821.

Problem 54.9 (RHK)

We have to verify that the binding energy per nucleon for ^{239}Pu *is* 7.56 MeV per nucleon. *The needed atomic masses are* 239.052158 u (^{239}Pu), 1.007825 u (^{1}H), *and* 1.008665 u (neutron).

Solution:

The atomic number of ^{239}Pu nucleus is 94. We note therefore a ^{239}Pu nucleus is a bound system of 94 protons and 145 neutrons. The total binding energy of 239 nucleons in a ^{239}Pu nucleus, which is equal to the mass defect times c^2, will, therefore, be

$$\left(94m\left(^{1}H\right)+145m_n - m\left(^{239}Pu\right)\right)\times c^2$$
$$=\left(94\times1.007825 \ +145\times1.008665 \ -239.052158\ \right)u\times c^2$$
$$=1.939817 \ uc^2 \ .$$

As

$$1\,u = 931.5 \ MeV \ c^{-2},$$

we have

$$BE_{^{239}Pu} = 1.939817 \times 931.5 \text{ MeV}$$
$$= 1,806.9 \text{ MeV}.$$

Therefore, the binding energy per nucleon in ^{239}Pu nucleus will be $= (1806.9/239) \text{ MeV} = 7.56 \text{ Mev}.$