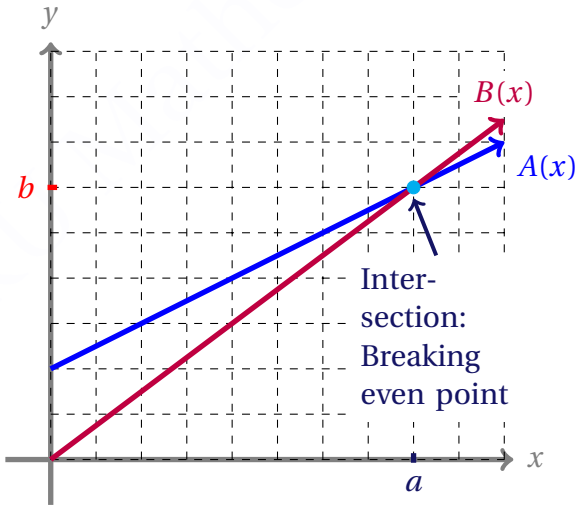
Worksheet Three **MATH 104** Name:_____

WORK ON THIS ASSIGNMENT IN GROUP OF 2-4. TURN IN YOUR WORK INDIVIDUALLY IN CLASS. YOU CAN USE YOUR NOTES FOR THIS ASSIGNMENT.

2.3: Modeling with Linear Functions

- To identify what can be modeled by a linear function, look for words or indication of concepts such as constant rate. Sometimes the assumption is directly given that a model is linear.
- Identify the input and output.
- Examine the information given to find point/s and/or slope of the line. Points are usually given by output values at some input value. The slope is usually given as rate per units of input.
- If only points are given, calculate the slope. Then use one of the points and the slope to find the equation of the line. Replace y by the function name.
- How to evaluate a function at a point: Plug in the x-value.
- How to find when an input is obtained: Set the y-value equal to that and solve for x.
- How to compare two linear functions: Solve to find the point of intersection, if any. For x-values before the x-value of intersection the function with smaller $\underbrace{\text{rate of change}}_{\text{slope}}$ has larger values. For x-values bigger than the x-value of the intersection, the function with bigger $\underbrace{\text{rate of change}}_{\text{slope}}$ has larger value.



$$\begin{array}{l|l} A(x) > B(x) & \text{when } x < a \\ A(x) < B(x) & \text{when } x < a \end{array}$$

- Motion with constant $\underbrace{\text{velocity}}_{\text{slope}=v}$ also follows a linear module. That is, the position is a linear function $s(t) = vt + s_0$. In this equation, velocity can be a positive or a negative number; depending on whether the distance is increasing or decreasing.

1. (a) Find an equation for the line L passing through the points $(3,4)$ and $(1,7)$.

   (b) Find an equation for the line **perpendicular** to L and passing through point $(0,2)$.

   (c) Find an equation for the line **parallel** to L and passing through point $(2,4)$.

2. Consider this scenario: A town's population has been decreasing at a **constant rate**. In 2015, the population was 6,500. By 2019, the population had dropped to 5,700. Assume this trend continues.

   (a) Predict the population in 2027.

   (b) Identify the year in which the population will reach 0.

3. When hired at a new job selling electronics, Nick is given two pay options:

   Option A: Base salary of $\$10,000$ a year with a commission of 9% of his sales

   Option B: Base salary of $\$25,000$ a year with a commission of 4% of his sales

   How much electronics would he need to sell for option A to produce a larger income?

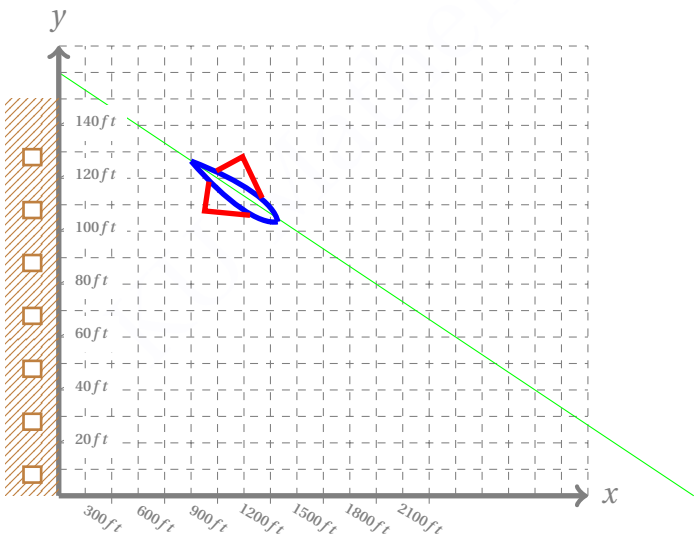
4. The sum of two numbers is 34. One number is 6 less than the other. Find the **larger** number.

