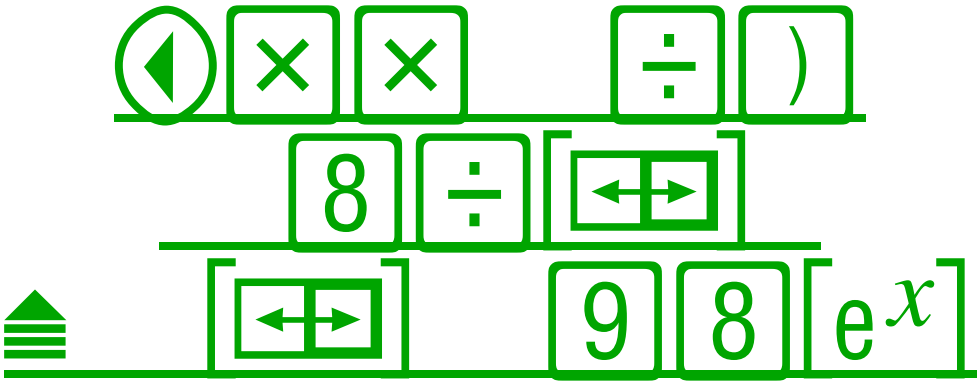


Krista Hauri
I2T2 Project

- Grade Level:
  9th Intergraded Algebra 1

- Time Span :
  5 (40 minute) days

- Tools:
  Calculator Base Ranger (CBR) at least 4
  TI-84 Graphing Calculator for each student
  3 sets of 10 plastic cups
  3 sets of 10 foam cups
  Rulers

Unit Objectives

Students Will Be Able To:

- Understand slope of a line as a rate of change.
- Understand distance versus time graphs.
- Use linear graphs to represent gathered data.
- Use slope to check predictions.
- Calculate slope of a line.
- Find x and y intercepts of a line
- Investigate how the slope and y-intercept affects the appearance of a line by graphing lines on a graphing calculator.

Standards

NCTM Content Standards:

- Algebra

NCTM Process Standards:

- Problem Solving
- Connections
- Representation

NYS Standards:

- ACNB1 – Algebra: Connections-translating between tables and graphic forms of functions.
- ARA1- Algebra: Representation –analyze functions using equations and graphs
- AAC4,5 – Algebra: Algebra- explain slope as a rate of change, determine slope of a line.
- ABB3 – Algebra: Geometry- investigate and generalize how changing the coefficients of a function affects its graphs.

Resources and Materials:

Resources:

- Friel, S. et. al. *Navigating Through Algebra.* NCTM. 2001.

Pg. 41 in grades 6-8

- Burger, E.B. et. al. *Algebra I.* Holt, Rinehart and Winston. 2008.

Chapter 5 Linear Functions

Materials:

Day 1:

- Calculator Base Ranger (5 rangers for a class of 20 students)
- TI-84 graphing calculators

Day 2:

- Rulers
- Graph paper
- 3 sets of 10 foam cups
- 3 sets of 10 plastic cups

Day 3:

- Calculators (simple calculations)
- Class notes

Day 4:

- Calculators (simple calculations)
- Class notes

Day 5:

- TI-84 graphing calculator
- Worksheet

Unit Plan

Day 1	Day 2	Day 3	Day 4	Day 5
Discovering slope as a rate of change using CBR units. -Discussion on reading distance vs. time graphs. -Match graphs from CBR. Relating slope as a rate (Increasing steps per second leads to a steeper slope. Standing still leads to zero slope). -Create your own story, distance vs. time and create the graph on the CBR. Show groups graphs on overhead discuss original stories.	Connecting slope to real world problems. Writing equations based on linear graphs. -Collect measurements arrange data in linear graph. -slope represented by change in height of stacked cups y-intercepts represented by height of one cup. -Based on graphs write linear equations to represent data.	Calculating slope by each of the following methods. - Counting rise/run on graphs. - Using slope formula with two points on the same line. - Writing linear equations in $y = mx + b$ form. What is m?	Finding the x and y-intercepts of a linear graph by each of the following methods. - By definition, where is the point where the line crosses the x and y axes. - Using substitution of 0 to find x and y values of intersection. - Writing linear equations in $y = mx + b$ form. What is b?	Investigating slope and intercepts changing the appearance the graphs of linear equations. -Graph 3 linear equations using TI-84 on the same set of axis changing the slope – describe the changes. -Graph 3 linear equations using TI-84 on the same set of axis changing the Y-intercepts - describe the changes.

