Algebra 3 Name_____

Unit 4 test: Take Home Justification Date Assigned_____ Date due_____

This is the take home portion of the test. You will be given the same questions in class to justify with a written statement. These questions are very involved and you should spend a significant amount of time justifying your results.

Directions:

- For each of the following problems solve completely and show all of your work (Please attach any additional work to this sheet to turn in).
- Provide a written justification in the space provided using complete sentences.

1.) Plutonium-241 (Pu-241) is valuable to many countries around the world for its civilian and military purposes and currently has a price approaching $4000/g (to compare, gold has a price of $38.70). Countries often barter and trade rare materials to countries where supplies are depleted or nonexistent. You have been hired to conduct an analysis on how the value of the plutonium a facility has will change over time due to inflation (natural increases in price due to economic growth) and the natural decay of the material.

a.) Construct a function using the decay model $A = A_0 e^{kt}$ to describe the decay of Pu-241 over time.

b.) If the United States has a constant inflation of 2.5% yearly for the foreseeable future (continuous growth) construct a function that will describe how the price of an item in the United States will change over time.

c.) Using both the functions that you have described, suppose a facility has a current supply of 10kg of Pu-241 today, how much Pu-241 will be left in October of 2041 and what will be the value of their supply of Pu-241 at that time?

d.) The same company has asked you write a single function describing this relationship so that they can utilize it at any time in the future. Describe a single function that could be used to predict how much value Pu-241 will have in the future.

2.) Chemists define the acidity or alkalinity of a substance according to the formula $pH = -log[H+]$ where $[H+]$ is the hydrogen ion concentration, measured in moles per liter. Solutions with a pH value of less than 7 are acidic; solutions with a pH value of greater than 7 are basic; solutions with a pH of 7 (such as pure water) are neutral. Information about pH has to be included with a product on a Material Safety Data Sheet (MSDS) and must be readily within any workplace that uses the product.

a.) The Clorox Company has hired you to evaluate a new product to determine some basic information about it. After testing you determine that the product has a hydrogen Ion concentration of approximately 1.7×10^{-13}mols/L. Find the pH of this new substance and determine whether it is acidic or basic.

b.) During testing the company wants to market the new product as a product that is safe for use around children. The company wants you to research materials with a similar pH, and write a brief synopsis of your findings with any recommendations you have about the safety of the product. Would you recommend this product for use around children based upon the pH? Why or why not? Cite any sources you use on a separate sheet.

c.) The company wants to offer a diluted solution as a 'gentler' version of their new product. The company would like this product to have a pH of 7.6 or below. Determine what ratio of their current product and pure water (pH of 7) is required to make 1L of the new product.