, (0, 4), I will ask the students how to get to the next point (1, 6). The students should be able to explain that you must go up 2 and to the right 1, and thus 2/1 yields a slope of 2. Then I will ask what if we went the other way, how would you determine the slope if you went from the point (1, 6) to (0, 4). Students should be able to say that we would have to go down 2, and back 1, so that would yield, -2/-1, and thus the slope is still 2. It is important to let the students know that the slope between any 2 points on a line will always yield the same slope. Once the students understand this, I will have them. Calculate the slope of each line from the Day 1 worksheet. Once they are done, I will introduce another way to find the slope, and that is by using the table or points on the graph. The students will take any 2 points, in our case, lets use the same one as before. What is our change in y, well it is $6 – 4$, and what is our change in x, well it is $1 – 0$, and thus we sill have 2/1, which yields a slope of 2. Students will be responsible, for finding the slope using 2 points from each of the tables they created from yesterday.

Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

Closure:
I will ask the students to summarize what slope means, and give me a formula to find it.

The Y-intercept of a Line:

Objective:
Students will understand what it means to be a y-intercept, and be able to relate it to the equation of a line.

Summary:
Students will continue to use the Day 1 worksheet to explore what it means to be a y-intercept. Ultimately the goal is that they should see that the y-intercept of the line is the same as the number that is added to the x in the equation.

Materials:
Students will be required to use their worksheets from the other day. Teachers will need to use a white board/chalkboard, as well as have transparencies of the worksheet from the day before, with the answers listed.

Anticipatory Set:
Students will be asked what the term y-intercept means, and we will try to give it a math context. That is to say, what is y-intercept when looking at a given line graph.

Lesson:
The students will be asked what it means to be a y-intercept, and then I will ask them what they think the y-intercept is for the example, $y = 2x + 4$. The teacher will then give a formal definition for the y-intercept, i.e. the point in which the equation crosses the y-axis. By looking at the given graph, they should see that the y-intercept is the point (0,4). At this point the students will be asked to find the y intercepts for all of the examples from the day 1 activity, by looking at each graphed equation.

Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

Closure:
I will ask the students to summarize what it means to be a y-intercept and give me a method to find it.

The Equation of a Line:

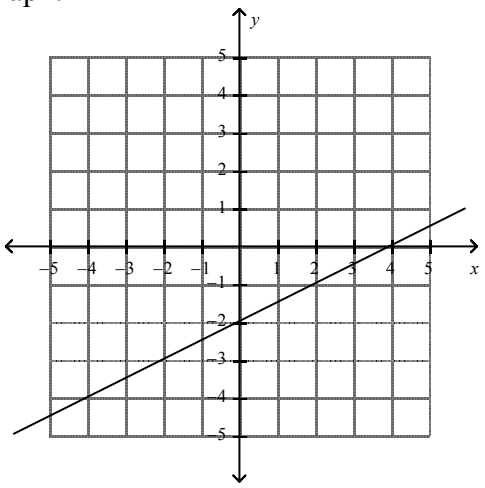
Objective:
Students will understand the equation of a line, y = mx + b, and be able to indentify the slope and y-intercepts of a line.

Summary:
Students will continue to use the Day 1 worksheet to explore how the equation of a line relates to the slope and y-intercept. Using the knowledge from the previous 2 lessons, each student should be able to write the equation of a line, based on looking at a graph, as well as draw a graph by looking at the equation of a line

Materials:
Students will be required to use their worksheets from the other day, as well as the worksheet attached to this lesson. The teacher should have transparencies of both worksheets, as well as have access to a whiteboard or chalkboard.

Anticipatory Set:
Students will be asked how the slope and y-intercepts relate to the equation of a line. Students should be able to depict that the slope of a line, is placed in front of the x, and the number added to that represents the y-intercept.

Lesson:
The students will be given a formal definition of the equation of a line, i.e. y = mx + b, where m represents the slope of the line, and b represents the y-intercept. Students will be asked to graph the equation, y = 3x + 2. The teacher should ask the students what is the slope and y-intercepts. Once the students have graphed the equation, the teacher should ask them to look at another problem, i.e. what is the equation of the line, when looking at the following graph.



