Zion Bank on the corner of  $4^{th}$  South and  $7^{th}$  East has a sign that reports the time and temperature. The temperature is given in two ways, using both the Celsius and Fahrenheit temperature scales. Here is a log of the temperature at different times of the day for August 29, 2013:

Time	Temp (C)	Temp (F)
11:03	31	87
12:00	32	90
2:00	35	95
3:04	35	95
4:08	34	93
8:03	27	81

The weather report said that the low for the night had been  $74^{\circ}$  F at 4 : 30 am and the high for the day was  $97^{\circ}$  F at 3 : 30pm. Using the information in the table, estimate what you think the Celsius readings on the bank sign would have been at those two times. Explain how you got your answers.

Use the coordinate systems below to plot the data. There are few issues that you should be paying attention to:

a. Choose an appropriate scale and plot the points that show how the Celsius temperature changes with time. Your first point will be (11:03,31).



Use the coordinate systems below to plot the data. There are few issues that you should be paying attention to:

b. Plot the points that show how the Fahrenheit temperature changes with time. Your first point will be (11:03,87).



c. Write a short description of what your graphs show. Compare the two graphs.

So far we have observed how the temperature reported in different scales depended on time. Now we will see how the Fahrenheit temperature changes with respect to the Celsius temperature. As before, choose an appropriate scale and plot the points from the table. Your first point will be (31, 87).



> a. The points of your graph should fall approximately in a straight line. Draw a straight line that seems to go through most of the points.

- b. What is the Fahrenheit temperature when the Celsius temperature is  $25^{\circ}$ ?
- c. What is the Celsius temperature when the Fahrenheit temperature is  $50^{\circ}$ ?
- d. Is there a temperature where a Fahrenheit and Celsius thermometer show the same number? If so, what is it?

If you increase the Fahrenheit temperature by one degree, by how much does the temperature increase on the Celsius scale?

a. Explain how you know whether your answer to the previous question is accurate.

b. How would your answer be different if you knew that  $25^{\circ}$ C is  $77^{\circ}$ F, and that  $50^{\circ}$ C is  $122^{\circ}$ F?

We want to come up with a general rule such that if we know the temperature in Fahrenheit we can calculate the temperature in Celsius.

a. From Question 4.3 we know the effect of increasing the Fahrenheit temperature by one degree on the temperature in Celsius.

b. Write down a rule that converts the temperature in Fahrenheit to the temperature in Celsius.

Use the function you just obtained to find the rule that converts the temperature in Fahrenheit to the temperature in Celsius.

There is another temperature scale called Kelvin. The scale is used because 0° Kelvin is the minimum temperature a system can have. If the temperature increases by one degree Kelvin, then the temperature also increases by one degree Celsius. Use the fact that  $272, 15^{\circ}C = 0^{\circ}K$ 

 $-273.15^{\circ}C = 0^{\circ}K.$ 

- a. Find a function g that represents the conversion between Celsius and Kelvin.
- b. Find a function *h* that represents the conversion between Fahrenheit to Kelvin.
- c. What is another way you can answer the previous question?

Kingda Ka is a steel accelerator roller coaster located at Six Flags Great Adventure in Jackson, New Jersey, United States. It is the world's tallest roller coaster, the world's second fastest roller coaster, and was the second strata coaster ever built. The steepest portion of Kingda Ka is a 418 foot drop. During the 418 foot drop the train moves 25 feet horizontally.





- a. Is there enough information to determine which roller coaster is steeper?
- b. If so calculate which coaster is steeper.
- c. Is steepness all you look for in a roller coaster?





#### Slope - Section 4.3 Definition of slope.

#### Definition

The slope of a line segment is defined as the ratio of rise to run:

 $slope = \frac{rise}{run}$ 

Steep roads sometimes have a sign indicating how steep they are. For example, the sign may say 5% Grade. This means that you gain 5 units of altitude (the rise) for every 100 units you move in the horizontal direction (the run).

