Name:________________________ Section:____________________

Homework Assignment #2 (Due in Sections Week of Jan. 24)

1) Draw a cross section of the planet, including the crust, mantle, core, asthenosphere, lithosphere, and Moho. In general terms, how do we know that the interior of the earth looks like this?

2) To absolutely date something, we can use the known decay of a radioactive compound. This uses the *radioactive decay equation*, or:

$$P_t=P_0 \cdot e^{-\lambda t}$$

Where *P* is the parent isotope (*D* would be the daughter, or decay product), P_t = the amount at time *t*, P_0 is the initial amount, and λ (lambda) is the decay constant. This relationship is called an *exponential decay* function and we will come across it in many different types of oceanographic problems (for example light in the ocean, the decay of organic material with depth, absolute dating of sediments, colorimetric determination of chemicals in seawater). It is useful to get an intuitive feel for what these equations mean…so, for this problem:

a) If you start with 100 units of P, and the decay constant is 0.1/yr (so ten percent of what's left decays per year), calculate how much is left (P_t) at 0, 1, 10, 25, 50 and 100 years. Plot this on a graph as P versus time by hand (i.e don't use Excel).
b) Based on your graph, at what time do you think exactly half of the initial amount of P would be left?
c) Derive the equation for the half-life of the isotope P (start by setting the equation to $0.5=1 \cdot e^{-\lambda t}$, which means the same thing). In order to do this you must remember that $ln(e^x) = x$. Also, $-ln(1/2) = ln(2)$. This latter equation isn't necessary, but is helpful. How does your value compare to your answer for b?

3) The theory of plate tectonics was initially dismissed because scientists argued that there was no source of energy great enough to move the continents. Where does this energy come from? How long (approximately) would we expect it to last?

4) What is the approximate age of the oldest ocean rock that you could find in today's oceans, and where would you look for it?

5) How are the alignments and age distribution patterns of the Emperor Seamount and Hawaiian island chains potentially explained by hot spots? What can you deduce about the plate movement that contains the Hawaiian island chain (has it moved at constant velocity? In the same direction?)

6) Find the paper by Tarduno, J.A. et al. (2003): "The Emperor Seamounts: Southward Motion of the Hawaiian Hotspot Plume in Earth's Mantle", Science 301: 1064-1069. After reading that article, briefly describe what method or technology the authors use to test the hypothesis about plate movements that you described in question 2.