NAME _____

MMBB 380 - Fall 2007

HOMEWORK #7 - Isotopes

This homework is due at 5:30 pm on Wednesday, Nov 07.

(5,000 pts)

1. **^{14}C, ^{32}P, ^{35}S and ^{3}H are all commonly used radioisotopes in biochemistry. All are β-emitters. The nuclear reactions by which ^{14}C decays follows.**

$$^{14}C \rightarrow {}_{-1}\beta^{o} + {}^{14}N$$

a. Provide the nuclear reactions for β-decay of ^{35}S, ^{3}H, and ^{32}P.

b. With a single β-emission, how does the number of protons change?

How does the number of neutrons change?

(5,000 pts)

2. **Some klutz in your lab spilled ^{32}P on your bench and you can not remove all the radioactivity. Radiation Safety determines the level of radioactivity is exactly one million-fold (10^6) too high to be safe to work near without first covering it with a suitable layer of plastic. After exactly 190 days, you get tired of working on top of a piece of plastic and wish to remove it. How much of the radioactivity remains after exactly 190 days of decay? Would it be safe after 190 days to remove the plastic?**

(4,000 pts)

3. ^{14}C has a half-life of 5715 years.

Calculate the fraction of ^{14}C atoms that decays each year.

What fraction decays every millennium (1,000 years)?

(6,000 pts)

4. Because ^{14}C is constantly produced in the upper atmosphere of the Earth, all carbon compounds being biosynthesized in organisms contain enough ^{14}C to generate 13.0 DPM per g of carbon. After death, the carbon in an organism decays with a half-life at the standard 5715 years. You are given a biological sample from the semi-famous "Marmes Rockshelter" from outside Washtucna, WA, that produces only 3.9 DPM per g of carbon. How old is this sample (i.e. when did the organism die)? Assume that these measurements are performed very carefully and that background radiation has been subtracted. To read more about the interesting Marmes site, use the link on the class website.