Students should start by identifying the slopes and y-intercepts and then by plugging them into the formula. Students will then be asked to complete the following worksheet and at the end of class, students will be allowed to check their answers by using the graphing calculator.

Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

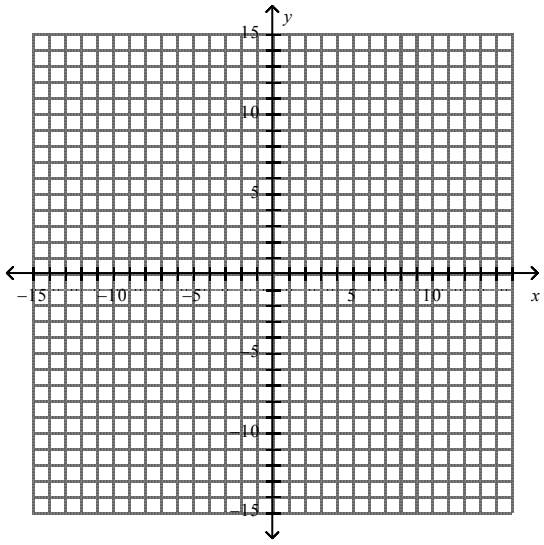
Closure:
I will prompt the students to define the equation of a line. What does the "m" stand for, and what does the "b" stand for?

Graph each of the following equations:

1) Y = 4x -8

m = _____

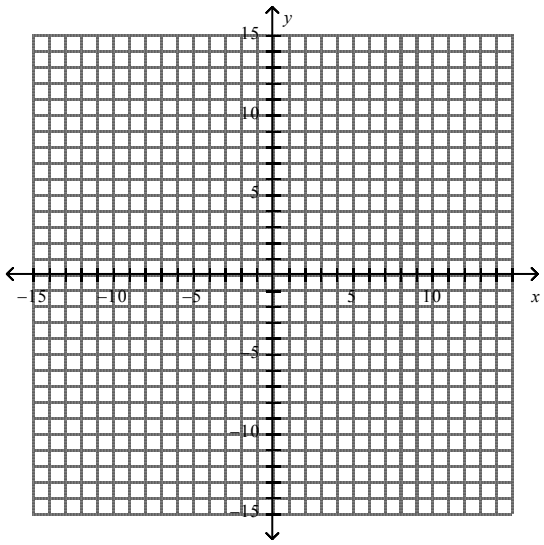
b = _____



2) Y = $-\frac{2}{3}$ x + 5

m = _____

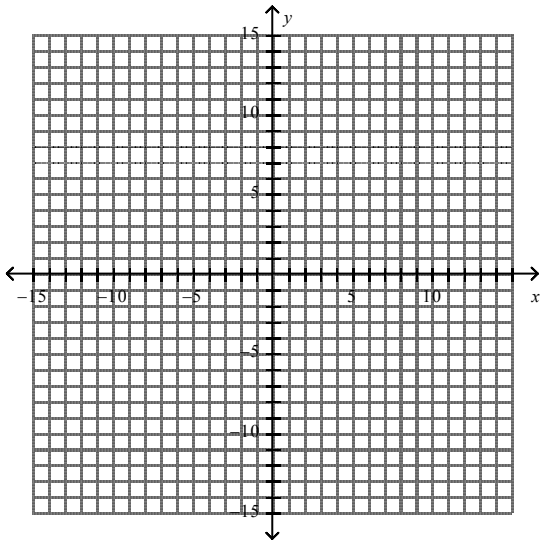
b = _____



1) Y = 2x - 3

m = _____

b = _____

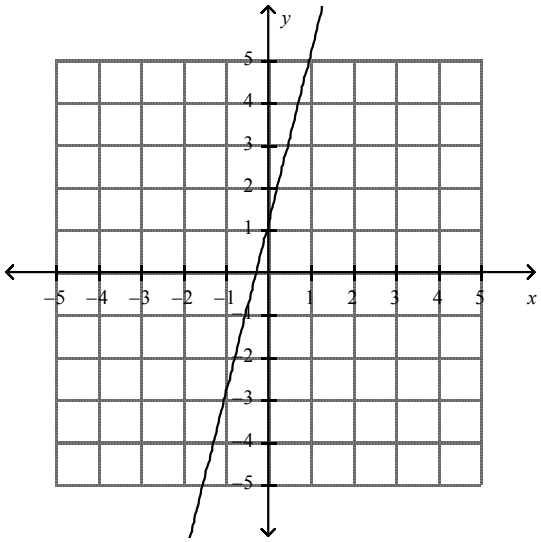


Using each of the following Graphs, define its equation:

