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!!

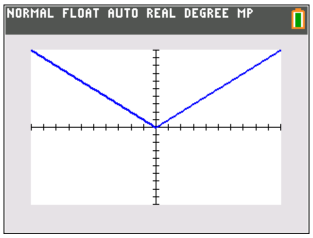
1. Let $f(x) = 3x - 5$ and let $g(x) = x^2 + f(x)$. Evaluate the following: {1,8,9,Q}

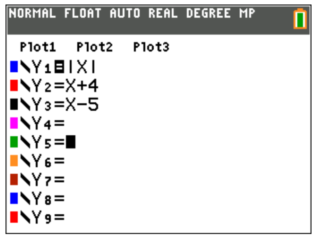
(a) $f(5)$ (b) $f(-1)$ (c) $f(K)$ (d) $f^{-1}(-1)$ (e) $f^{-1}(0)$ (f) $f(2x-1)$ (g) $f(x^2)$ (h) $g(5)$ (i) $g(-1)$

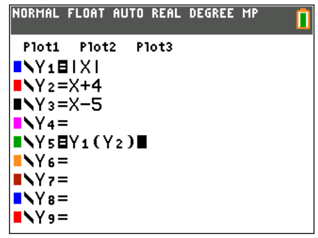
2. Two functions are given as $f(x) = \dfrac{1}{2}x + 5$ and $g(x) = 2x - 10$. {1,9,10}
   a. Evaluate (i) $f(4)$ (ii) $g(7)$ (iii) $g(4)$ (iv) $f(-2)$ (v) $f\big(g(7)\big)$ (vi) $f\big(g(4)\big)$ {1,9}
   b. What conclusion can you make about the two functions? {9,10}

3. Consider these three linear functions ➔ $f(x) = 7 - 2x$ and $3x - 5y - 30 = 0$ and $h(x) - 2 = -\dfrac{2}{3}(x+6)$.
   a. **Show that** $3x - 5y - 30 = 0$ can be written as $g(x) = \dfrac{3}{5}x - 6$. {3}
   b. Find the equations of the following compositions: {9}
      (i) $f \circ g(x)$ (ii) $g \circ f(x)$ (iii) $f \circ h(x)$ (iv) $h \circ g(x)$ (v) $g \circ h(x)$
   c. Solve the equation $f(x) = g(x)$ and **hence** solve the inequality $f(x) < g(x)$. Verify graphically. {6}
   d. Find the equations of $f^{-1}(x)$ and $g^{-1}(x)$. {8}
   e. Find the equations of the following compositions: {9}
      (i) $f^{-1} \circ g(x)$ (ii) $h \circ g^{-1}(x)$ (iii) $f \circ g \circ h(x)$
   f. Perform the following compositions: $f \circ f^{-1}(x)$, $f^{-1} \circ f(x)$, $g \circ g^{-1}(x)$, $g^{-1} \circ g(x)$. What do you notice? {9,10}

4. Use your TI-84 for the following graphical investigation. Start by graphing $f(x)=|x|$ in a standard view window. Then program in $g(x)=x+4$ and $h(x)=x-5$, inactivate these equations. You should have the following in your equation editor on the TI-84: {9,11,12,13}







a. Find the equations for (i) $f \circ g(x)$ (ii) $f \circ h(x)$ (iii) $g \circ f(x)$ (iv) $h \circ f(x)$

b. Graph the composition $f \circ g(x)$ in your calculator as: $f \circ g(x)$ as $Y_5 = Y_1(Y_2)$. Describe what does and doesn't change in the appearance of the graph of $f(x)=|x|$.

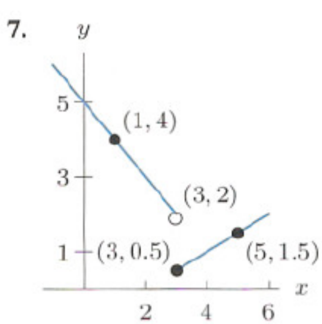
c. Graph the composition $f \circ h(x)$ in your calculator as: $f \circ g(x)$ as $Y_6 = Y_1(Y_3)$. Describe what does and doesn't change in the appearance of the graph of $f(x)=|x|$.

d. Repeat for $g \circ f(x)$ & $h \circ f(x)$.

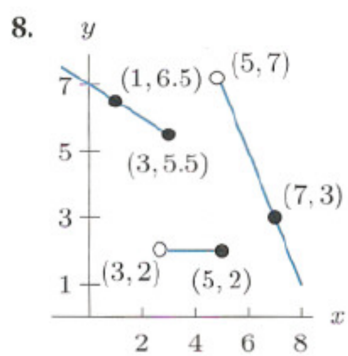
e. Summarize your observations and thus make some generalizations about the effect of composing any function with a linear function.

5. Write equations for each of the following piecewise functions: {13}

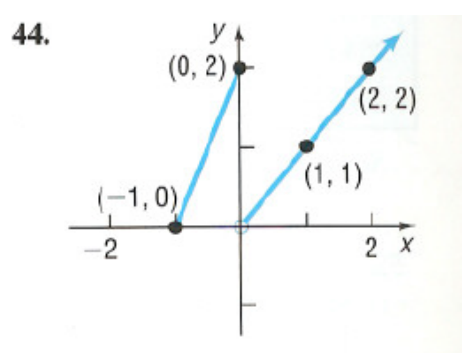
(a) Write an equation for the function



(b) Write an equation for the function



(c) Write an equation for the function



6. The following example will illustrate one way of understanding the composition given a practical context. Let's say my son Andrew is a carpenter & earns a **daily** wage of \$20/h plus \$15 for travel expenses. {5,9}

   a. Write this information as an equation. Use $W(h)$ in writing your equation. Why?
   b. Complete the Daily Wages column in the table of values below.

However, Andrew belongs to a Carpenter's Union and must pay union fees at 2.5% of his daily wages.

   c. Write an equation, relating his union fees, F, to his wages, W. So use $F(W)$ in writing your equation. Why?
   d. Complete the Union Fees column in the table of values below.
   e. Write an equation relating Union Fees to hours worked. Use $F(h)$ in your equation. Use the data table to test/verify your equation.
   f. Write a composite function equation $F \circ W(h)$. Use the data table to test/verify your equation.
   g. What do you notice about the two equations you have generated in part (e) and (f)

Hours worked	Daily Wages	Union Fees
2		
4		
6		
8		
9		
10		
12		

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