BIG PICTURE of this UNIT:	• How do we WORK WITH & EXTEND the concept of "functions" • Why are linear equations written in different forms? • How do we EXTEND our knowledge of LINEAR functions, beyond the basics of IM2?

This lesson will be based upon a STUDENT DIRECTED DISCUSSION model ….. in your groups, you should be having DISCUSSIONS about how to think and work through and then present the solutions to the following questions. The questions will involve basic ideas from IM2 Linear Relations UNIT including (i) functions, (ii) linear functions, (iii) GEOGEBRA and Co-ordinate Geometry. EVERY LESSON this semester will involve **spiralling through** these 4 major concepts as you will be given the opportunity to deepen and extend your conceptual knowledge & skill set on these 4 major themes as you see them multiple times in our lessons.

So, in your group, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for DISCUSSIONS !!!! If your group has (i) multiple solutions that lead to the same answers OR (ii) same/different solutions that lead to different answers, present them ANYWAY!!

1. Bob bumps his head and starts plotting all his data points in "reverse" order. For example, when he tries to plot (3,2), he plots (2,3) instead. A problem in his textbook tells him to graph the line $y = 3x + 2$ {2,8}

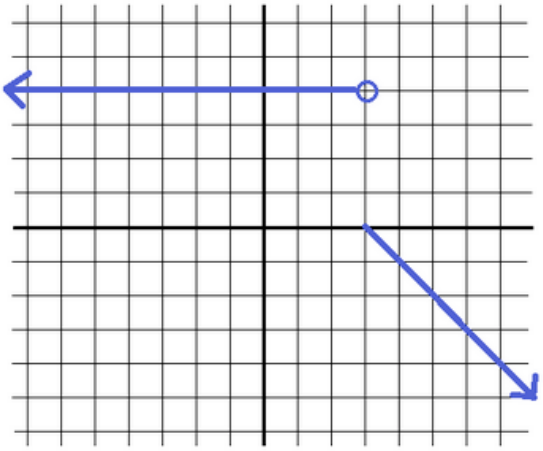
   a. List some of the points that would be on the line $y = 3x + 2$. Draw the CORRECT line.
   b. List some points that Bob would use in his line. Draw Bob's line.
   c. What is the slope of Bob's line? What is the equation of Bob's line?
   d. Now also draw the line $y = x$. Describe what you observe about the three graphs.

2. Use DESMOS to graph the absolute value function ($f(x) = |x|$). {13}

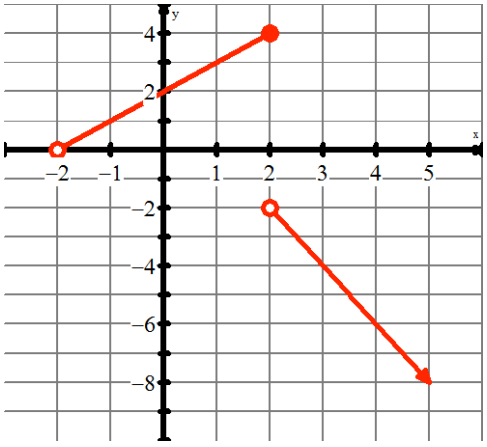
   a. State the domain and range of $f(x) = |x|$.
   b. The equation for the absolute value function can also be written as a piecewise function. Identify the two "pieces", their domain and thus write the piecewise function equation for $f(x) = |x|$. Verify your work by graphing this piecewise function on DESMOS.
   c. Translate the function 4 units to the left. Draw the graph and write the new equation for this newly transformed function.

3. Determine the equations of the two piecewise functions graphed below: {13}

(a)



(b)



4. For the following data tables or number sets, write an algebraic equation that tells me: {3,8}

   a. how I can get the **output value**, $f(x)$ from the **input value**, x (hence the direction of the arrow.)
   b. how I can get the **input value**, x, from the **output value**, $f(x)$ (hence the second arrow at the bottom.)

x →	f(x)
1	3
2	5
3	7
4	9

x →	f(x)
2	23
3	19
4	15
5	11

x →	f(x)
2	4
4	9
6	14
8	19

5. A line that goes through the point (2,-3) and has a slope of 2. {1,3}

   a. Write its equation in standard form.
   b. State the slope of a line that is perpendicular to the line you worked with in Q5a.
   c. Knowing that this perpendicular line goes through the point (2,-3) as well, write its equation as well.
   d. Use your GDC to graph these two lines and verify that they look perpendicular (HINT: window adjustments or ZOOM options) {2}

6. John works at a clothing store and his weekly salary is $300 and he earns 5% commission on his weekly sales, up to a maximum of $24,000 in weekly sales. In this question, you will explore the relationship between John's salary and the number of weeks he works. {5,13}

   a. Write an equation to help analyze this situation. Use the variables *E* and *S*, so your equation is in the form of *E*(*S*). Define these variables.

   b. Determine the slope & state its meaning.

   c. Determine the *y*-intercept and state its meaning.

   d. What will be John's earnings if he sells $6,525 worth of clothing?

   e. When will John's earnings be $700?

   f. Evaluate *E*(7000)

   g. Solve *E*(*S*) = $1,000

   h. CASE 1: John gets a raise in pay and now earns a base salary of $500, but his commission remains at 5% of total sales. Write a new equation and graph it on the grid. What is similar about the 2 graphs? What is different about the 2 graphs.

   i. CASE 2: John now gets a raise in pay. He stills earns a base salary of $300, but his commission is now 7.5% Write a new equation and graph it on the grid. What is similar about the 2 graphs? What is different about the 2 graphs.

   j. CASE 3: John now gets promoted to Store Manager and earns a weekly salary of $1100. and graph it on the grid. What does this graph look like?

HL EXTENSION: Floor & Ceiling (or STEP) Functions (or Greatest Integer Functions). MODIFIED SALARY: John works at a clothing store and his weekly salary is $300 and he earns 5% commission **on every $1000 of weekly sales**.

   k. Evaluate *E*(12500).

   l. Solve *E*(*S*) = $950. Is it possible to solve for *E*(*S*) = $925? Why/why not?

   m. Write an equation and then graph it on DESMOS.

7. A linear function is defined as follows: {1,2,3,6,7}

   I. It only exists on the domain of $\{x \in R | -2 < x \leq 10\}$
   II. It goes through the points A(1,2) as well as B(5,8).

   a. Determine its equation and write the equation in all 4 forms presented in IM3.
   b. Graph the line by hand on graph paper.
   c. State the range of this linear function.
   d. Mr. D wonders whether or not this line intersects with the line $4x + 3y + 24 = 0$. Show/explain whether or not the two lines intersect.

Higher Level Questions for More Complex Concepts OR an EXTENSION of basic concepts involved with linear relations and functions in general.

8. I have been observing the motion of a bug that is crawling on my graph paper. When I started watching, it was at the point (1, 2). Ten seconds later it was at (3, 5). Another ten seconds later it was at (5, 8). After another ten seconds it was at (7, 11). {16}

   a. Draw a picture that illustrates what is happening.
   b. Write a description of any pattern that you notice. What assumptions are you making?
   c. Where was the bug 25 seconds after I started watching it?
   d. Where was the bug 26 seconds after I started watching it?

9. Switch your calculator to parametric mode and enter these equations: ➔ $X_{1T} = 1 + 2T$ as well as $Y_{1T} = 2 + 3T$. Do a ZOOM 6 and readjust your window settings to Tmin = -10 and Tmax = 10 and Tstep = 1. Describe what you see. How might this graph be related to Q8? {2,16}