1) Y =

m = _____

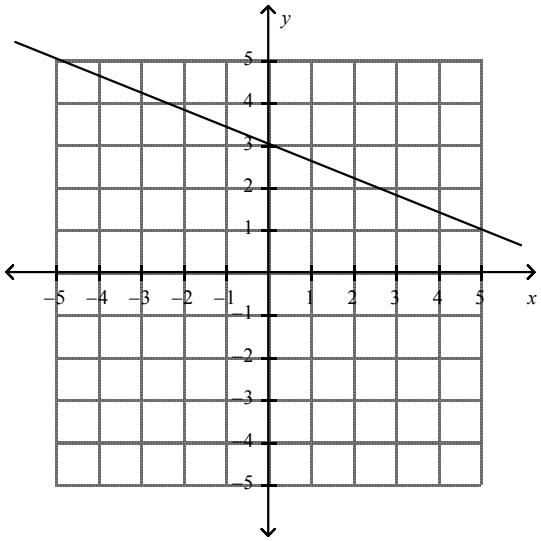
b = _____



2) Y =

m = _____

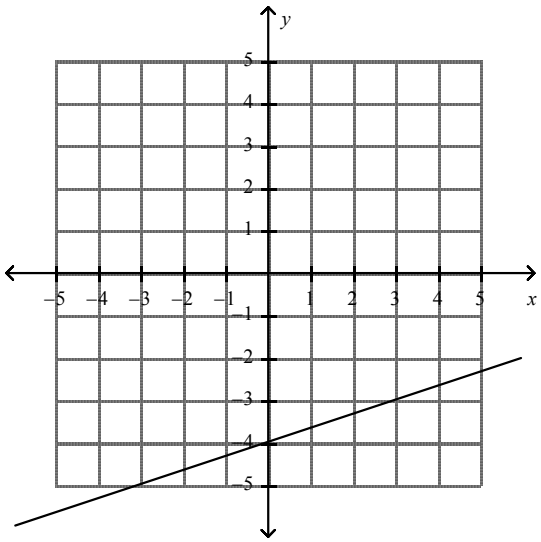
b = _____



3) Y =

m = _____

b = _____



Linear and Non-Linear Graphs:

Objective:
Students will understand the difference between Linear and Non-Linear graphs.

Summary:
Students will use a graphing calculator to graph linear as well as quadratic equations, and explore when a graph is linear or non-linear.

Materials:
Students will be required to acquire the attached worksheet that has 8 coordinate graphs, and a list of 8 equations. Students will also be required to pick up a TI-83/84 Graphing calculator. The teacher will need either a copy of TI SmartView or a Graphing calculator with overhead projector.

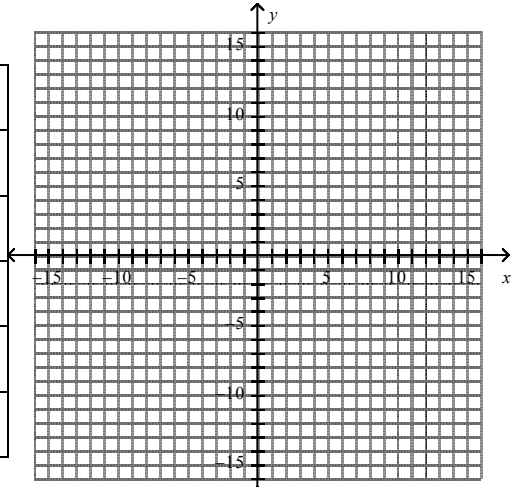
Anticipatory Set:
Students will be asked to reflect on what it means to be linear. Then they will be asked what it means to be non-linear.