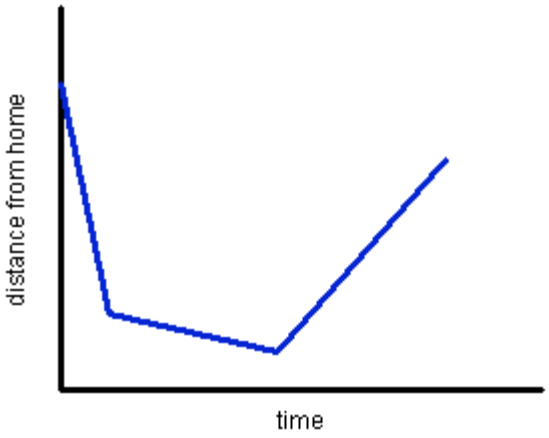
Day 1:

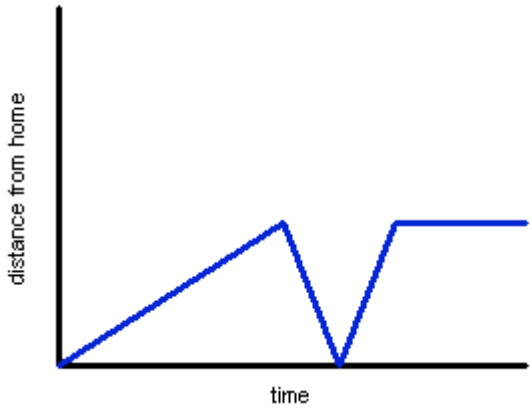
Objective: All students will be able to

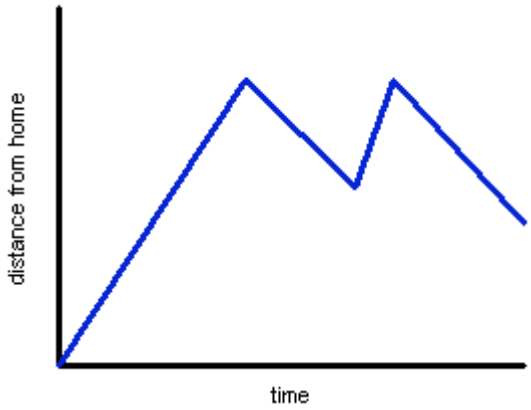
Understand slope of a line as a rate of change.
Understand distance versus time graphs.

Anticipatory Set:

On front board when students enter room are 3 distance vs. time graphs. Which of the 3 graphs represents James trip to school, if James first walked to the bus stop, then realized he forgot his math book so he ran back home. After retrieving his book he had to run back to the bus stop. While catching his breath he waited for the bus.







The only graph that matches the story is graph 2. As a class discuss the other graphs and explain why they do not create the same story.

Procedure:

1.) Anticipatory set

2.) Pick one student to show how the CBR units work and what they are measuring. Discuss what the axes are measuring. X-axis = time, Y-axis = distance

3.) Calculator Base Ranger activity.
*Groups students to create their own distance vs. time graphs to see how the CBR calculates their own movements.
* As a group, students will read and decipher the graph given by the CBR. One student from the group will attempt to match the graph.
* Pick two groups to compete on matching the same graphs given by the calculator.

4.) Class questions:
a.) Describe the movements needed to create a positive slope on the graph.
Walk away from the CBR. Increase the distance away from yourself and the trigger.
b.) Describe the movements needed to create a negative slope on the graph.
Walk towards the CRR. Decrease the distance away from yourself and the trigger
c.) Describe the movements needed to create a zero slope on the graph.
Stay sill. Keep the distance away from yourself and the trigger constant.
d.) Describe how to create a steep slope on the graph.
Walk faster. Increase the distance covered in less time.

Closure:

Pick two groups to compete on matching the same graphs given by the calculator. Each group should have 3 or 4 members. Together discuss the direction and speed needed to match the graph.

Day 2:

Objective: All students will be able to

Connect linearity with real word contexts.
Create graphs to display gathered data.
Recognize slope.

Anticipatory Set:

Class discussion on activity.
You're a local shipping company that offers custom-made shipping containers for many different types of products. Your newest assignment is for shipping foam and plastic cups. You need to determine how to stack 50 cups for each shipping container and determine the measurements of your containers.

Procedure:

1.) Anticipatory Set

2.) Activity
- Split class into groups of 4 students.
- Each group will gather data; showcase their data in a table and in a graph, and make predictions and conjectures based on their data.
- Complete Stacking Cups worksheet.

3.) Closure

Closure: After activity is complete.
1.) Each group will share their predicted 50 cup height measurements. Then as a class actually measures the height to see which group had the best prediction.
2.) Display one foam cup measurement graph and one plastic cup measurement graph. As a class discuss the following questions.
- What is the overall "look" of both graphs?
- Will that relationship continue after 10 cups?
- Graph the actual measurement of 50 cups on both graphs. Extend the line to show that the relationship will continue. Brief discussion on "counting" slop on a linear graph to show a constant measurement throughout.

Name: Algebra 1

Stacking Cups

You're a local shipping company that offers custom-made shipping containers for many different types of products. Your newest assignment is for shipping foam and plastic cups. You need to determine how to stack 50 cups for each shipping container and determine the measurements of your containers.

