822.

Problem 54.10 (RHK)

We have to calculate the average binding energy per nucleon of $^{62}\mathrm{Ni}$, *which has an atomic mass of* 61.9238346 u. *This nucleus has the greatest binding energy per nucleon of all the known stable nuclei*.

Solution:

The atomic number of $^{62}\mathrm{Ni}$ is 28. Therefore, $^{62}\mathrm{Ni}$ nucleus has 28 protons and 34 neutrons. We will use the following data for calculating the mass defect:

$m\left(^{1}\mathrm{H}\right)=1.007825\ \mathrm{u}$,

$m_{\mathrm{n}}=1.008665\ \mathrm{u}$,

and

$m\left(^{62}\mathrm{Ni}\right)=61.9238346\ \mathrm{u}$.

Therefore, the mass defect of $^{62}\mathrm{Ni}$ will be

$28\times m\left(^{1}\mathrm{H}\right)+34\times m_{\mathrm{n}}-m\left(^{62}\mathrm{Ni}\right)$

$=28\times 1.007825\ \mathrm{u}+34\times 1.008665\ \mathrm{u}-61.928346\ \mathrm{u}$

$=0.585364\ \mathrm{u}.$

As $1\ \mathrm{u}c^2 = 931.5\ \mathrm{MeV}$, the total binding energy of $^{62}\mathrm{Ni}$ will be

$$BE_{^{62}\mathrm{Ni}} = 0.585364 \times 931.5\ \mathrm{MeV} = 545.26\ \mathrm{MeV}.$$

Therefore, the average binding energy per nucleon of $^{62}\mathrm{Ni}$ will be $(545.266/62)\ \mathrm{MeV} = 8.79\ \mathrm{MeV}$.