	• How do we WORK WITH & EXTEND the concept of "functions"
BIG PICTURE of this UNIT:	• 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. A piecewise function, $y = h(x)$ has the following characteristics: {6,13}

   i. The domain is $\{x|\text{-}2 \le x \le 6\}$,

   ii. The value of $h(-2)$ is 5 and $h(6) = 17$,

   iii. The function decreases for the first half of its domain and then increases for the second half of the domain

   iv. CHALLENGE OPTION: (The function decreases for the first half of its domain and then increases for the second half of the domain at a rate that is twice as great as first piece's rate-of decrease).

   a. Sketch the function and calculate its equation.
   b. Determine the domain and range of $y = h(x)$

2. The highest and lowest marks awarded on an examination were 285 and 75. All the marks must be reduced so that the highest and lowest marks become 100 and 45. {5}

   a. Determine a linear function that will convert 285 to 100 and 75 to 45.
   b. Use your function to determine the new marks that correspond to original marks of 95, 175, 215 and 255.

3. Have every student at the table move one seat to their left. Explain whether this is or isn't a "new" seating arrangement. Would your answer change if your group was seated at a round table? {P1}

4. Use DESMOS to graph the following functions and then use the graph to determine the domain and range of each function:

    c. $f(x) = -|x-4|$ (this is a variation of the "absolute value" function) {13}

    d. $g(x) = 5 + \sqrt{x+3}$ (this is a variation of a "root" function) {8}

    e. $h(x) = \dfrac{1}{x+2} - 3$ (this is a variation of a "reciprocal" function) {15}

5. Each of the functions above represent "transformations" of "parent" functions. The "parent" functions were $f(x) = |x|$, $g(x) = \sqrt{x}$, $h(x) = \dfrac{1}{x}$. Graph the parent functions as well and then state how the parent functions had been "transformed" to produce the graphs described by the function equations in Q9. {11}

6. Equation writing: {5}

4. For each statement, define two variables and write a linear equation that models the sentence.
  (a) The sum of two numbers is 12.
  (b) The sum of the width and length of a rectangle is 36 m.
  (c) The total value of nickels and dimes is 75¢.
  (d) Fives times some number less three times another number is ten.
  (e) A sum of money invested at 5% per year and another sum at 8% per year earned a total of $150 in the first year.
  (f) The cost of the rental is $50 plus $5/h.
  (g) A rectangle is 2 m longer than it is wide.
  (h) The total value of $5 bills and $10 bills is $135.

7. A line goes through the points A(1,2) as well as B(5,8). Determine its equation and verify that the points (3,5) and (7,11) are also on the line. Graph the line using technology. {1,2,3}

8. An investor has two investments. One investment, Investment A, earns 7% p.a. and the other investment, Investment B, earns 12% p.a. Last year, the original investment of $14,000 earned $1230. You are going to work toward determingin how much money was invested in EACH of the two investments, A and B. {5,6}

    a. Define your variables and write an equation modeling this scenario.
    b. Determine the x- and y-intercepts and explain their meaning.
    c. Determine the slope and explain its meaning.
    d. How much did the investor put into Investment B?
    e. Would the investor earn more or less if she switched the amounts?
    f. State the domain and range of the function(s) in this model. Explain.

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

1. Use DESMOS to graph the function $f(x) = \lfloor x \rfloor$ (the floor function). Select the functions "button" and then select the "misc" tab and now finally select "floor". {13}

    a. Describe the appearance of the function and include a sketch.
    b. Use the gear wheel on DESMOS (tools) to create table. Now enter any numbers you want into the table to "see" what the function "does" to the input numbers.
    c. State the domain and range.
    d. IF the domain is limited to $\{x | 1 \le x \le 5, x \in R\}$, write the equation as a piecewise function.

2. Use DESMOS to graph the function $f(x) = \lceil x \rceil$ (the ceiling function). Select the functions "button" and then select the "misc" tab and now finally select "ceil". {13}

    a. Describe how this graph is similar and yet different than the floor function.
    b. Describe the appearance of the function and include a sketch.
    c. Graph the inverse of $f(x) = \lceil x \rceil$. Is the inverse a function? Explain your reasoning.