1.) Complete the following tables based on the height measurements of 1 cup to 10 stacked cups.

FOAM CUPS

# of stacked cups	Height (cm)

PLASTIC CUPS

# of stacked cups	Height (cm)

2.) Determine the dependent and independent variables.

3.) Based on above data. Create a coordinate graph to display the relationship between the two variables. (Use graph paper).

*Label both axes and name your graph.

4.) Describe the correlation between the two variables.

5.) Using the table and graph predict the height of 50 stacked foam cups.

6.) Using the table and graph predict the height of 50 stacked plastic cups.

7.) Measure the depth of each cup at its widest point (top of the cup).

8.) Determine the measurement of your shipping container to contain 50 cups.

Name: KEY Algebra 1

Stacking Cups

You're a local shipping company that offers custom-made shipping containers for many different types of products. Your newest assignment is for shipping foam and plastic cups. You need to determine how to stack 50 cups for each shipping container and determine the measurements of your containers.

1.) Complete the following tables based on the height measurements of 1 cup to 10 stacked cups.

FOAM CUPS

# of stacked cups	Height (cm)
1	9
2	10.5
3	12
4	13.5
5	15
6	16.5
7	18
8	19.5
9	21
10	22.5

PLASTIC CUPS

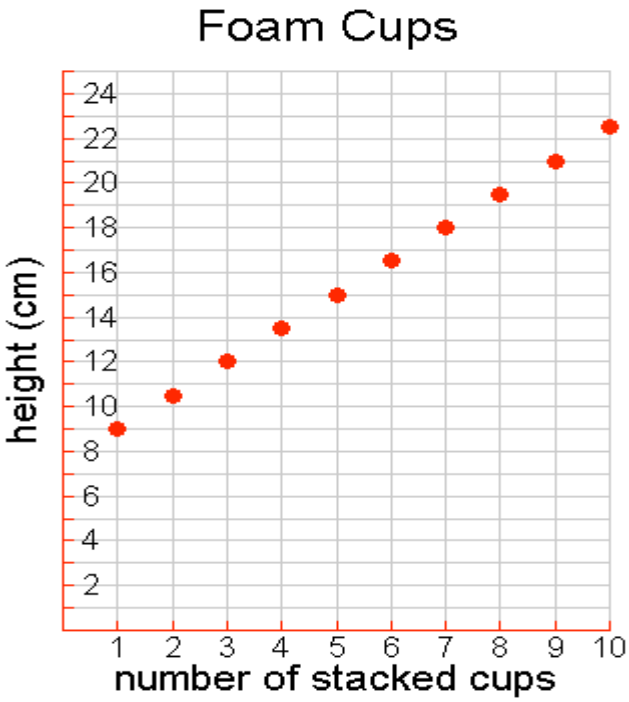
# of stacked cups	Height (cm)
1	12
2	13
3	14
4	15
5	16
6	17
7	18
8	19
9	20
10	21

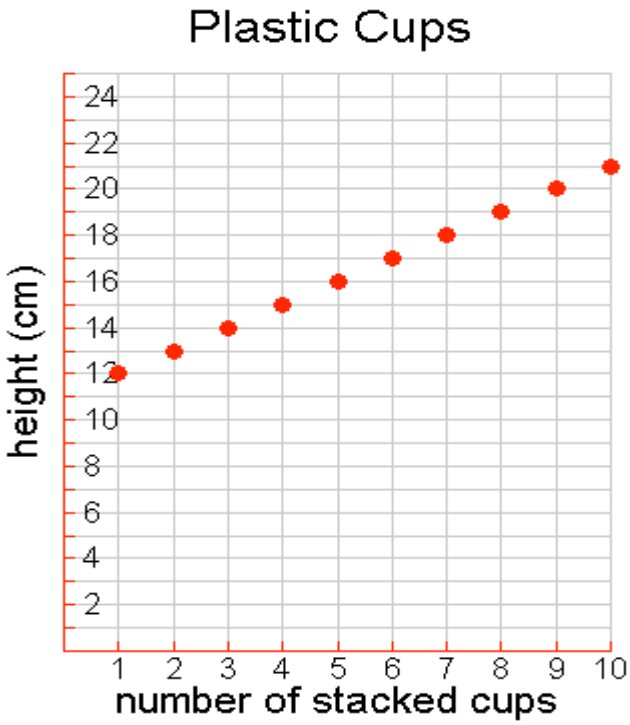
2.) Determine the dependent and independent variables.

Dependent variable = number of cups stacked
Independent variable = height

3.) Based on above data. Create a coordinate graph to display the relationship between the two variables. (Use graph paper).

*Label both axes and name your graph.





4.) Describe the correlation between the two variables.

There is a positive correlation because the line is increasing, as the number of stacked cups increases the height increases.