   (a) 14 (b) 20 (c) 26 (d) 32 (e) None of these

5. **Aerospace Engineering:** A glider clears a 150 ft tall building by 10 ft. If the glide ratio is 15 : 1, i.e. the glider drops 1 ft when it travels 15 ft horizontally,

   (a) express the height of the glider y in ft as a function of horizontal distance traveled x in ft.

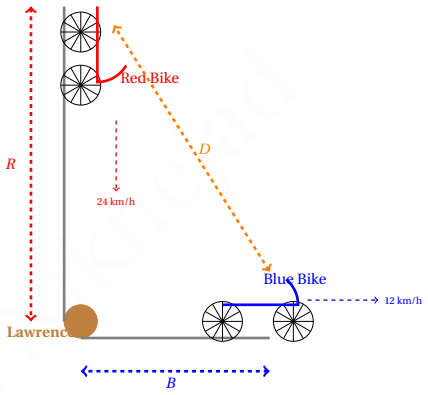
   (b) how **far from the building** does the glider land?



INDIVIDUAL WORK

UPLOAD TO CANVAS OR SUBMIT IN CLASS BEFORE DUE DATE. DISCUSSING THESE QUESTIONS IN YOUR GROUP IS ENCOURAGED BUT MAKE SURE YOU ARE TURNING IN YOUR OWN WORK.

6. A red bike is traveling south, toward Lawrence, at constant speed of 24 km/h; a blue bike is also traveling east, away from Lawrence, at constant speed of 12 km/h (See figure on the right).
When $t = 0$, the **red** bike is 10 km north and the **blue** bike is 6 km east of Lawrence.



(A) *(1 point)* Express the distance of the red bike from Lawrence, R, as a function of time in hours, t. (Note that the distance is decreasing linearly.) $R(t) =$ km

(B) *(1 point)* Express the distance of the blue bike from Lawrence, B, as a function of time in hours, t. (Note that the distance is increasing linearly.) $B(t) =$ km

(C) *(1 point)* Express the distance of the blue bike from the red bike, D, as a function of time in hours, t. (Note the triangle.) $D(t) =$ km

7. A phone company has a monthly cellular data plan where a customer pays a flat monthly fee of \$10 and then a certain amount of money per gigabyte (GB) of data used on the phone. If a customer uses 20 GB, the monthly cost will be \$11.2.

(A) *(1 point)* Find a linear function for the monthly cost of the data plan as a function of x, the number of GB used.

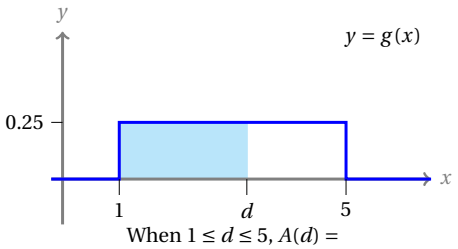
(B) *(1 point)* Interpret the slope and y-intercept of the equation.

(C) *(1 point)* Use your function to find the total monthly cost if 120 GB are used.

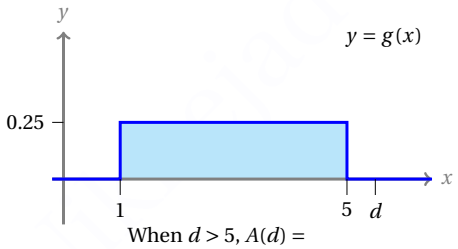
Note: The probability distributions are used in many STEM fields. The following function $g(x)$ is a **uniform probability distribution function**. We are computing the cumulative probability function $A(x)$ in the following problem. This problem was created to address a concept in your **Physics** courses.

8. Consider the function $g(x) = \begin{cases} 0.25 & \text{When } 1 \le x \le 5 \\ 0 & \text{Otherwise} \end{cases}$.

   (A) *(1.5 points)* Define function $A(d)$ to be the area entrapped between the graph of the function g and x-axis to the left of line $x = d$; we compute the area function in terms of d. What is $A(d)$ if $1 < d < 5$? What is $A(d)$ if $d > 5$?



When $1 \le d \le 5$, $A(d) =$



When $d > 5$, $A(d) =$

   (B) *(0.5 points)* Replace d with x in your answers for Part (A) and write $A(x)$ as a piecewise function. $A(x) =$

$$\begin{cases} \square & \text{When } x < 1 \\ \square & \text{When } 1 \le x \le 5 \\ \square & \text{When } x > 5 \end{cases}$$

Example Video:

1. https://mediahub.ku.edu/media/t/1_428nj7u6
2. https://mediahub.ku.edu/media/t/1_zssn6026
3. https://mediahub.ku.edu/media/t/1_kxdcm7jt or on Youtube https://youtu.be/6rEcY099hIU