1. In order to bring in some extra money, you decide to start your own coffee shop on campus. Being the nice guy that I am, I let you rent out my office for $20 per day. You estimate that it will cost you 25¢ to make each cup of coffee. You haven't yet decided how much you'll charge per cup.

   Calculate your daily costs as a function of the number of cups of coffee you make. Fill-in the table and sketch a graph.

# of Cups	Daily Cost
0	
1	
2	
10	
100	
X	$C(x) = 20 + 0.25x$

Independent variable = _____   Dependent variable = _____

Domain = _____   Range = _____

This is an example of a **linear function**. The slope-intercept form of a linear function is: $f(x) = mx + b$ Where m represents the slope and b represents the y-intercept.

What does it mean for a function to be linear? _____

What does the slope of a linear function represent? _____

How do we calculate the slope of a linear function? _____

What does the y-intercept of a linear function represent? _____

How do we calculate the y-intercept of a linear function? _____

2. If we're given the slope and y-intercept, it is very easy to find the formula for a linear function.

Immediately after a tanker spill, a biologist measures 96 tons of contaminant in a lake. The biologist estimates that 7 tons of the contaminant will dissipate every hour.

Will a linear function model the amount of contaminant as a function of time? _____

Write out the formula for the linear function: _____

How long will it take until the lake is free from contaminant? _____

Your answer to the previous question is the x-intercept of the linear function. Explain how we calculate the x-intercept.

Sketch a graph of this function:

How much contaminant will remain in the lake after 5 hours? _____

According to our model, how much contaminant will remain in the lake after 15 hours? _____

What is the domain of our function? _____

What is the range of our function? _____

When will only 47 tons of the contaminant remain? _____

Note: We can solve linear equations analytically or graphically.

3. Finding linear functions can be a bit more difficult when we're not given both the slope and y-intercept.

| If we're given: | a) Two points or |
| | b) One point and the slope, |

$f(x) = mx + b$

Where *m* represents the slope and *b* represents the y-intercept.

Ballard Power Systems manufactures fuel cells for automobiles. Before it began selling any fuel cells, the company spent $42 million on research and development. The company expects to break even once it sells 9.8 million fuel cells.

Let's assume that Ballard Power's revenues are a linear function of the number of fuel cells they sell.

Points are often written as ordered pairs: (x, y). What two points are given in the above situation? _____

Sketch a quick graph of this linear function:

We need to find the slope of our linear function: _____

What does the slope represent in this situation? _____

Now use the point-slope form to find the linear function.

How many fuel cells will Ballard Power have to sell in order to make $50 million in profits? Solve graphically & analytically.

How many fuel cells will Ballard Power have to sell to make at least $20 in profits?

4. Sometimes, we may be given the slope and one point.

It is a biological fact that most crickets chirp at a rate that increases as the temperature increases. For the snowy tree cricket (*Oecanthus fultoni*), the relationship between temperature and chirp rate is so reliable that this type of cricket is called the thermometer cricket. It is known that as the temperature increases 12˚ Fahrenheit, the chirp rate increases by 3 chirps per minute. It is also known that when the temperature is 80˚, the crickets chirp sixty times per minute

Let's find a linear function to model the chirp rate as a function of the temperature.

What point are we given? _____

Calculate the slope of this linear function. What does it represent?

Sketch a graph of this function:

Find the formula for the linear function:

What is the chirp rate when it is 32 degrees outside?

Identify the domain and range of this function.

If the crickets are chirping at a rate of 52 chirps per minute, what is the approximate temperature? Solve graphically.

5. What is true about the slopes of two parallel lines?

6. What is the slope of a horizontal line? What is the slope of a vertical line?

7. While Clark Kent was busy attending a Pulitzer Prize ceremony for Lois Lane, Lex Luthor stole an experimental X-43A aircraft from NASA headquarters. Knowing Superman would eventually find out, Lex flies the X-43A towards his kryptonite-defended base. He travels at a speed of mach 6.7 (5,100 miles per hour).

   After the ceremony had ended (2 hours later), Superman arrived at NASA headquarters and discovered the missing aircraft. He quickly flies after Lex at a speed of 6,600 miles per hour.

   Lex Luthor's secret base is 50,000 mlles away from NASA headquarters. Will Superman be able to catch him in time?

   Let's find a linear function to model Lex Luthor's distance as a function of time. What are the slope and y-intercept of this function?

   Sketch a graph of this function. How far away is Lex when Superman begins his pursuit?

   How long will it take Lex to reach his secret base?

   Now, let's model Superman's distance from NASA as a function of time. What point and slope are we given?

   Find the formula for Superman's distance as a function of time. Sketch this graph on the same set of axes.

Will Superman catch Lex Luthor in time? In other words, how long will it take until Lex and Superman are the same distance from NASA headquarters?

How close to the secret base did Lex get?

Graph the functions for Lex and Superman on a graphing calculator. Find the point of intersection.

8. Solve the following linear equations using the specified methods:

(a) Solve $\dfrac{x+7}{6} + \dfrac{2x-8}{2} = -4$ analytically. Use the intersection of graphs method to check your answer.

(b) Solve $6x - 4(3 - 2x) = 5(x - 4) - 10$ analytically. Use the intersection of graphs method to check your answer.

(c) Solve $3\pi x - \sqrt[4]{3} = 0.75\pi x + \sqrt{19}$ using the intersection of graphs method..

We now turn our attention to linear inequalities. The only thing you need to remember when working with inequalities is…

If you multiply or divide both sides by a negative number, you must reverse the sign of the inequality.

Example: $-3x - 9 \geq 4x + 5$

$-3x - 4x \geq 5 + 9$ (combining like terms)

$-7x \geq 14$ (simplifying)

$x \leq -2$ (reversing the direction of the inequality)

9. Fog forms when the air temperature is less than or equal to the dew point. This phenomenon also causes clouds to form at higher altitudes. Both the air temperature and the dew point decrease at a constant rate as the altitude above ground level increases. At an altitude of x miles, the air temperature and dew point are modeled by:

Temperature: $T(x) = 75 - 29x$ Dew Point: $D(x) = 55 - 5.8x$

Determine the altitudes where clouds will not form.

Graph the two functions and solve the inequality graphically.

Three telecommunications companies offer the following long-distance plans:

      Company A: $10 per month plus 50 cents per minute
      Company B: $20 per month plus 25 cents per minute
      Company C: $40 per month with unlimited minutes

1. Write out the monthly phone bills as a function of minutes for each company. Graph these functions and determine which long-distance plan is the best.