5.) Using the table and graph predict the height of 50 stacked foam cups.

About 80 to 90 cm, answers will vary.

6.) Using the table and graph predict the height of 50 stacked plastic cups.

About 58 to 68 cm, answers will vary.

7.) Measure the depth of each cup at its widest point (top of the cup).

8.5 cm for foam cups. 10 cm for plastic cups.

8.) Determine the measurement of your shipping container to contain 50 cups.

Answers will vary depending on if they want to stack 50 or have 2 stacks of 25.

Day 3:

Objective: All students will be able to

Calculate slope by examining a graph of several points on the same line.
Calculate slope by slope formula given two points on the same line.
Find slope by solving linear equations for y = mx + b.

Anticipatory Set-

Review stacking cups graphs on overhead. Discuss why when the line was extended out to 50 cups the line was still straight and slope was constant throughout the entire line. Lead to calculating slope of a line.

Procedures: Class notes

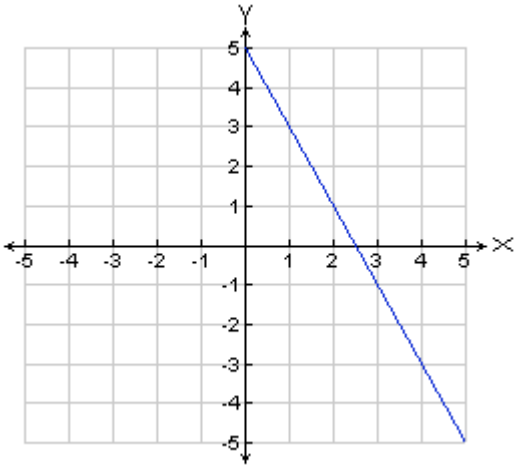
1.) Anticipatory Set
2.) Methods of finding the slope

a.) Counting

- Used when given a graph of the line with at least 2 points on the line
- $m = \frac{rise}{run}$,

Where; rise = number of units up or down the y-axis and
run = number of units right along the x-axis.

Ex. 1)

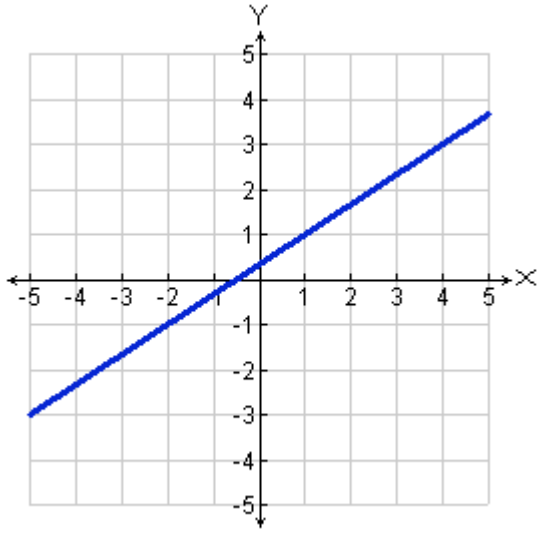


** Find 2 points with whole number coordinates.

(1, 3) and (3, -1)

$$m = \frac{down\ 4}{right\ 2} \Rightarrow \frac{-4}{2}$$

Ex. 2)



Two whole number coordinates:

(1, 1) and (4, 3)

$$m = \frac{up\ 2}{right\ 3} \Rightarrow \frac{2}{3}$$

b.) Using Slope Formula

- Used when you are given any two points on the same line.
- $m = \frac{y_1 - y_2}{x_1 - x_2}$, where (x_1, y_1) and (x_2, y_2) are points on the same line.

Ex.) Find the slope of the line containing the points (2,3) and (4, 6)

$$m = \frac{y_1 - y_2}{x_1 - x_2}$$

$$m = \frac{3-6}{2-4}$$

$$m = \frac{-3}{-2}$$

$$m = \frac{3 \quad "up\ 3"}{2 \quad "right\ 2"}$$

Ex.) You try: Find the slope of the line containing the points (-1, 0) and (4, -3)

$$m = \frac{-3}{5}$$

c.) Solving for y in standard form of a linear equation y = mx + b.

** Equation must be solved for y!
*** m = slope

Ex.) Find the slope of the line with the equation $y - 3x = 1$.

$$\begin{array}{r} y - 3x = 1 \\ +3x \quad +3x \\ \hline y = 3x + 1 \end{array} \qquad \Rightarrow m = \frac{3\text{ "up"}}{1\text{ "right"}}$$

Ex.) Find the slope of the line with the equation $2y = 3x - 6$

$$\frac{2y}{2} = \frac{3x}{2} - \frac{6}{2}$$

$$y = \frac{3}{2}x - 3 \qquad \Rightarrow m = \frac{3}{2}$$

Ex.) You try: Find the slope of the line with the equation $9 + 3y = x$

$$y = \frac{1}{3}x - 3 \qquad \Rightarrow m = \frac{1}{3}$$

3.) **Closure Activity** – Slope can be calculated from **any** two points.

