Slopes and Lines

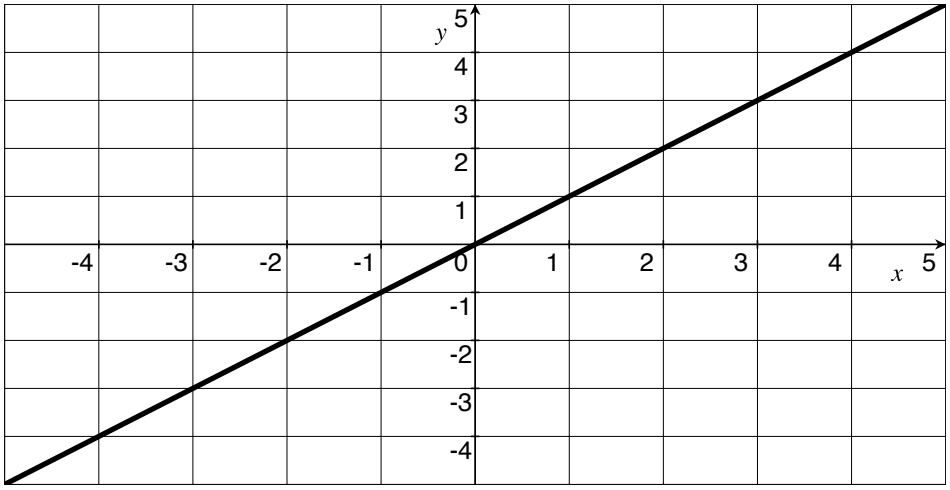
This *must* be completed in groups of 2 to 3. One copy of the group's work & answers are to be turned in as part of the WrittenHW. You will likely need to arrange a meeting outside of class, so exchange contact information! As always with group work, make sure each of you:

- Expect to make mistakes but be sure to reflect/learn from them!
- Are civil and are aware of your impact on others.
- Assume and engage with the strongest argument while assuming best intent.

1. Shape: Let $g(x) = 1 \cdot x$. The graph of g is plotted below and is an example of a line. All the functions on this worksheet will have graphs that are lines.

   (a) Let the function h be defined by $h(x) = -2 \cdot x$. The multiplication sign is often suppressed and we write $h(x) = -2x$ instead. Plot the graph of h below.

   (b) Plot the graphs of the functions $\alpha(x) = \frac{-1}{2}x$, $\beta(x) = 0x$, and $\gamma(x) = 3x$. You should have four different graphs drawn below by the end of this question.



   (c) For each graph above, determine if the graph defines a function or not.

   (d) For each graph above, find the intervals that the graph is increasing & decreasing. For example, the graph of g is increasing on the interval $(-\infty, \infty)$.

   (e) Let f be the function with the rule $f(x) = mx$ where m be some fixed number (like 2, $\frac{1}{3}$, -4, etc...). Use the above observations to determine if the graph of f is always increasing, decreasing, or doing neither when:

   - $m > 0$:
   - $m = 0$:
   - $m < 0$:

2. Slope:

   (a) Given points (a, b) and (c, d) on a line, explicitly find a formula for the slope.

   (b) Let $h(x) = -2x$ be the function from (1a). Find two points that are on the graph of h and use the formula from 2a to compute the slope of the line defined by h.

   (c) If $f(x) = mx$ where m is some fixed number (like 2, $\frac{1}{3}$, -4, etc...), what is the slope of the graph of f?

3. Let δ be a linear function defined by $\delta(x) = h(x) - 2.5$ where h was defined in #1. Since $h(x) = -2x$ we could also write $\delta(x) = -2x - 2.5$. Identify the y-intercept of δ.

4. Let ϵ be the linear function defined by $\epsilon(x) = h(x) + 1$ where $h(x) = -2x$ again.

   (a) Find another way to write the rule of ϵ much like we did for the function δ.

   (b) Identify the y-intercept of ϵ.

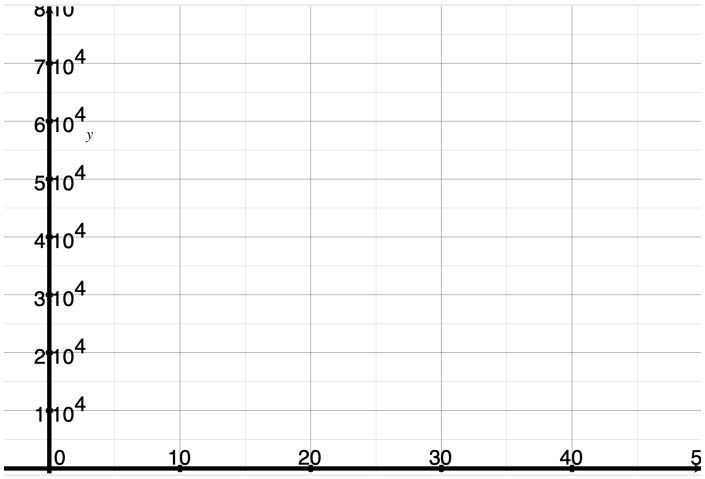
5. Let m and b be fixed numbers (like 2, $\frac{1}{3}$, -4, etc...) and define $f(x) = mx + b$.

   (a) Where is the y-intercept of f? (Consider looking at #3 & 4, and generalize!)

   (b) The rule of the function f is a special form called slope intercept form. Why does it have this name?

6. Use the the information from #5 to fill in the table below and then graph w & b.

function	slope	y-intercept
$w(x) = 566x + 40738$		
$b(x) = 390x + 21970$		



7. The functions above (approximately) return the median annual income of Americans since 1960 for white Americans (w) and black Americans (b). (Source: `https://resources.corwin.com/tmsj-highschool?fbclid=IwAR3gCmbRZAbDdQWiVR1DBmDhNB8lPIOBS7OiZbCw10RVs`)

   (a) What was the median annual income of black Americans in 1960?

   (b) Interpret what the slope for the w means in this context.

   (c) Identify if the graphs of w and b intersect and then interpret the practical significance of your finding.

8. Let the graph of the function α be a line with slope $\frac{-1}{3}$ and assume the graph crosses the y-axis at $(0, 7)$. Find the rule of α without graphing it.

9. Let the graph of the function β be a line with slope $\frac{1}{2}$ and assume it passes through the point $(3, 4)$. Find the rule of β.

   Hint: Since you know what m is, write $\beta(x) = mx+b$, and try to solve for b by plugging in points. Otherwise, there is a "point-slope formula" that can be used that is on page 20. *Be aware, you will have no books or notes on the exam and quizzes so make sure whatever materials you use to answer this question can be memorized easily.*

10. Let the graph of the function γ be a line that passes through the points $(-1, 2)$ and $(2, -5)$, find the rule of γ.

11. Special Cases: What is the slope of a horizontal line? A vertical one? In each case, is the line the graph of a function?

12. Parallel Lines & Perpendicular Lines

    (a) If two lines are parallel, what is the relationship between their slopes? What if perpendicular?

    (b) Find a line that is parallel to $\frac{4}{7}x + \pi$ and passes through the point $(-1, 3)$.

    (c) Find the equation of a line perpendicular to the line that passes through $(-2, -1)$ and $(4, 3)$. Note: There are *many* right answers.