Lesson:
After a quick review of how to use the graphing calculators, students will be asked to complete the attached worksheet. They will be responsible for not only graphing each of the given equations, but also completing the associated tables. After all the tables and graphs had been completed, the students will be required to define if the graph is linear or non-linear. The teacher should then ask the students to look at the equations for all of the graphs, when did they get linear graphs, and when did they get non-linear graphs. What is important is that the students make a connection so when they see an x^2 value, the graph is non-linear. They should also make note to call these non-linear graphs parabolas or quadratics.

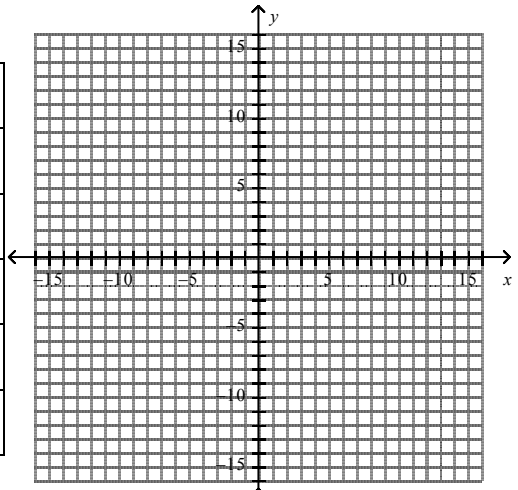
Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

Closure:
-*What makes a graph linear?*
-*What makes a graph non-linear?*
-*What is the name given to these non-linear graphs?*

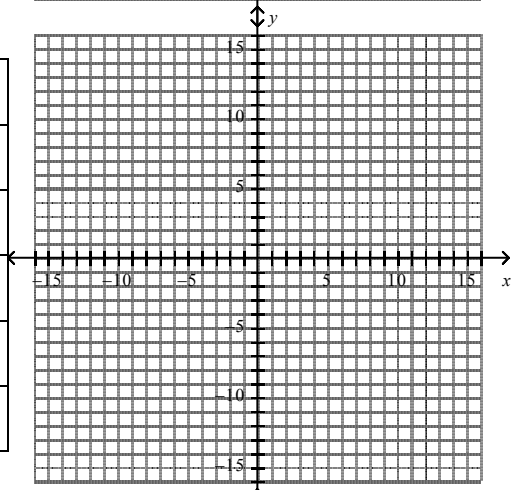
X	$Y = -\frac{1}{2}x + 3$	Y	(X,Y)



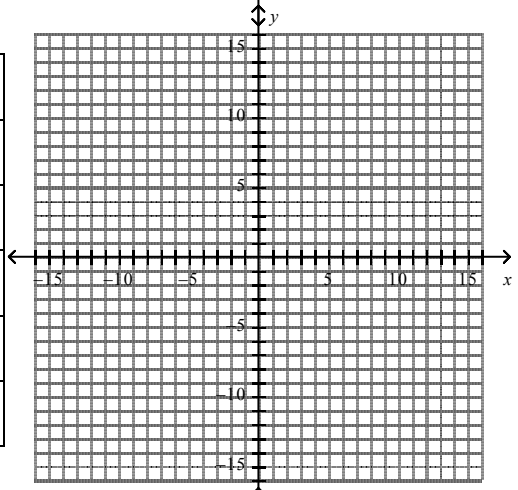
X	$Y = -2x^2 - 1$	Y	(X,Y)



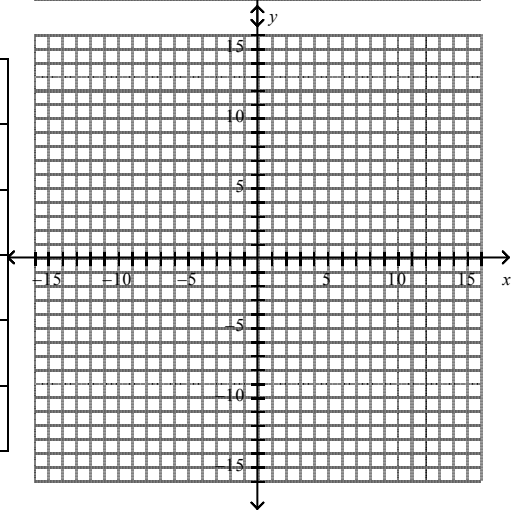
X	$Y = x^2 + 3$	Y	(X,Y)