Each student will graph any two points and connect them with a line, they can be as close or as far apart as your want.
Pass your graph paper to a neighbor and your neighbor can find the slope.
Check your answers with each other.

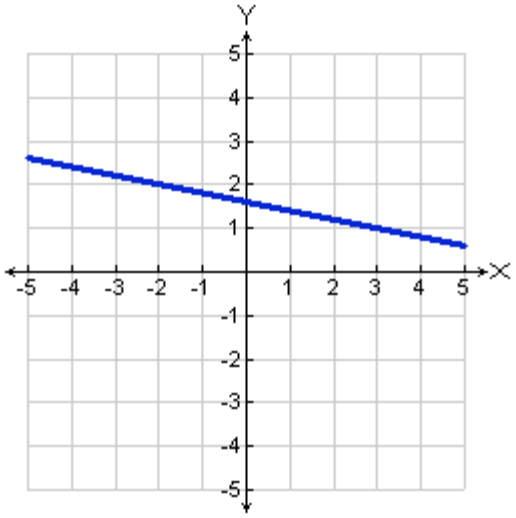
Homework: Slope worksheet

Name: Slope homework

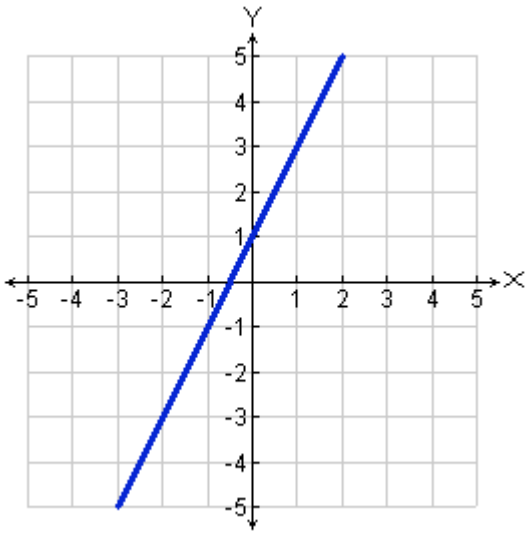
Directions: Answer each of the following questions.

1.) Determine the slope of the line from the following graph.

a.) m =



b.) m =



2.) Determine the slope of the line from 2 given points on the line:

a.) (6 , 4) and (1, 1)

b.) (-1, 5) and (1, -1)

c.) (-3 , 1) and (2 , 1)

Determine the slope of the line from the given linear equations:

a.) $y = 3x + 9$

b.) $4y = -8x + 4$

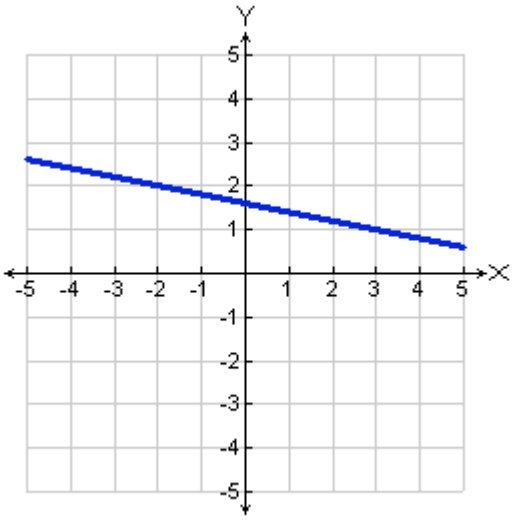
c.) $y - 3x = 4$

Name: KEY Slope homework

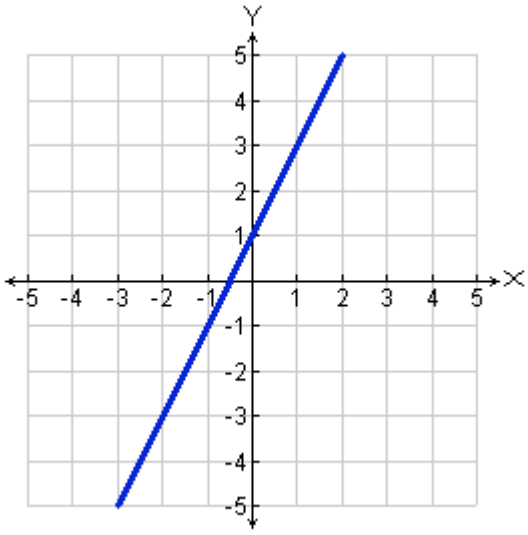
Directions: Answer each of the following questions.

