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. So, 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 $f(x) = 8 - 2^{x+4}$; {8,9,13,16,17}

   a. Determine the domain, range, asymptote(s) and intercept(s) of $f(x)$. Sketch and label key points.
   b. The function $f(x) = 8 - 2^{x+4}$ represents a transformation of the "parent function" $y = 2^x$. Describe which transformations must be applied to $f(x) = 8 - 2^{x+4}$ to **get back to** $y = 2^x$.
   c. Determine the equation of the inverse of $f^{-1}(x)$. Sketch and label key points.
   d. (**CA**) Use your TI-84 to graph $y = |f(x)|$ (that is $y = |8 - 2^{x+4}|$. Sketch it in your notes. Explain WHY the graph now appears as it does.
   e. (**HL**) Determine the equation of $f^{-1} \circ f(x)$ and $f \circ f^{-1}(x)$. Show the key steps of your work. Expain the significance of the result.

2. Questions dealing with half-life can use a "special equation/formula". Go on line and find this formula. Use this formula to answer the following questions: {11,20}

   a. The half life of caffeine in a child's system when a child eat or drinks something with caffeine is 1.5 hours. How much caffeine would remain in a child's body if the child ate a chocolate bar with 30 mg of caffeine 8 hours before?
   b. The half-life of Carbon-14 is about 5370 years. What percentage of the original carbon-14 would you expect to find in a sample after 2500 years?
   c. Now rework these questions, wherein we now set up the scenario of **continuous changes, hence you must use the special base of e**. So, write new equations using base e to rework your solutions.

3. A hard-boiled egg has a temperature of 98 degrees Celsius. If it is put into a sink that maintains a temperature of 18 degrees Celsius, its temperature *x* minutes later is given by the formula $T(x) = 18 + 80e^{-0.29x}$. Hilda needs her egg to be exactly 30 degrees Celsius for decorating. How long should she leave it in the sink? {4,11,20}

4. There has been an accident at the local nuclear plant and a new radioactive material (Santogen) has been spilled. This radioactive material begins to decay exponentially. Assume that this decay is **continuous**. There were 1820 Bq (becquerels) of Santogen initially. Eight hours later there were 576 Bq. {11,20}

   a. What is the decay rate of Santogen?
   b. This material becomes non-leathal when there is a max of 20 Bq. When will it be safe for workers to enter the space and clear it out?
   c. Will there ever be 0 Bqs left of the Santogen material?
   d. What is the half life of Santogen?

5. Use your TI-84 to determine the value of the following logarithms: {6,7}

$\log_2 0$	$\log_2 1$	$\log_2 2$	$\log_2 3$	$\log_2 4$	$\log_2 5$	$\log_2 6$
$\log_2 7$	$\log_2 8$	$\log_2 9$	$\log_2 10$	$\log_2 11$	$\log_2 12$	$\log_2 13$
$\log_2 14$	$\log_2 15$	$\log_2 16$	$\log_2 17$	$\log_2 18$	$\log_2 19$	$\log_2 20$

Look for patterns amongst the numbers & outputs:

   a. Compare $\log_2 2$ and $\log_2 5$ and $\log_2 10$
   b. Compare $\log_2 3$ and $\log_2 4$ and $\log_2 12$
   c. Compare $\log_2 3$ and $\log_2 6$ and $\log_2 18$
   d. Can you see some patterns that will lead to some GENERALIZATIONS that would then in turn allow us to make PREDICTIONS?
      i. So, predict the value of (i) $\log_2 48$, (ii) $\log_2 36$, (iii) $\log_2 75$
      ii. So, predict the value of (i) $\log_2\left(\frac{1}{3}\right)$, (ii) $\log_2 7.5$, (iii) $\log_2 \sqrt[3]{12}$

6. Four months ago after it stopped advertising, a manufacturing company noticed that its sales per unit "*y*" had dropped each month according to the function $y = 100{,}000e^{-0.05x}$ where "*x*" is the number of months after the company stopped advertising. {4,11,20}

   a. Find the projected drop in sales per unit six months after the company stops advertising.
   b. How many months until sales per unit had dropped $50,000?

7. Solve the following logarthmic equations: {6,7}

   a. SL level (http://www.mathworksheets4kids.com/logarithms/solve-level2-easy1.pdf)
   b. HL Level (http://www.mathworksheets4kids.com/logarithms/evaluating-expressions-level2-hard1.pdf)

8. At any time $t \geq 0$, in days, the number of bacteria present, y, is given by $y = Ce^{kt}$ where k is a constant. The initial population is 1000 and the population triples during the first 5 days. {4,11,20}

    a. What does "C" represent? What is its value?
    b. Write an equation for y at any time $t \geq 0$.
    c. By what factor will the population have increased in the first 10 days?
    d. At what time, t, in days, will the population have increased by a factor of 6?

9. (**CI**) Evaluate the following: {6,7}

$\log_4 64 =$ $\quad$ $\log_2 32 =$ $\quad$ $\log_{\frac{1}{5}} 25 =$ $\quad$ $\log_{12} 144 =$ $\quad$ $\log_4 2 =$ $\quad$ $\log_{\frac{2}{3}}\left(\frac{4}{9}\right) =$

$\log_{125} 5 =$ $\quad$ $\log_9 3 =$ $\quad$ $\log_8 2 =$ $\quad$ $\log_2 \frac{1}{16} =$ $\quad$ $\log_{243} 27 =$ $\quad$ $\log_8 4 =$

$\log_2 \frac{1}{8} =$ $\quad$ $\log_9 \frac{1}{81} =$ $\quad$ $\log_3 \frac{1}{27} =$ $\quad$ $\log_{\frac{3}{5}}\left(\frac{25}{9}\right) =$ $\quad$ $\log_{27} \frac{1}{3} =$ $\quad$ $\log_{128} \frac{1}{2} =$

10. During a certain epidemic, **the number of people that are infected at any time increases at a *rate proportion to* the number of people that are infected at that time**. If 1000 people are infected when the epidemic is first discovered and 1200 are infected 7 days later, how many people are infected 12 days after the epidemic is first discovered? {4,11,20}

11. The following data represents the price and quantity supplied in 1997 for IBM personal computers. {4,11,20}

Price ($/Computer)	2300	2000	1700	1500	1300	1200	1000
Quantity Supplied	180	173	160	150	137	130	113

    a. Use your calculator draw the scatter plot. Use price as the independent variable. Label your axes.
    b. Use your calculator to fit a logarithmic model to this data.

12. Let P(t) represent the number of wolves in a population at time t years, when $t \geq 0$. The population of wolves is given by $P(t) = 800 - Ce^{-kt}$. {4,11,20}

    a. If $P(0) = 500$, find P(t) in terms of t and k.
    b. If $P(2) = 700$, find k
    c. As time increases without bound, what happens to the population of wolves? Support your answer with a graph and a written explanation.