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. The population of a town is modeled by the function $P(t) = 15{,}752(1.045)^t$ where t is time in years since 1990. Answer the questions below using the function given. {11,20}
    a. Is the population of the town growing or shrinking… by what percentage?
    b. Find $P(5)$. Interpret.
    c. What was the population of the town in 1990?
    d. When will the population of the town become more that 50,000?
    e. What assumptions are we making in questions (d)?

2. Answer the following investment questions: {11,20}
    a. Determine the final value of $12,500 invested at 8% p.a. compounded monthly for 5 years.
    b. How much should I invest now (at 6.25% p.a. compounded continuously) so that I have $15,000 in 6 years time?
    c. How many years does it take for an investment of $7,500 @ 3% p.a. compounded quarterly to grow to $9,750?
    d. At what rate should I invest $40,000 so that it grows to $50,000 in 5 years time? (Assume the money is compounded continuously)

3. A company is trying to expose a new product to as many people as possible through television advertising in a large city with 2 million potential viewers. A model for the number of people, N, in millions, who are aware of the product after t days of advertising was found to be $N(t) = 2\left(1 - e^{-0.037t}\right)$. {11,20}

   a. How many viewers are aware of the product after 2 days? After 10 days?

   b. How many days will it take until half of the potential viewers will become aware of the product?

4. Solve the following equations, providing both exact and approximate answers. {4,5}

   (a) Solve $2^x = -7$

   (b) Solve $2e^{3x+2} = 14$

   (c) Solve $1 + 2e^{3(x-2)} = 9$

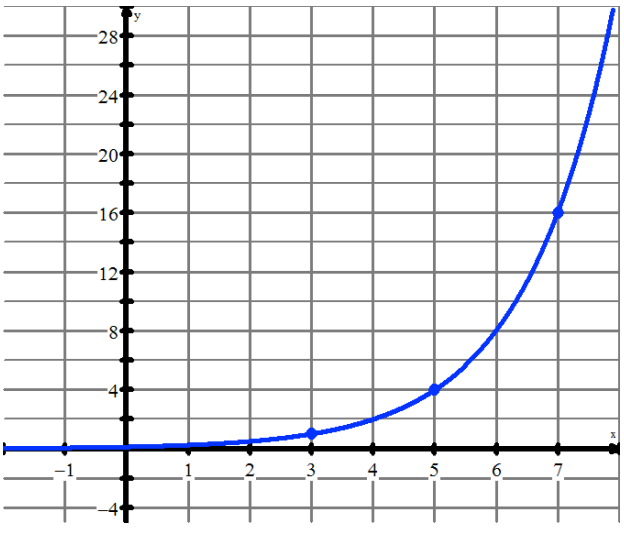
   (d) Solve $\dfrac{16}{2 + 4e^{-x}} = 4$

   (e) Solve $\dfrac{24e^{-2x}}{2 + 4e^{-2x}} = 2$

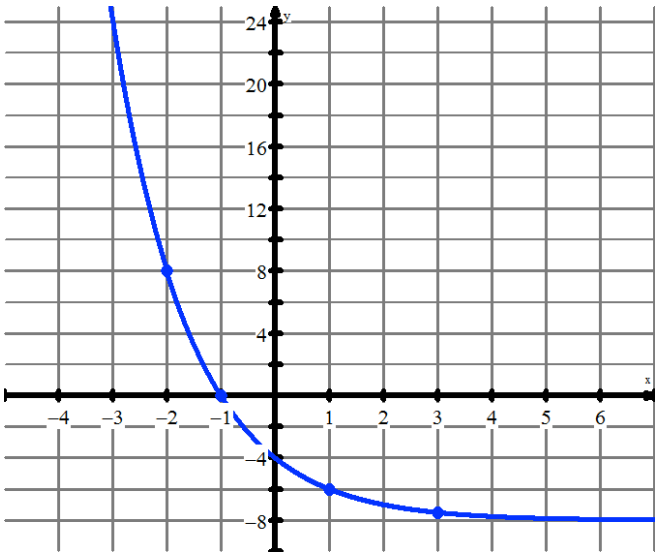
   (f) Solve $e^{\ln(x-2)} = 2$

5. Given the two graphs provided, determine the equation of each function. {6}

   (a) write the equation in the form of $f(x) = ab^x$



   (b) Write the equation in the form of $f(x) = ab^x + c$



6. Convert all log equations to equivalent exponential equations & vice versa (convert exponential equations into equivalent logarithmic equations. {6}

(i) Convert to exponential form

(a) $\log_{16} 256 = 2$

(b) $\log_9 81 = 2$

(c) $\log_2 \frac{1}{8} = -3$

(d) $\log_{25} 5 = \frac{1}{2}$

(e) $\log_{20} 400 = 2$

(f) $\log_{\frac{1}{4}} 64 = -3$

(g) $\log_5 \frac{1}{625} = -4$

(h) $\log_{169} \sqrt{13} = \frac{1}{4}$

(ii) Convert to logarthmic form

(A) $4^{\frac{1}{2}} = 2$

(B) $3^5 = 243$

(C) $14^{-2} = \frac{1}{196}$

(D) $18^2 = 324$

(E) $\left(\frac{1}{3}\right)^3 = \frac{1}{27}$

(F) $6^{-3} = \frac{1}{216}$

(G) $\left(\frac{1}{2}\right)^{-2} = 4$

(H) $32^{-\frac{3}{5}} = \frac{1}{8}$

7. (CI) Evaluate & solve the following logarithmic expressions/equations. {5,7}

Evaluate the following logarithmic expressions

$\log_3 \frac{1}{243} =$

$4 \log_2 4 =$

$\log_2 64 =$

$\log_{\frac{1}{6}} 36 =$

$2 \log_4 2 =$

Solve the following logarithmic equations

$\log_9 x = \frac{1}{2}$

$\log_5 0.04 = x$

$\log_2 \frac{1}{x} = 4$

$\log_x 2 = \frac{1}{3}$

$\log_x 256 = -4$

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

1. Pattern Set: Use your calculator to evaluate each of the following expressions in the each row and then make a summary statement

$\ln\left(e^2\right)$	$\ln\left(e^3\right)$	$\ln\left(e^4\right)$	$\ln\left(e^0\right)$	$\ln\left(e^{-2}\right)$	$\ln\left(\frac{1}{e^4}\right)$	$\ln\left(\sqrt{e}\right)$	In general?
$\ln\left(2^2\right)$	$\ln\left(2^3\right)$	$\ln\left(2^4\right)$	$\ln\left(2^0\right)$	$\ln\left(2^{-1}\right)$	$\ln\left(\frac{1}{2^4}\right)$	$\ln\left(\sqrt{2}\right)$	In general?
$\log_3 2$	$\log_3 4$	$\log_3 8$	$\log_3 16$	$\log_3 32$	$\log_3 0.5$	$\log_3 0.25$	In general?

2. (**CI**) If ln(2) = 0.69 and ln(3) = 1.1 and ln(5) = 1.6, determine the values of:

(a) ln(100) (b) ln(1.5) (c) ln(150) (d) ln(0.1)

(e) ln(135) (f) ln (1.2) (g) $\ln\left(\sqrt[3]{200}\right)$