CONCEPT: NUCLEAR BINDING ENERGY

Mass to Energy Conversion

- If the mass defect is known then its conversion to energy can be determined.
  - □ **Nuclear Binding Energy** (___): the energy that is __________ during the formation of an isotope.
    - Recall, the process can also be seen as energy being __________ to break up the isotope.
  - □ The ____ the nuclear binding energy, the more __________ the nucleus.

Nuclear Binding Energy

The formula for the nuclear binding energy per ___ mole of a radioisotope.

$E = \_\_\_ \bullet \_\_\_$

- □ E = Nuclear Binding Energy in J
- □ ____ = Mass Defect in kg
- □ ____ = Speed of Light as ___________ $\frac{m}{s}$
- □ ____ = $\frac{kg \bullet m^2}{s^2}$

EXAMPLE: Calculate the nuclear binding energy (in MeV/mole) of beryllium-10. The atomic mass of Be-10 is 10.0135347 amu.

STEP 0: Repeat STEPS 1 to 3 of the previous topic to calculate the mass defect of the radioisotope.

STEP 4: Plug in the values into the nuclear binding energy formula to solve for the missing variable.

Conversion Factors

$1\ amu = 1.66 \times 10^{-27}\ kg$

$1\ MeV = 1.60 \times 10^{-13}\ J$

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PRACTICE: Calcium-41 is commonly used radioisotope in the study of osteoporosis. If calcium-41 has a mass of 40.962278 amu, determine the nuclear binding energy per nucleon in MeV. (1 amu = 1.66×10^{-27} kg). (1 MeV = 1.60×10^{-13} J)

PRACTICE: Calculate the mass defect (in g/mol) for the formation of a helium-6 nucleus, and calculate the binding energy in (MeV)/nucleon. (1 amu = 1.66×10^{-27} kg). (1 neutron = 1.00866 amu 1 proton = 1.00727 amu, & 1 electron = 0.00055 amu) (1 MeV = 1.60×10^{-13} J).

$$2\,{}^{1}_{1}\mathrm{H} + 4\,{}^{1}_{0}\mathrm{n} \longrightarrow {}^{6}_{2}\mathrm{He}$$