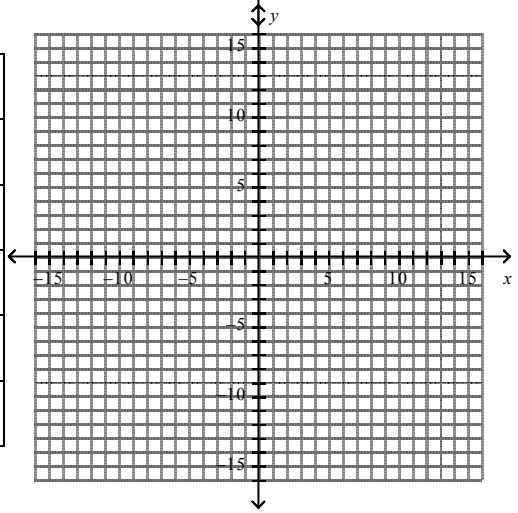
X	$Y = x^2 + 3x - 2$	Y	(X,Y)



X	Y = - 2x - 7	Y	(X,Y)



X	$Y = -x^2 + 3x - 2$	Y	(X,Y)



Exploring the Quadratic Equation:

Objective:
Students will be able to distinguish how the a, b, and c in the quadratic equation, change theshape/look of the graphed parabola.

Summary:
Students use their graphing calculators to explore how each coefficient manipulates the shape of the given quadratic. Students will be required to complete a 3 page packet and answer the corresponding questions.

Materials:
Students will be required to acquire the attached worksheet as well as a TI-83/84 Graphing calculator. Students should use colored pencils to differentiate between all the different equations. The teacher will need either a copy of TI SmartView or a Graphing calculator with overhead projector.

Anticipatory Set:
Students will be asked to reflect on what it means to be linear vs. non-linear. Then they will be asked if they remember what the name is given for quadratic equation.

Lesson:
After a quick review of how to use the graphing calculators, students will be asked to complete the attached worksheet. They will be responsible for not only graphing each of the given equations, but also answering the corresponding questions. The teacher's role in this activity will be to guide the students through the lab. Most of the help that students will need will correspond to answering the questions. At the end of the class, it is important for the teacher to go over how each coefficient affects the quadratic equation.

Assessment:
Because we are going over this in class, as we go along, assessment will be determined by individual participation, as well as what the students complete in their worksheet.

Closure:
The teacher will ask the students to summarize what each coefficient means to the quadratic equation.

Exploration of Quadratic Equations Name _____

Quadratic Equations - $y = ax^2 + bx + c$

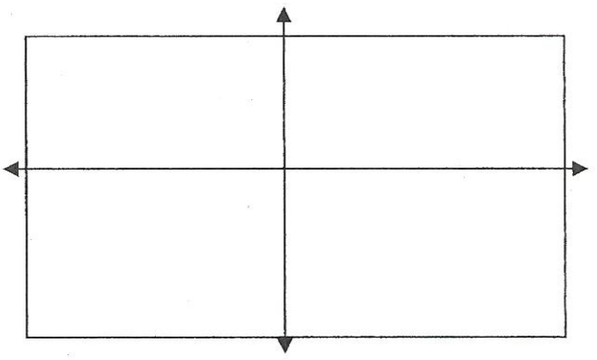
PartA

1. Explore 'a' by holding b and c constant (we will make b= 0 and c= 0). Use you calculator to graph each of the following equations.

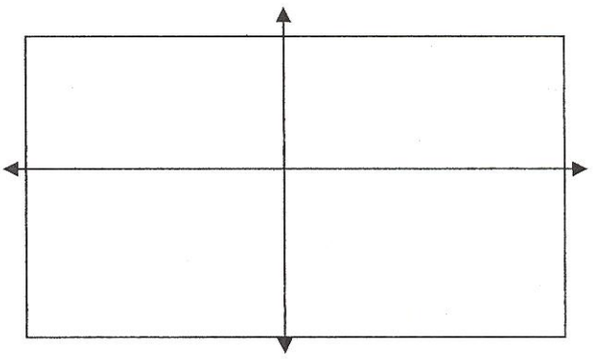
2. Window should be set $-10 < x < 10$ scale = 1 and $-10 < y < 10$ scale = 1

3. **Sketch** the graphs on the axes below. **Label** the axes and **label** each graph with the **letter** in front of the equation.

