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 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. (CA) Determine the following: {4,11,20}
   a. Find the future value of $10,000 invested for 6 years compounded quarterly at 5% p.a.
   b. What amount must be invested NOW at 6% p.a. compounded weekly to earn $80,000 in 12 years time?
   c. If $40,000 is invested at 4.25% compounded monthly, how long does it take to triple in value?
   d. What annual rate needs to be applied if $27,500 grows to $42,000 in 10 years time?

2. (**CI**) You will analyze the function $g(x) = 4(0.5)^{x-2} - 8$ by determining: {8,9,13,19}
   a. the domain and range of this function.
   b. the equation of the asymptote of this function.
   c. the *x*- and *y*-intercepts.
   d. Sketch the function.
   e. Sketch the inverse function and hence, determine the domain, range, asymptote, intercepts of the inverse function.
   f. The function $y = g(x)$ represents a transformation of a parent function of $y = 2^x$. Explain what transformations were applied.

3. Complete the following table, wherein you will convert between FORMS, you will convert from log form to exponential form. {6}

Log form	$\log_5 25 = 2$	$\log_{\frac{1}{4}} 64 = -3$	$\log_{125} 5 = \frac{1}{3}$	$\log_2 \frac{1}{8} = -3$
Exp form				

4. GIVEN: the formula for working with compound interest ➔ $FV = PV\left(1+\frac{i}{n}\right)^{nt}$, determine the value after 1 year of a \$1 investment invested at 100% pa under the following compounding conditions:

Compounding condition	**Value of the money**
(a) 100% pa compounded annually	
(b) 100% pa compounded semi-annually	
(c) 100% pa compounded quarterly	
(d) 100% pa compounded monthly	
(e) 100% pa compounded daily	
(f) 100% pa compounded hourly	
(g) 100% pa compounded every minute	
(h) 100% pa compounded every second	
(i) 100% pa compounded n times per year	

a. FINAL QUESTIONS? ➔ BY WHAT **RATIO** HAS YOUR MONEY INCREASED IN VALUE?

b. FINAL QUESTIONS? ➔ WHAT DOES THE IDEA OF **COMPOUNDING CONTINUOUSLY MEAN**?

5. Graph the function $g(x) = \log_3(x+2)+9$ on your TI-84 and then also on DESMOS. Make a sketch and label the asymptote and the intercepts. Draw a sketch of the inverse and then use DESMOS to graph the inverse as well. Finally, determine the equation of the inverse of $g(x)$. {7,8,13}

6. A bacteria grows **continuously** according to the formula $A(t) = 5000e^{0.4055t}$, where t is time in hours. {11,20}

   a. What will the population be in 8 hours

   b. When will the population reach 1,000,000

   c. At what hourly rate does the population change? Show/explain how you determined your answer.

7. Graph and compare the following sets of exponential functions (provide sketches in your notebook)

   a. Compare the graphs of the functions $f(x) = 2^x$ and $g(x) = e^x$ and $h(x) = 3^x$.

      i. Which function increases "faster"?

      ii. Where do each of the functions have their asymptotes? Their y-intercepts?

   b. $y = e^x$ and $y = -e^x$ and $y = e^{-x}$ and $y = -e^{-x}$

   c. $y = 5 + e^x$ and $y = -5 + e^x$ and $y = 5 - e^x$ and $y = 5 - e^{-x}$

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

1. Use the summation formula $\sum_{x=0}^{n}\left(\frac{1}{x!}\right)$ and generate some terms and sums and see what happens as we progress further into the series. Start by letting n = 1, then let n = 2 and then let n = 3 ……. etc ……

2. Given the expression $\left(1+\frac{1}{x}\right)^x$, prepare a table of values wherein x is: {1,2,3,4,5,10,15,20,50,75,100,250). Now predict the value of $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.