Exponential Growth and Decay – In-Class/Take-Home Problems

You will be assessed on your knowledge, application, communication and thinking regarding exponential growth and decay through this assessment. Your task is to:

- Choose **one problem from Section 1** and **one problem from Section 2** to complete in class. You will complete the other 2 questions for HW.
- Write up (by hand) your full solutions (complete, clear and concise) on separate paper – ***no typed solutions will be accepted***.
- When explanations are involved, do not write a ton, thinking that "if I write a lot, I'll get a good mark because I'll have *something* that is probably correct." On the contrary, you would probably get a low mark because your ideas become muddled when you go on and on, and you may say something that is *incorrect* if you try to say too much. To communicate your ideas well, **think** about what you want to say before you write anything down, then **write down your thinking**, then **move on**.
- This is not a project! It's just a 2-problem in-class/take-home assessment. Focus on clearly demonstrating the *correct* work, just as you would on a homework assignment or quiz.
- You may use your book, class notes/handouts, the blog, or other online resources (like the Khan Academy videos) for help, but **you may not get help from another person** (tutor, parent, peer). If you are *absolutely stuck*, you may come see me for help. Work that is identical to that of a peer will not be assessed.

Section 1

1) According to worldbank.org (http://devdata.worldbank.org/AAG/phl_aag.pdf), the current (2010) population of the Philippines is 92 million and is growing at an average rate of 1.8% per year.
    a. Write an equation to model the population of the Philippines over time, making sure to **clearly define your *x* and *y* variables**.
    b. Use your equation to predict the population of the Philippines in the year 2030.
    c. Sketch a graph by hand to model the predicted population of the Philippines over the next 100 years. Remember to include all aspects of a **good** graph (title, labels, correct points, appropriate scale, clear and easy to read).
    d. To find out the population of the Philippines prior to the year 2010, would it work to use negative *x*-values in the equation or to look at negative *x*-values on the graph? Briefly explain why or why not, giving an example to support your thinking.

2) On her 18^{th} birthday, Sheena decides to make an investment of $3,000 into an account that pays an annual interest rate of 5.3%, **compounded monthly**.
    a. Write an equation to model the amount of money in Sheena's account over time, making sure to **clearly define your *x* and *y* variables**.
    b. Use your equation to predict how much money Sheena will have when she turns 25.
    c. Explain how the "compounded monthly" part of the problem is represented in your equation. To aid in your explanation, give an example of how your equation would differ if the interest were compounded *weekly*.
    d. Find out how many years it will take for Sheena to have $10,000 in her account. If you are using your calculator to do this, describe your thinking and general processes here so that I can assess your thinking.

Section 2

3) According to www.cheetah.org and other corroborative sources, the cheetah population has declined drastically in the last 100 years. Namibia is the country with the largest population of cheetahs today, with many people making conservation efforts there to try to help the cheetah population recover. However, "even in Namibia, the cheetah's numbers drastically declined by half in the 80s, leaving an estimated population of less than 2500 animals" (in 1990).

(a) **Copy and complete** this table to represent the trend described in quotes above. Let *y* represent the estimated cheetah population in Namibia *x* years after 1980.

x	***y***
0	
10	2500
20	
30	
40	

(b) Write an equation to model the data in the above table (keeping the same variable definitions – *be careful with this!*).

(c) **Clearly show** that your equation works by testing it with appropriate values from your table.

(d) Is the cheetah population likely to continue declining at the same rate as in the 1980s? Give a good reason to support your thinking.

1) Used cars usually depreciate (lose their value) at a rate of about 15% per year. Ben buys a used car for $9,500.

(a) Write an equation to model the value of Ben's car over time, making sure to **clearly define your *x* and *y* variables**.

(b) Use your equation to predict how much money Ben could expect to get if he sells his car after 6 years.

(c) Create a clear table of data to show the value of Ben's car over time.

(d) Do you think your equation would be a suitable model for the value of Ben's car after 10 years? What about 20 years or 30 years? At what point do you think your equation is no longer a suitable model? Briefly explain your thinking (1-2 sentences).

Example of student work that would earn full marks:

2) A deadly disease called the "Santokopp Virus" strikes a certain region with a population of about 250,000 and, within the first week, 5% of the population succumbs to the virus. A census is taken again after the second week and it is determined that another 5% of the population has died from the virus.

(a) Write an equation to model the population of the region over time, making sure to **clearly define your *x* and *y* variables**.

Let x represent the number of weeks since the outbreak of the virus, and let y represent the population of the region after x weeks.

$y = 250000\,(.95)^{x}$

(b) Use your equation to predict the population of the region after two months.

$y = 250{,}000\,(.95)^{8} \approx 166{,}000$ people

(c) Explain the meaning of each part of your equation.

The 250,000 is the initial population at the outbreak of the virus. The .95 is the percent (95%) of the population remaining after each week. The exponent (x) is the number of weeks since the outbreak of the virus.

(d) What major assumption did you make in the "K" and "A" parts above? What factors could contribute to the reasonableness of your equation and prediction?

The major assumption is that the 5% decline in the population will continue every week. The pop. will probably not decline as rapidly after the first 2 weeks, because people may learn by then how to stop the spread of the virus (like by washing hands more often).