1.) Determine the slope of the line from the following graph.

a.) m = $\frac{-1}{5}$



b.) m = $\frac{2}{1}$



2.) Determine the slope of the line from 2 given points on the line:

a.) (6 , 4) and (1, 1)

m = 3/5

b.) (-1, 5) and (1, -1)

m = -3/1

c.) (-3 , 1) and (2 , 1)

m = 0

Determine the slope of the line from the given linear equations:

a.) y = 3x + 9

m = 3/1

b.) 4y = -8x + 4

m = -2/1

c.) y – 5x = 4

m = 5/1

Day 4:

Objective: All students will be able

Find x and y intercepts by examining linear graphs.
Find x and y intercepts by using substitution of 0 into the equation of a line.
Find y-intercept by solving linear equations for y = mx + b.

Anticipatory Set:

Review stacking cups graphs on overhead. Discuss why both graphs start above (0 , 0). Foam cups graph start at 9 cm and plastic cup graph starts at 12 cm. Discussion leads to y-intercept of a line.

Procedure:

1.) Anticipatory Set
2.) Methods of finding x and y-intercepts.

X and Y Intercepts = point of intersection of the x and y-axes.

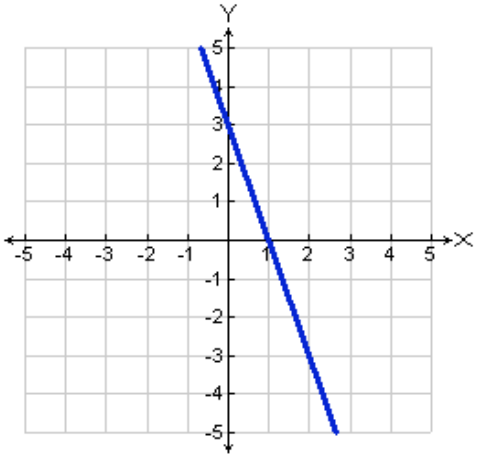
X-intercept = (x , 0)

Y-intercept = (0 , y)

a.) Reading graphs:

- Used when given graph of the line
- Look for the point where the line crosses (intersects) both axes.

Ex. 1.)



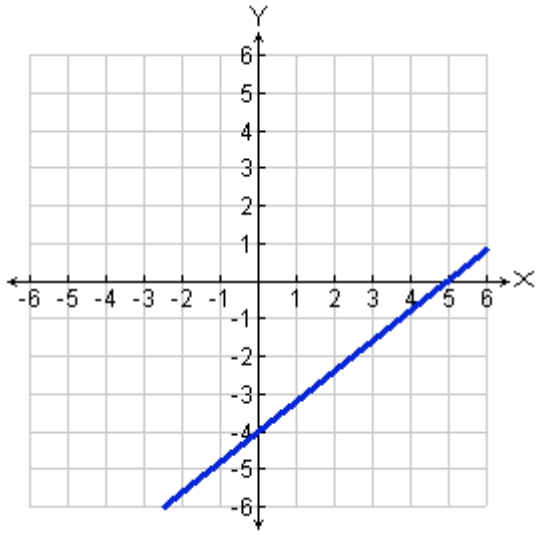
x – intercept = coordinate where it crosses the x-axis

(1 , 0)

y – intercept = coordinate where it crosses the y-axis

(0 , 3)

Ex. 2.)



x – intercept = (5 , 0)

y – intercept = (0 , -4)

b.) Use Substitution of 0 to.

- Used when given equation of the line
- Since x –intercept = (x , 0), where y = 0 substitute 0 for y and solve for x.
- Since y-intercept = (0 , y) , where x = 0 substitute 0 for x and solve for y.

Ex. 1.) Find both x and y intercepts if $y = 3x + 6$

x – intercept

$y = 3x + 6$

$0 = 3x + 6$

$-6 \quad -6$

$\frac{-6}{3} = \frac{3x}{3}$

$-2 = x$

x – intercept = (-2, 0)

y – intercept

$y = 3x + 6$

$y = 3(0) + 6$

$y = 6$

y – intercept = (0, 6)

Ex. 2.) Find both x and y intercepts if $2x + y = 8$

x- intercept

$2x + y = 8$

$2x + 0 = 8$

$\frac{2x}{2} = \frac{8}{2}$

$x = 4$

x-intercept = (4, 0)

y – intercept

$2x + y = 8$

$2(0) + y = 8$

$y = 8$

y-intercept =(0, 8)

Ex. 3.) You Try: Find both x and y intercepts if $y - 8 = 4x$

x-intercept = (-2, 0)

y-intercept = (0, 8)

c.) Solving for y in standard form of a linear equation y = mx + b.

