107 Answer Key HW #10- Chapter 15 assignment

Conceptual: 2, 4, 14, 24
Problems: 2, 4

November 22, 2005

1 Conceptual Exercises

2.) "Which force is stronger between two protons separated by 10^{-10} m (the size of an atom), the electric or strong force? What evidence do you have for your answer?"

The electric force will be stronger than the strong force, because the nuclei of atoms in a solid can be about an atom's distance apart - if the strong force were stronger, then the atoms in a solid would be pulled together and wouldn't be arranged in a regular structure (as we know they are).

4.) "How many protons and neutrons are in ^{90}Sr? In ^{3}H?"

To the numbers attached to the element symbols are the amount of protons plus neutrons in the element; thus, ^{90}Sr (or Strontium-90) has 90 protons and neutrons, and ^{3}H (or Hydrogen-3) has 3 protons and neutrons. To find the number of protons, we look on the Periodic table - the atomic number of the element is the number of protons. Thus, ^{90}Sr has 38 protons (and therefore 90-38=52 neutrons), and ^{3}H has 1 proton (and therefore 2 neutr

14.) "Can a hydrogen nucleus emit an alpha particle?"

No, a hydrogen nucleus cannot emit an alpha particle, because an alpha particle carries away 2 protons and 2 neutrons (i.e. a Helium nucleus) from the nucleus, but hydrogen only has 1 proton - it doesn't have the protons to spare!

24.) "If you start with a gram of pure ^{14}C, about how much will remain after 12,000 years?"

Notice that 12,000 years is exactly 2 half-lives of Carbon-14, and after two half lives we have half of half of one gram, or .25 grams left ($1\ g * .5 * .5 = .25\ g$).

2 Problems

2.) "You start with 5 grams of ^{131}I. How long will it take the radiation to get down to 5% of its original value? (Use Figure 15.10)"

Notice that Figure 15.10, while originally made for ^{14}C, also has the horizontal axis written in terms of number of half-lives - this is what we are going to use. In terms of a fraction, 5% is .05; estimating where the blue line and .05 intersect, we find that it is approximately 4.3 half-lives. Since one half-life for ^{131}I is 8 days, it should take about $\boxed{4.3 * 8\ days = 34\ days}$ until only 5% is remaining. Notice that we didn't need to know we started with 5 grams!

4.) "The ^{14}C/C ratio in an old piece of cloth (made from natural fibers) is found to be 70% of the ratio in living organisms. How old is this piece of cloth?"

Since the ratio is 70% of what it is in normal organisms, that means that 70% of the radioactive material is remaining from the time that the fibers were used to make the cloth. Using Figure 14.10, we find that for ^{14}C it takes about half of a half-life to get to this level, or $\boxed{\text{about 3000 years.}}$