- a. On a 5% grade, how many units of altitude do you gain for every 200 units you move in the horizontal direction.
- b. On a 5% grade, how many units in the horizontal direction would you have to move to increase your altitude by 100 units?
- c. How would a mathematician report a 5% grade? What is the corresponding slope?
- d. If the road up Little Cotton Wood Canyon travels 8.26 miles horizontally and the elevation change is about 4000 feet, what is the average grade of canyon road? What is the average slope? (Use the fact that there are 5280 feet in a mile)
- e. What is the grade when you are driving on the Salt Flats?

Steep roads sometimes have a sign indicating how steep they are. For example, the sign may say 5% Grade. This means that you gain 5 units of altitude (the rise) for every 100 units you move in the horizontal direction (the run).

a. On a 5% grade, how many units of altitude do you gain for every 200 units you move in the horizontal direction.

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e. What is the grade when you are driving on the Salt Flats?



a. Find the slope of each hypotenuse in the above figure.



- a. Which triangle has the steepest hypotenuse?
- b. Two of the triangles' hypotenuse have the same slope. Why might someone make the mistake and report all three of the triangles have the same slope?



a. Draw a triangle on the geoboard that would have a hypotenuse with the largest possible slope. Calculate the slope of the figure you drew. Explain how you know it is the requested triangle.



b. Draw a triangle on the geoboard that would have a hypotenuse with the smallest possible slope. Calculate the slope of the figure you drew. Explain how you know it is the requested triangle.



c. List all the possible slopes of the triangles you can draw on the geoboard. Report them as fractions.

What can you say about the slope of a line if, when you follow the line from left to right

a. It goes up?

b. It goes down?

c. It doesn't go up or down?

What can you say about the slope of a line that does not contain any points in the

a. First quadrant.

b. Second quadrant.

c. Third quadrant.

For each equation below find two pairs of numbers, (x, y), that satisfy the equation. Label the two points and calculate the slope of the line segment that connects the two points.

a. y = 1.5x + 3

b. y = -1.5x + 3

c. y = 2x + 3

d. y = -3x + 3

e. How did your answer compare to people who chose different points?

For each equation below find two pairs of numbers, (x, y), that satisfy the equation. Label the two points and calculate the slope of the line segment that connects the two points.

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c. y = 2x + 3

The slope between two points is the quotient of the difference between their *y*-coordinates and the difference between their *x*-coordinates  $(\frac{\Delta y}{\Delta x})$ .

a. What does this mean for the slope of a vertical line?

b. What does this mean for the slope of a horizontal line?

For each equation below find two pairs of numbers, (x, y), that satisfy the equation. Label the two points and calculate the slope of the line segment that connects the two points.

d. y = -3x + 3

For each equation below find two pairs of numbers, (x, y), that satisfy the equation. Label the two points and calculate the slope of the line segment that connects the two points.

e. How did your answer compare to people who chose different points?

Find two (x, y) pairs that satisfy the equation y = mx + b (your pairs should be in terms of *m* and *b*). Use the pair of points to calculate the slope of the line segment connecting the two points.

Given an equation for a line y = .5x + 3, how do you calculate the *y*-intercept? Explore both a geometric technique and an algebraic technique.

Given an equation for a line y = mx + b, calculate the *y*-intercept. Did you use an algebraic or geometric approach?

Fill out the following tables.

a. y = x + 2





x	у
1	
3	
6	
8	

Fill out the following tables.

b. 
$$y = -4 - 3x$$







Fill out the following tables.

c. y = 9





x	у
1	
3	
6	
8	

When x = 0, what is y? When x increases by 1, how much does y increase? (If y decreases, think of it as a negative increase.)

a . b . c .

Where do you find that number in each of the tables for each equation?

In the 2013-2014 academic year the tuition to attend the University of Utah is \$6400 a year (for 12 credits a semester). In the 2012-2013 academic year the cost of tuition was \$6000 a year (for 12 credits a semester).

- a. Suppose that a linear function can model the tuition at the U. What will the tuition cost for the academic year 2014 2015 (for 12 credits a semester)?
- b. Write down a function f such that f(t) represents the tuition in the academic year t (for 12 credits a semester). Discuss what a reasonable domain might be for your function by thinking about what f(0) what f(10000000) would represent.
- c. For what values of t will f(t) be most accurate?
- d. In what year will tuition cost \$10000 per semester? (according to our model)

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c. For what values of t will f(t) be most accurate?

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