PHYSICS 2102

Problem Set #5

Due: March 29, 2010

Please hand in your solutions at the start of class on the given date. Please staple all pages and attach a cover sheet with your name, student number, and the course name on it. Please show your work neatly. All Problems are from the text unless otherwise stated.

1. Consider a nucleus of uranium $^{238}_{92}$U.
   (a) Estimate the radius of the nucleus.
   (b) Estimate the mass density of the nucleus. Assume that the mass of the nucleus is $A = 238$ atomic mass units.

2. Problem 43.10.

3. Problem 43.16.

4. Problem 43.24.

5. Before 1900 the activity per unit mass of atmospheric carbon due to the presence of ^{14}C averaged about 0.255 Bq per gram of carbon. In analyzing an archaeological specimen containing 600 mg of carbon, you measure 152 decays in one hour. Determine the age of the specimen, given that it stopped taking atmospheric CO_2 out of the air when it died.

6. Use the semi-empirical binding energy formula (eq. 43.11 in text)

$$E_B = C_1\,A - C_2\,A^{2/3} - C_3\,\frac{Z(Z-1)}{A^{1/3}} - C_4\frac{(A-2Z)^2}{A}\,(\pm,0)\frac{C_5}{A^{4/3}}, \tag{1}$$

   to find the most stable atomic number Z for a nucleus with $A = 56$ nucleons. The answer should be close, but not exactly equal to, the atomic number of iron, $Z = 26$. Use the empirically determined values of C_i given in the text.

Practice problems:

Chapter 43 Problems 1, 7, 11, 13, 25, 27, 29, 33.