IM3 PS1.6 – Function Concepts and Linear | Unit 1 – Function Concepts with Linear

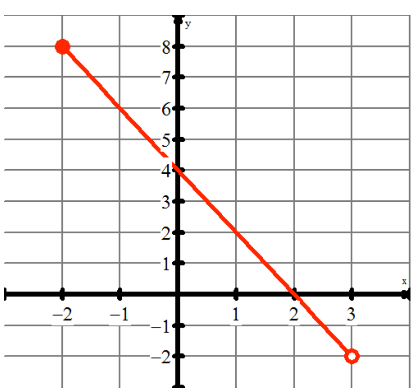
BIG PICTURE of this UNIT:	• How do we WORK WITH & EXTEND the concept of "functions" • Why are linear equations written in different forms? • How do we EXTEND our knowledge of LINEAR functions, beyond the basics of IM2?

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 **<u>spiralling through</u>** 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.

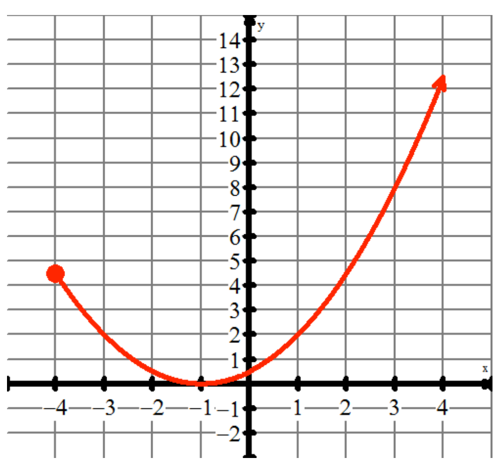
So, in your group, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for 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. State the domain and range of the following graphs. You MUST use set notation (for practice!!) and may use interval notation. {1,7}

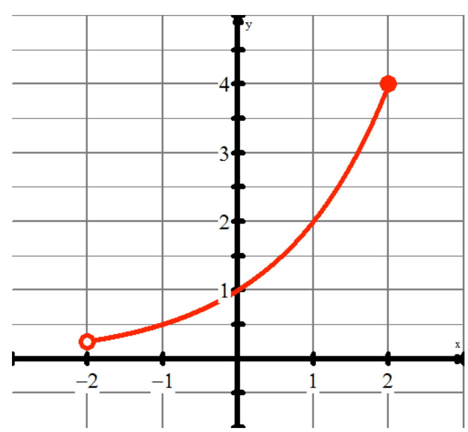
(a)



(b)



(c)



2. Solve the following equations for x: {1,8}

(a) Solve for x if $-3 = 2x + 5$

(b) Solve for x if $y = 2x + 5$

(c) Solve for x if $3x - 2 = 5$

(d) Solve for x if $3x - 2y = 5$

(e) Solve for x if $8 - 5 = 3(x - 2)$

(f) Solve for x if $y - 5 = 3(x - 2)$

3. Given the linear function $\frac{x}{5}+\frac{y}{10}=1$, determine: {3,4}
   a. The slope
   b. The intercepts
   c. Write the equation in function form.

4. A function, $f(x)$, has the following features: {1}
   - The domain of $f(x)$ is the set of **natural numbers**;
   - $f(1)=1$
   - $f(x+1)=f(x)+3x(x+1)+1$

   a. Determine $f(2)$, $f(3)$, $f(4)$, $f(5)$ and $f(6)$
   b. Describe the function.

5. Mr Santowski has a summer cottage for which he paid $120,000. Each year, the value of the house increases by $8,000. For this question, you will model how the value of the cottage is related to the years during which Mr. S owns the cottage.

   a. Write an equation to help analyze this situation. Define your variables.
   b. Determine the slope & state its meaning.
   c. Determine the *y*-intercept and state its meaning.
   d. When will my cottage double in value?
   e. What will be the value of my cottage in 5 years time?
   f. At what rate is the value of the house changing from year to year?
   g. Explain the meaning of statement $V(10) = 200{,}000$
   h. What is the *x*-intercept and what does it mean?
   i. What would be a reasonable domain for this scenario? Why

   CONCEPT EXTENSION Questions:

   j. Write an equation for the following NEW scenario ➔ After 10 years, the value of the cottage increases annually by $12,000. Now evaluate $V(15)$ and re-determine the doubling time.
   k. The $8,000 increase in the first year is percent increase of $6\frac{2}{3}\%$. If the change in value were to be modeled with an EXPONENTIAL function, determine (i) a new equation, (ii) $V(10)$ and (iii) the "doubling time"

6. Use algebraic methods to solve the following systems of equations. Algebraically as well, verify your answers. {6}

   a. $\begin{aligned} a + 3b &= 7 \\ 2a - 5b &= -8 \end{aligned}$

   b. $\begin{aligned} y - 6 &= \frac{1}{2}(x - 2) \\ \frac{x}{5} + \frac{y}{10} &= 1 \end{aligned}$

   c. $\begin{aligned} 4x + 6y &= 11 \\ y + \frac{1}{6} &= -\frac{2}{3}(x - 3) \end{aligned}$

7. A long distance calling plan charges \$1.29 for any call up to 20 minutes in length and 7 cents for each additional minute (or each part of a minute)

   a. What is the independent variable (input)? What would the domain be?
   b. What is the dependent variable (output)? What would the range be?
   c. Would you expect this relation to be a function? Why/why not?
   d. Evaluate $C(50)$ and interpret.
   e. Evaluate \$2.41 = $C(m)$ and interpret.
   f. To help draw a graph, complete the following table of values. Then graph this relation.
   g. Now, how would you write an equation for this relation?

Time (min)	0	5	10	15	20	25	30	35	40
Cost (\$)									

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

1. Use your GDC to graph the parabola $f(x) = (x - 1)^2 - 4$. Find the x-intercepts and **hence** write the equation of the parabola in factored form. {Q1}

2. To this graph of the parabola $f(x) = (x - 1)^2 - 4$, add the graph of the linear function $g(x) = 2x - 7$. So you now have a system of equations. Where do they seem to intersect? {2,18}

3. Use algebra to solve the system defined by $\begin{aligned} f(x) &= (x - 1)^2 - 4 \\ g(x) &= 2x - 7 \end{aligned}$. {6}

4. Use DESMOS to graph the parabola $f(x) = (x - 1)^2 - 4$ as well as the point (2,-3). Use DESMOS to start zooming in on the function at the point (2,-3). As you continue to zoom in: {18,19}

   a. Why does the "curve" start to appear linear?
   b. Using DESMOS, select 2 points on this "linear curve" and calculate the slope.
   c. Using DESMOS, zoom in once more, select 2 points and calculate the new slope.
   d. Using DESMOS, zoom in once more, select 2 points and calculate the new slope.
   e. You should now be able to predict what should happen if we continue to zoom into the "curve" at the point (2,-3). Make your prediction.
   f. Now, with the zoomed in graph, use DESMOS to graph the line $y = 2x - 7$.
   g. Describe your observation.