BIG PICTURE of this UNIT:	• How do we WORK WITH & EXTEND the concept of "functions" • Why are exponential equations written in different forms? • How do we EXTEND our knowledge of exponential 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 including (i) exponential functions, (ii) functions in general, (iii) linear functions, and (iv) number patterns. 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 problem sets.

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. Given the following sequence of numbers, identify the pattern present in the sequence and then use this pattern to predict the 12^{th} term of each sequence: {22}
   a. 9, 27, 81, 243, 729 , ……..
   b. 256, 64, 16, 4, ……
   c. 4, 8, 12, 16, 20, 24, …….
   d. -22.5, -33.75, -50.625, -75.9375

2. (CI) Given the function $f(x) = 2^x$, prepare a table of values (using x = -3, -2, -1, 0, 1, 2, 3) and then prepare a sketch of $f(x) = 2^x$. Label the intercept(s) and show the horizontal asymptote (include its equation). State the range if the domain was infinite: $\{x \in R\}$. Now work with the transformed function $y = f(x) - 4$ and repeat the analysis and sketch. {8,9,17}

3. (CI) Given your work in Q2 with the function $f(x) = 2^x$, prepare a data table for the inverse of $f(x) = 2^x$ and prepare a sketch of $f^{-1}(x)$. Label the intercept(s) and show the asymptote (include its equation). State the domain and range of $f^{-1}(x)$. Now, for the transformed function $y = f^{-1}(x - 4)$ repeat the analysis and sketch. {8,9,13,17}

4. The number of a certain bacteria doubles every hour. The initial population of this bacteria is 36. {11,4}

   a. Determine the number of bacteria after 8 hours.
   b. Determine an exponential model for N, the number of bacteria after t hours i.e. $N(t)$ = ???
   c. How long does it take before the population exceeds 5000 bacteria?

5. The number of a certain bacteria doubles every 2 hours. The initial population of this bacteria is 36. {11,4}

   a. Determine the number of bacteria after 8 hours.
   b. Determine an exponential model for N, the number of bacteria after t hours i.e. $N(t)$ = ???
   c. How long does it take before the population exceeds 5000 bacteria?
   d. (HL EXTENION Question) Determine the growth rate PER HOUR.

6. Evaluate each of the following (ideally without the use of a calculator) {1}

$(a)\ 2^8$ $(b)\ 3^5$ $(c)\ (-2)^4$ $(d)\ -2^4$ $(e)\ -4^2$ $(f)\ 6^0$

$(a)\ \left(\frac{1}{2}\right)^8$ $(b)\ \left(\frac{1}{3}\right)^5$ $(c)\ \left(-\frac{3}{2}\right)^4$ $(d)\ -\left(\frac{1}{3}\right)^4$ $(e)\ -\left(\frac{1}{4}\right)^2$ $(f)\ \left(\frac{1}{6}\right)^0$

$(a)\ 2^{-8}$ $(b)\ 3^{-5}$ $(c)\ (-2)^{-4}$ $(d)\ -2^{-3}$ $(e)\ -4^{-2}$ $(f)\ 6^{-1}$

7. (CI) Solve the following equations for x. {4}

(a) Solve $3^x = 27$ (b) Solve $2^x = \frac{1}{4}$ (c) Solve $5^{2x-1} = \frac{1}{125}$

Higher Level Questions for More Complex Concepts OR an EXTENSION of basic concepts involved with Exponential and Logarithmic Functions.

1. What are the domain and range of the function $g(x) = 3 \cdot 5^x - 4$?

2. (**CI**) Find all values of x such that:
   a. $5^{2x-3} = 25$
   b. $6^{3x-1} = 36^{x-3}$
   c. $2^{(16^x)} = 16^{(2^x)}$

3. (**CI**) Suppose $5^x = 3$. Find 5^{2x+3}.

4. (**CI**) Suppose $9^{x-1} = 7$, then what is 3^{2x+3}?