

Massachusetts Institute of Technology

Department of Physics

8.276 Nuclear and Particle Physics May 1, 2007

Exam 2 will be given in class on Tuesday, 5/8. It will cover the material in Problem Sets 5-9 (assigned reading through Chapter 16). It will be an open-book exam: you may refer to "Particles and Nuclei," but to no other books, notes, handouts, problem sets, or solutions.

Reading Assignment for 5/10, 5/15 and 5/17

Particles and Nuclei, Chapter 19

Problem Set #10 (due 5/10)

1. The maximum energy of the positrons emitted when a nucleus (Z, A) beta-decays to a nucleus $(Z - 1, A)$ is given by

$$Q = [M(Z, A) - M(Z - 1, A) - m]c^2$$

where M and m are the nuclear (not atomic) and electron masses, respectively. Experimentally, in the β -decay of ${}^{35}_{18}\text{Ar}$ it is found that $Q = 4.95$ MeV. Use this information to determine a value for a_c in Eq. (2.8). Compare your result with the given "typical" value.

2. The stable $A = 135$ isobar is ${}^{135}_{56}\text{Ba}$. Use this information to deduce a value of a_a in Eq. (2.8), and compare your result with the given "typical" value.

3. Using the semi-empirical mass formula show that the energy S_n required to separate a neutron from the nucleus (A, Z) is given approximately by:

$$S_n \approx a_v - \frac{2}{3}a_sA^{-1/3} - \frac{1}{4}a_a[1 - 4Z^2/A(A - 1)].$$

Estimate the mass number of the Na ($Z = 11$) nucleus which is just stable against neutron emission. Use the values of the coefficients given on page 19.