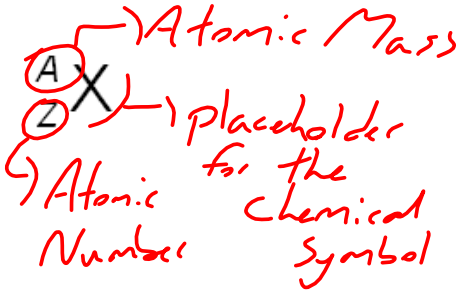
Unit IV - Nuclear Physics

Nuclear Notation



$m_p = 1.6727 \times 10^{-27}\ kg$

$m_n = 1.67949 \times 10^{-27}\ kg$

${}^{9}_{4}Be \rightarrow {}^{9}Be$

$r \approx (1.2 \times 10^{-15}) A^{1/3}$

$V = \frac{4}{3}\pi r^3 \qquad V \propto A$

$A = Z + \#n^{\circ}$

Isotopes

Isotopes are nuclides that have the same number of protons, but a different atomic mass number.

^{1}H ^{2}H ^{3}H

4) Deuterium 4) Tritium

Isotones are nuclides having the same number of neutrons

Isobars are nuclides having the same mass number (same number of nucleons)

Atomic Weights and Isotopic Composition for All Elements

Table of Isotopes (Nuclides)

Atomic mass units

For convenience, nuclear masses are often given in unified atomic mass units (u), also called simply atomic mass units.

Carbon-12 is the standard for this scale and is defined to have a mass of 12.000 000 u

$E = mc^2$

$m = \frac{E}{c^2}$

	Mass		
Object	kg	u	MeV/c^2
Electron	9.1094×10^{-31}	0.00054858	0.51100
Proton	1.67262×10^{-27}	1.007276	938.27
$^{1}_{1}H$	1.67353×10^{-27}	1.007825	938.78
Neutron	1.67493×10^{-27}	1.008665	939.57

Notice that nuclear masses for atoms are given for electrically neutral atoms (hence atomic mass given for hydrogen).

Binding Energy

$^{12}_{6}C$ 6 protons, 6 neutrons & 6 electrons

Total Mass by parts:

$6(1.007825u + 1.008665u) = 12.09894u$

Total Mass of Atom:

$12.000000u$

Mass Defect and Binding Energy

$\Delta m = 12.09894u - 12u = 0.09894u$

$E = mc^2$

$\Delta mc^2 = BE$ (total Binding Energy)

$BE = (0.09894u) \cdot 931.15 \frac{MeV}{u}$

$= 92.16\ MeV$

Binding Energy per Nucleon

$BE_{ave} = \frac{BE}{A}$, where A is the atomic mass

Binding Energy of the last Nucleon (specify neutron or proton)

Find the difference in mass before and after removing the nucleon and use that to calculate Binding Energy

Binding Energy per Nucleon