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Problem 3.30 (R)

The nucleus C^{12} *consists of six protons* (H^1) *and six neutrons* (*n*) *held in close association by strong nuclear forces. The rest masses are*

C^{12} 12.000000 amu,

H^1 1.007825 amu,

n 1.008665 amu.

We have to calculate the energy required to separate a C^{12} *nucleus into its constituent protons and neutrons. This energy is called the binding energy of the* C^{12} *nucleus.* (*The masses are really those of the neutral atoms, but the extra-nuclear electrons have relatively negligible binding energy and are of equal number before and after the break up of* C^{12}.)

Solution:

We note that $1 \text{ amu} = 931 \text{ MeV c}^{-2}$.

Total mass of six H^1 atoms and six neutrons is

$6 \times (1.007825 + 1.008665) \text{ amu} = 12.09894 \text{ amu}.$

Therefore, energy equivalent of mass of 0.09894 amu is required for breaking up of a C^{12} nucleus into six protons and six neutrons. Its energy equivalent is 92.11 MeV.