NE-104A: Nuclear Engineering Laboratory

Department of Nuclear Engineering
University of California
Berkeley

Spring Semester 2008

Problem Set 1

Assignment Date: Wednesday 1/30/08
Due: Wednesday 2/6/08 10:00

Chapter 1 of the text, p. 27, problems

1.1
1.2
1.4
1.5
1.6
1.7
1.8

Note: The required mass data for problem 1.5 can be found in the tables of Audi and Wapstra, which are included on the Isotopes Project web site. The URL for this very useful site is http://ie.lbl.gov/toi.html; the URL for the mass table is http://ie.lbl.gov/txt/awm.txt. Note that the tabulated values are the *mass excesses*, the atomic mass minus the mass number (number of nucleons). The Q value (energy release in the reaction) is equal to

$$\begin{aligned} Q &= \sum_{\text{reactants}} mass_i - \sum_{\text{products}} mass_j \\ &= \sum_{\text{reactants}} (mass\ excess + A)_i - \sum_{\text{products}} (mass\ excess + A)_j \\ &= \sum_{\text{reactants}} mass\ excess_i - \sum_{\text{products}} mass\ excess_j \end{aligned}$$

since the number of nucleons of the reactants and products are equal. All mass excesses are for the neutral atoms, and are given in units of keV (energy equivalent of the mass, $E = mc^2$).

Note also that each column of the Audi-Wapstra table contains two numbers. The first is the value, the second the uncertainty of the value. For example, the mass excess of the neutron (A=1, Z=0) is 8071.323 ± 0.002 keV.