** Equation must be solved for y!
*** b = y-intercept

Ex. 1.) Find the y-intercept of $4y = 3x + 8$

$4y = 3x + 8$

$\frac{4y}{4} = \frac{3x}{4} + \frac{8}{4}$

$y = \frac{3}{4}x + 2 \qquad \Rightarrow y - \text{int}ercpet = 2$

$(0,2)$

Ex. 2.) You try: Find the y-intercept of $2y - 4 = x$

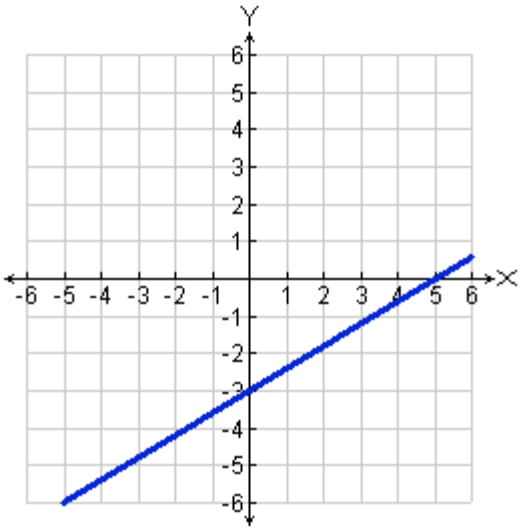
y-intercept = (0, 2)

Name: Intercept homework

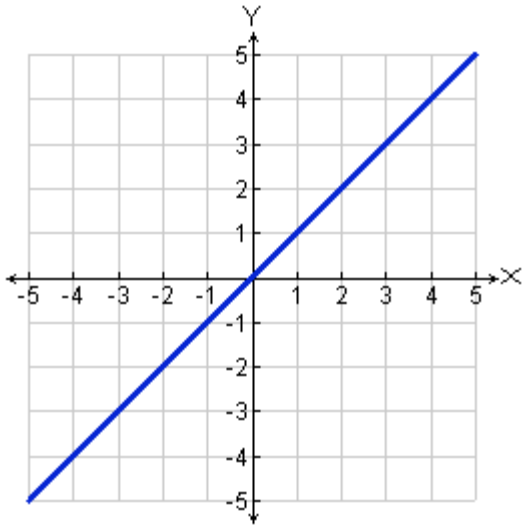
Directions: Answer each of the following questions.

1.) Using the graphs below find both the x and y intercepts.

a.) x- intercept = ( )
y-intercept = ( )



b.) x- intercept = ( )
y-intercept = ( )



2.) Find both x and y intercepts by substitution.

a.) $-3x + 5y = 30$

b.) $4x + 2y = 16$

c.) $y - 3x = -15$

3.) Solve for y in standard form to find the y-intercepts from the equation.

a.) $4 + y = x$

b.) $-2y = 6x + 6$

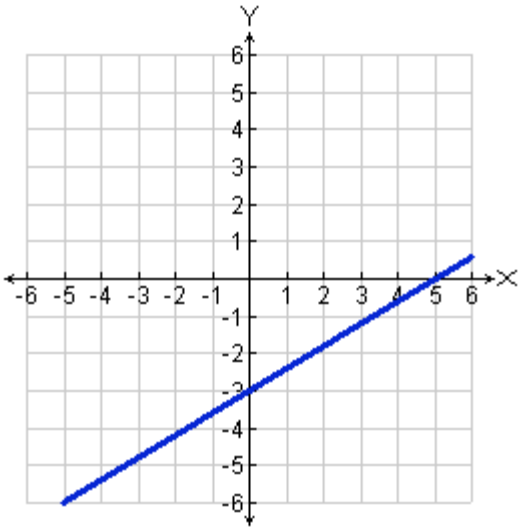
c.) $y = 3x$

Name: KEY x -y intercept HW

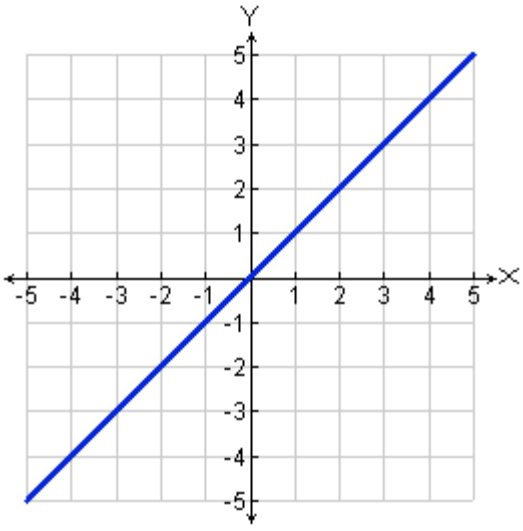
Directions: Answer each of the following questions.