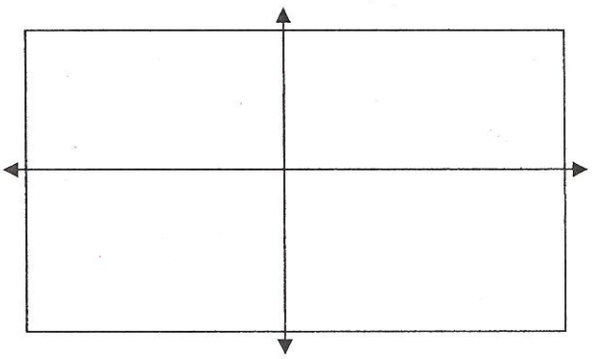
Set 1:
- A $y = x^2$
- B $y = 2x^2$
- C $y = 5x^2$
- D $y = 10x^2$



Set 2:
- E $y = x^2$
- F $y = \frac{3}{4}x^2$
- G $y = \frac{1}{2}x^2$
- H $y = 1/8\ x^2$



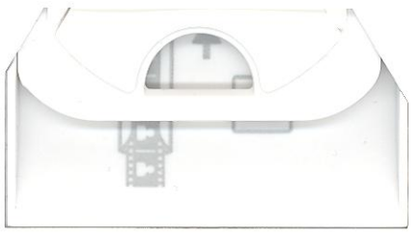
Set 3
- I $y = -x^2$
- J $y = -4x^2$
- K $y = -\frac{1}{4}x^2$
- L $y = -1/10\ x^2$



In a quadratic equation, what effect does 'a' in $y = ax^2$ have on the graph?_____

When 'a' is negative?_____

When the value of 'a' is large?_____



Part B

1. Explore 'b' by holding a and c constant (we will make a= 0 and c= 0 mostly). Use you calculator to graph each of the following equations.

2. Window should be set **-10< x <10 scale = 1 and -10< y < 10 scale = 1**

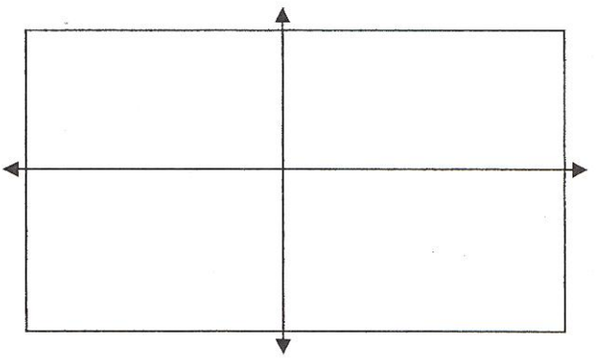
3. **Sketch** the graphs on the axes below. **Label** the axes and **label** each graph with the **letter** in front of the equation.

Set 1:

A $y = x^2$

B $y= x^2 + 4x$

C $y = x^2 + 4x + 6$

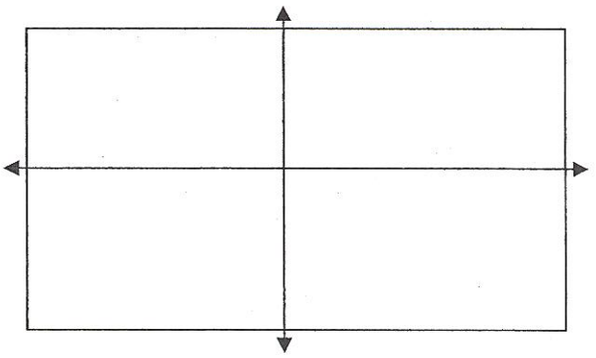


Set 2:

D $Y= x^2$

E $Y = x^2 - 2x$

F $y= x^2 -2x + 3$

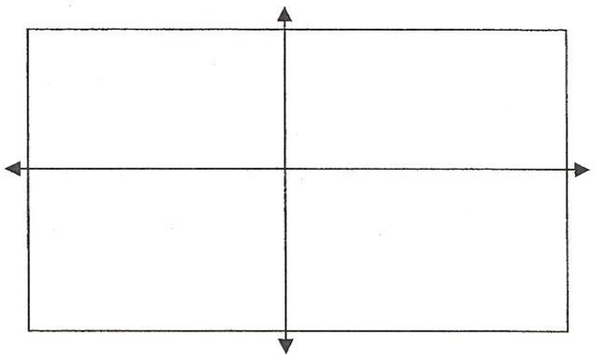


Set 3:

