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. (**CI**) Given the function $f(x)=\left(\frac{1}{2}\right)^x$, prepare a table of values (using x = -3, -2, -1, 0, 1, 2, 3) and then prepare a graph of $f(x)=\left(\frac{1}{2}\right)^x$. Label the intercept(s) and show the horizontal asymptote (include its equation). State the range if the domain of $f(x)=\left(\frac{1}{2}\right)^x$ was infinite: $\{x \in R\}$. How is this graph **different** than tbe graph of $f(x)=2^x$? {8,9}

2. (**CI**) The graph of $f(x)=\left(\frac{1}{2}\right)^x$ is now translated left by 3 and down by 4. {8,9,17}

   a. List the new ordered pairs of the translated curve for $f(x)=\left(\frac{1}{2}\right)^x$.

   b. Label the intercept(s) and show the horizontal asymptote (include its equation).

   c. State the range if the domain of $f(x)=\left(\frac{1}{2}\right)^x$ was infinite: $\{x \in R\}$.

   d. Explain why Mr S knows that the equation for the new function has to be $g(x)=\left(\frac{1}{2}\right)^{x+3}-4$.

3. Evaluate the following expressions: {1}

$(a)\ 49^{\frac{1}{2}} + 16^{\frac{1}{4}}$ $(b)\ \left(16^{\frac{1}{2}}\right)^{3} + 16^{-0.5}$ $(c)\ \left(2^2 \times 5\right)^{-1}$

$(d)\ \left(\frac{3^{-1}}{2^{-1}}\right)^{-2}$ $(e)\ \left(5^0 \times 5^4 \div 5^3\right)^{-4}$ $(f)\ 4^{\frac{1}{2}} + (-8)^{\frac{1}{3}} \times \left(\frac{1}{16}\right)^{\frac{1}{2}}$

4. Use internet resources to define and thus to explain the difference between the following terms: (i) base, (ii) power, (iii) exponent. In the equation $2^3 = 8$, label the base, the power and the exponent. {2}

5. Use your TI-84 (KEY: use math 5 on your TI-84) to work through the following evaluations: {1,3}

   a. Exponents vs Roots

Exp	$8^{\frac{1}{3}}$	$16^{\frac{1}{4}}$	$20^{\frac{1}{5}}$	$100^{\frac{1}{10}}$	$8^{\frac{2}{3}}$	$50^{\frac{3}{4}}$
roots	$\sqrt[3]{8}$	$\sqrt[4]{16}$	$\sqrt[5]{20}$	$\sqrt[10]{100}$	$\left(\sqrt[3]{8}\right)^2$	$\left(\sqrt[4]{50}\right)^3$

   b. Explain what it means to take the nth root of a number.

6. What is the average annual rate of inflation if a loaf of bread cost \$1.19 in 1991 but costs \$1.50 in 2001? {4,20}

7. In 1996, the population of Germany was 84 million and the population of Egypt was 64 million. If the populations of Germany and Egypt grow at annual rates of -0.15% and 1.9% respectively, when will Egypt have a greater population than Germany? {11,20}

8. Use the Future Value (Compounding) formula $FV = PV\left(1 + \frac{i}{n}\right)^{nt}$ to answer the questions: {4,11,20}

   a. Find the future value of \$5,000 invested for 5 years compounded monthly at 8% p.a.
   b. What amount must be invested NOW at 5% p.a. compounded quarterly to earn \$10,000 in 8 years time?
   c. If \$20,000 is invested at 7% compounded semi-annually, how long does it take to double in value?
   d. What annual rate needs to be applied if \$30,000 grows to \$40,000 in 7 years time?

9. Do NOT use a calculator as you work these out {1,4,13}

Evaluate $4^{\frac{3}{2}}$ Evaluate $f^{-1}\left(\frac{1}{4}\right)$ if $f(x)=2^x$ Evaluate $f\left(\frac{3}{5}\right)$ if $f(x)=32^x$ Evaluate $f\left(-\frac{3}{2}\right)$ if $f(x)=9^x$

Evaluate $\left(\frac{16}{81}\right)^{\frac{3}{4}}$ Evaluate $g\left(\frac{3}{2}\right)=\left(\frac{1}{4}\right)^{-x}$ Evaluate $f^{-1}\left(\frac{1}{4}\right)$ if $f(x)=(-8)^x$ Evaluate $\left(\frac{-343}{1000}\right)^{\frac{2}{3}}$

10. Use GEOGEBRA to graph $f(x)=2^x$ and then perform the following transformations: {14,17,18,19}

a. Reflect $f(x)$ across the y-axis and determine the new equation of this function.
b. Reflect $f(x)$ across the x-axis and determine the new equation of this function.
c. Reflect $f(x)$ across the line y = x and determine the new equation of this function.
d. Translate $f(x)$ five units right and up 4 and determine the new equation of this function.
e. If $g(x)=x-3$, PREDICT the appearance of the graphs of: $(i)\ f\circ g(x)$ $(ii)\ g\circ f(x)$.

11. Solve the following equations: {4,10}

(a) Solve $3(2^x)=24$ (b) Solve $3-(2^x)=-29$ (c) Solve $9^{-x-2}=\left(\frac{1}{27}\right)^{x+3}$

12. (**CA**) Working with a **new base**. The number of bacteria in a culture is given by the function $N(t)=10e^{0.22t}$, where *t* is time in hours and *t* > 0. {11,20}

a. What is the initial population of the culture (at t = 0)?
b. Evaluate and interpret n(15).
c. Solve and interpret 500 = n(t).
d. What is the doubling time for this bacterial population?
e. What is the rate of growth of this bacterium population? Express your answer as a percentage.

13. Given the following sequence of numbers, identify the pattern present in the sequence and then use this pattern to predict the 10th term: {22}

a. 5, 3.75, 2.8125, 2.109375, 1.58203125 , …….. (CHALLENGE: Find the SUM of the first ten terms, first 10,000 terms, the sum of an infinite number of terms)

b. 600, 540, 486, 437.4, 393.66, …………(CHALLENGE: Find the SUM of the first ten terms, first 10,000 terms, the sum of an infinite number of terms)