1.) Using the graphs below find both the x and y intercepts.

a.) x- intercept = (5 , 0)
y-intercept = (0 , -3)



b.) x- intercept = (0 , 0)
y-intercept = (0 , 0)



2.) Find both x and y intercepts by substitution.

a.) $-3x + 5y = 30$

x-intercept = (-10,0)
y-intercept = (0,6)

b.) $4x + 2y = 16$

x-intercept = (4,0)
y-intercept = (0,8)

c.) $y - 3x = -15$

x-intercept = (5,0)
y-intercept = (0,-15)

3.) Solve for y in standard form to find the y-intercepts from the equation.

a.) $4 + y = x$

$y = x - 4$ $\Rightarrow$ y-intercept = (0,-4)

b.) $-2y = 6x + 6$

$y = -3x - 3$ $\Rightarrow$ y-intercept = (0,-3)

c.) $y = 3x$
$\Rightarrow$ y-intercept = 0

Day 5:

Objective: All students will be able to

Observe and make connections on how slope changes the appearance of a line.
Observe and make connections on how y-intercepts change the location of a line.
Graph linear equations with a TI-84 graphing calculator.

Anticipatory Set:

1.) Graph $y = 2x + 1$ with domain $\{-2, 0, 4\}$
(Create xy chart graph ordered pairs)

3.) With TI-84 calculator and overhead students will follow along step by step to graph $y = 2x + 1$ on the calculator.

4.) On the calculator explore the Table, Window, and Trace applications.

5.) Match the calculator table with the table completed by hand. Do they match?

Procedure:

1.) Anticipatory set.

2.) Graphing worksheet completed individually using graphing calculators. To explore how slope and the y-intercept change the appearance and location of a line.

3.) Closure

Closure:

After completing graphing worksheet, as a class discuss students' answers to questions 6 and 7. Gather several answers and display them on the board.

Name: Algebra

Calculator Notes:

y = used to enter an equation into the calculator in standard form **y = mx + b**

x,T,θ, n Used to put in the **x** variable into your equation

Graph Allows you to see the graph

2nd Graph (Table) Allows you to see the xy chart (**points on the line**)

Directions: Complete the following chart. Use the chart to answer the questions below.

Equation	Find the Slope	Find 3 other points on the line
y = 1x		
y = 2x		
y = -5x		

1.) How does a positive slope value change the appearance of the line? How does a negative slope value change the appearance of the line?

2.) What happens to the line when the slope value gets larger?

3.) Describe how an equation of $y = \frac{1}{2}x$ would look like. Graph it on your calculator to check your answer.

Equation	Find the Slope AND Find the y-intercept	Find 3 other points on the line
$y = 1x + 3$		
$y = 1x - 5$		
$y = -1x + 6$		

4.) How does a positive y-intercept change the appearance of the line? How does a negative y-intercept change the appearance of a line?

5.) From the above charts graph the lines $y = 1x$, $y = -5x$, and $y = x + 3$on the same set of axis on your own graph paper. Label each line with its equation.

6.) Describe in your own words what slope does to a line.

7.) Describe in your own words what the y-intercept does to a line.

Name: ANSWER KEY Algebra

Calculator Notes:

y = used to enter an equation into the calculator in standard form **y = mx + b**

x,T,θ , n Used to put in the **x** variable into your equation

Graph Allows you to see the graph

2nd Graph (Table) Allows you to see the xy chart (**points on the line**)

Directions: Complete the following chart. Use the chart to answer the questions below.

Equation	Find the Slope	Find 3 other points on the line
y = 1x	m = 1	Answers will vary on what values each student chooses from the table.
y = 2x	m = 2	
y = -5x	m = -5	

1.) How does a positive slope value change the appearance of the line? How does a negative slope value change the appearance of the line?

A positive slope makes the line travel "up hill" A negative slope makes the line travel "down hill"

2.) What happens to the line when the slope value gets larger?

The line will get steeper as the slope value increases.

3.) Describe how an equation of $y = \frac{1}{2}x$ would look like. Graph it on your calculator to check your answer.

The line will not be as steep as y = 1x, because the slope ½ is smaller than a slope of 1. The line will lie between the x-axis and y=1x.

Equation	Find the Slope AND Find the y-intercept	Find 3 other points on the line
$y = 1x + 3$	m = 1, b = 3	Answers will vary on what values each student chooses from the table.
$y = 1x - 5$	m = 1, b = -5	
$y = -1x + 6$	m = -1, b = 6	

4.) How does a positive y-intercept change the appearance of the line? How does a negative y-intercept change the appearance of a line?

A positive y-intercept will move the line up the y-axis. A negative y-intercept will move the line down the y-axis.

5.) From the above charts graph the lines $y = 1x$, $y = -5x$, and $y = x + 3$ on the same set of axis on your own graph paper. Label each line with its equation.

See attached graph.

6.) Describe in your own words what slope does to a line.

Answers will vary.
As slope increases it creates a steeper line. If slope is positive the line travels up from left to right, if slope is negative the line travels down from left to right.

7.) Describe in your own words what the y-intercept does to a line.

Answers will vary.
The y-intercepts move the entire line up the y-axis if positive, and down the y-axis if negative.

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