G $y = -x^2$

H $y= -x^2 - 5x$

I $y = -x^2 - 5x -2$

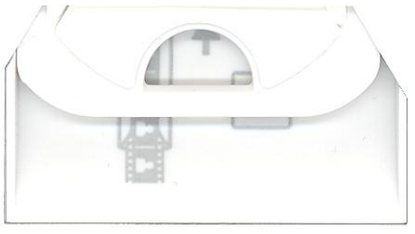


In a quadratic equation, what effect does 'b' in $y= ax^2 + bx + c$ have on the graph?

_____

What does a negative 'b' have on the equation?_____

What does a large value for 'b' do? _____



Part C

1. Explore 'c' by holding a and b constant (we will vary the value of a and b= 0. Use you calculator to graph each of the following equations.

2. Window should be set $-10 < x < 10$ scale = 1 and $-10 < y < 10$ scale = 1

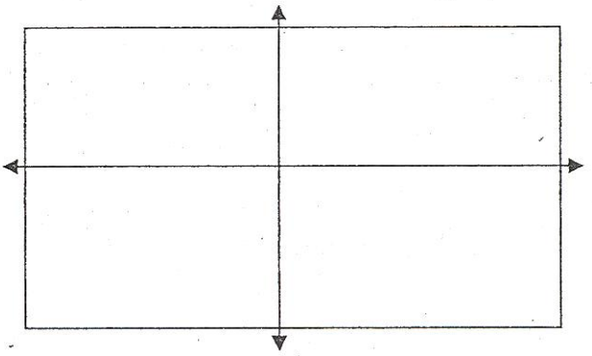
3. **Sketch** the graphs on the axes below. **Label** the axes and **label** each graph with the **letter** in front of the equation.

Set 1:

A $y = \frac{1}{2}x^2$

B $y = \frac{1}{2}x^2 + 1$

C $y = \frac{1}{2}x^2 - 2$

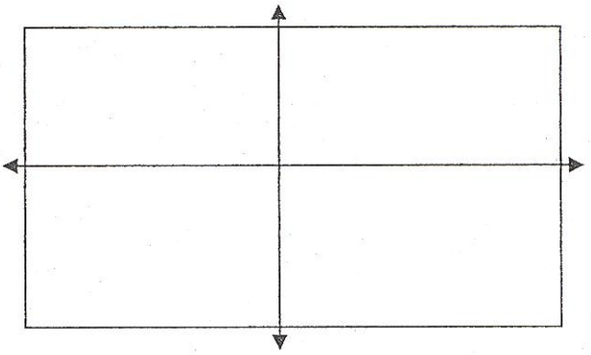


Set 2:

D $y = 3x^2$

E $y = 3x^2 - 2$

F $y = -3x^2 + 4$

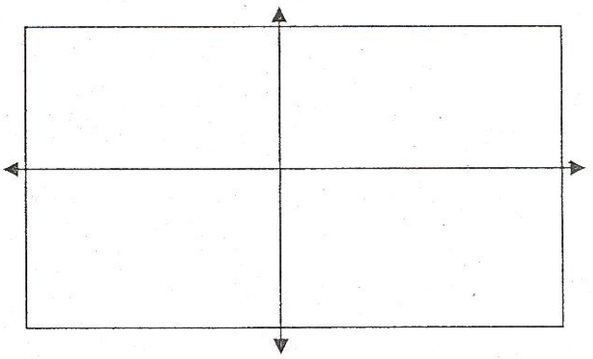


Set 3:

G $y = -x^2 + 3$

H $y = -x^2 + 1$

I $y = -x^2 - \frac{1}{2}$



In a quadratic equation, what effect does 'c' in $y = ax^2 + bx + c$ have on the graph?

_____

What does a negative 'c' have on the equation?_____

What does a large value for 'c' do? _____