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) functions, (ii) linear functions, (iii) exponential functions, and (iv) quadratic functions. 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. Given the following sequence of numbers, identify the pattern present in the sequence and then use this pattern to predict the 12th terms: {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 graph 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 graph the transformed function $y = f(x) - 4$. {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 garph 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 graph the transformed function $y = f^{-1}(x - 4)$. {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 Question) Determine the growth rate PER HOUR.

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

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

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

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

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

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

8. The population of a small town appears to be increasing exponentially. Town planners need a model for predicting the future population. In the year 2000, the population was 35,000, while in the year 2010, the population grew to 57,010.

    a. PREDICT: What will be the town's population in 2030?
    b. Create an **exponential** algebraic model for the town's population growth.
    c. Check your population model by using the fact that the town's population was 72,825 in 2015.
    d. CALCULATE: What will be the town's population in 2030?

9. The value of Mr. Santowski's car has been exponentially decreasing at a rate of 9% every year. My car was originally purchased four years ago for $25,000. What will be the value of this car in 2 years from now? {4,11}

10. The number of students at CAC has been exponentially increasing at a rate of 4% every year. Three years ago the student population was 750 students. How long will it take for the school population to reach 850 students? {4,11}

11. A total of $7,000 was invested at 9% p.a compounded annually. {4,11}

    a. Determine the future value of this money in 8 years time.
    b. How long does it take for this money to double in value?
    c. If the same $7,000 was earning 9% interest compounded monthly, what would the value be in the same 8 years time? Explain why this value is greater than the value from question (a).

12. Use your TI-84 to help answer these questions. Then, try to figure out HOW to come up with the answer without the use of the TI-84. {1}

$16^{\frac{1}{2}}$ $144^{\frac{1}{2}}$ $\left(\frac{1}{625}\right)^{\frac{1}{2}}$ $8^{\frac{1}{2}}$

$27^{\frac{1}{3}}$ $343^{\frac{1}{3}}$ $\left(\frac{1}{1000}\right)^{\frac{1}{3}}$ $100^{\frac{1}{3}}$

13. Use your TI-84 to help answer these questions ➔ try to figure out HOW to come up with the answer without the use of the TI-84. {1}

$8^{\frac{1}{3}}$ $8^{\frac{2}{3}}$ $8^{\frac{4}{3}}$ $8^{\frac{5}{3}}$

$27^{\frac{1}{3}}$ $27^{\frac{2}{3}}$ $27^{\frac{4}{3}}$ $27^{\frac{5}{3}}$

$16^{\frac{1}{4}}$ $16^{\frac{2}{4}}$ $16^{\frac{3}{4}}$ $16^{\frac{5}{4}}$