Prove: 1 amu = 931 MeV

According to the Einstein Mass- energy equivalence,

$$E = mc^2$$

Taking, $m = 1\ amu = 1.66 \times 10^{-27}\ Kg$ and $c = 3 \times 10^8\ m/s$

$$E = (1.66 \times 10^{-2})(3 \times 10^8)^2$$

$$E = 1.49 \times 10^{-10}\ Joule$$

or, $$E = \frac{1.49 \times 10^{-10}}{1.6 \times 10^{-19}}$$

$\therefore$ $$E = 931\ MeV$$

Hence, energy equivalence to $1\ amu = 931\ MeV$

Similarly, energy equivalence of the mass of electron, proton and neutron are respectively given by,

$$m_e = 0.511\ MeV$$

$$m_n = 938.279\ MeV$$

$$m_n = 939.573\ MeV$$

Significance of Einstein's mass-energy equivalence:

- It gives a relationship between mass & energy. Thus, it shows that mass & energy can be converted into each other.
- It forms the basis of understanding nuclear reactions like Fission & Fusion.

The conversion of mass into energy can be seen in many devices like Atom Bomb, hydrogen Bomb, nuclear reactor etc.

[***But yet the Scientist has not devised a machine that can convert energy into mass.***]

MASS DEFECT (Δm):

The difference between the sum of the masses of constituent Nucleon & mass of a nucleus is called the Mass defect. The total mass of all the constituent Nucleon is always greater than the mass of the nucleus.

i.e. $Mass\ defect = sum\ of\ masses\ of\ nucleons - Rest\ mass\ of\ nucleus$

$$\Delta m = (Zm_p + Nm_n) - M$$

$$\Delta m = (Zm_p + (A - Z)\, m_n) - M$$

Where, $Z = atomic\ number$

m_p = mass of proton

m_n = mass of neutron

M = rest mass of nucleus

Significance of mass defect

The mass defect is a measure of the binding energy of the nucleus.

Larger the mass defect, larger will be the binding energy and vice versa.

BINDING ENERGY or NUCLEAR BINDING ENERGY:

The Binding energy of a nucleus is defined as the minimum energy required in splitting (breaking) a nucleus into its constituent nucleons.

It is also defined as the minimum energy required for binding the nucleons to form a nucleus.

The binding energy is the energy equivalent of mass defect (Δm).

i.e., $BE = \Delta m\, c^2$