This homework is due on Monday, April 4, at class time. The assignment will be accepted until the start of class on Tuesday, April 5, with a 20% penalty. Assignments turned in after class that day will receive no credit, though I will look through them if you want me to.

1. (2 points) To make seaborgium (Z = 106), a 0.25-mg sample of californium-249 was used as the target. Four neutrons were emitted to yield a nucleus with 106 protons and a mass of 263 u. What was the bombarding particle?

2. (8 points) For each of the following, identify the new nucleus formed through the indicated process. Write the equations for each.
   a. Protactinium-231 decays through four successive alpha emissions.
   b. Bismuth-215 decays through two successive beta emissions.
   c. Lead-196 goes through two successive EC processes.

3. (6 points) Several different isotopes can be used in dating samples in addition to the well-known carbon-14. An example used in dating geological specimens is the potassium-40 isotope. It decays to argon-40 with a half-life of 1.2 billion years.
   a. Write the equation for the decay of potassium-40 to argon-40.
   b. If a sample of moon rock was dated to be 3.6 billion years old based on the level of potassium-40, what percentage of the potassium-40 was left in the sample?
   c. Explain why the measurement of potassium-40 would be a better measure of the age of this moon rock specimen than looking at the carbon-14 level, even though the specimen contained carbon-14.
4. (6 points) A very small amount of americium-241 is used in smoke detectors. Americium-241 decays to neptunium-237.

   a. Write the equation for this decay process.

   b. The half-life of americium-241 is 432 years. The typical lifetime of a smoke detector is about 10 years. Would you say the radiation level of a new smoke detector is substantially higher than that of a 10-year old smoke detector? Explain your answer.

   c. In addition to the reaction you have written above, americium-241 decay also emits low energy gamma rays. Should you be concerned about this emission in your house? Explain your reasoning.