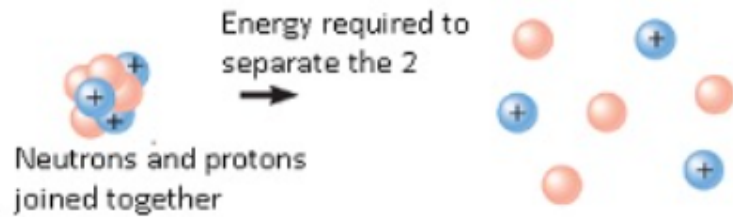


Nuclear binding energy

- Nuclear binding energy is the energy required to hold an atom's protons and neutrons together in the nucleus.
- Energy required holding neutrons and protons together therefore keeps the nucleus intact.
- It can also be defined as the energy needed to separate the nucleons from each other.



- Importance of nuclear binding energy describes how strongly nucleons are bound to each other. By determining its value we will come to know whether the neutrons and protons are tightly or loosely bound to each other.
- If nuclear binding energy is high -> high amount of energy is needed to separate the nucleons this means nucleus is very stable.
- If nuclear binding energy is low -> low amount of energy is needed to separate the nucleons this means nucleus is not very stable.

- Mass defect:-
 - Mass defect is the difference in the mass of nucleus and its constituents(neutrons and protons).
 - It is denoted by ΔM .
 - Mathematically :- **$\Delta M = [Z m_p + (A-Z) m_n] - M$**
 - Where m_p = mass of 1 proton, Z = number of protons, $(A-Z)$ = mass of neutrons, m_n = mass of 1 neutron and M = nuclear mass of the atom.
 - For example: - ($^{16}_8\text{O}$) → Oxygen atom has 8 protons and 8 neutrons.
 - Mass of 8 protons → (8×1.00866) u and Mass of 8 neutrons → (8×1.00727) u.
 - Therefore Oxygen nucleus → $(8p + 8n)$ → $8(1.00866 + 1.00727) = 16.12744$ u.
 - From spectroscopy → Atomic mass of ($^{16}_8\text{O}$) = 15.9949u.
 - Mass of 8 electrons = (8×0.00055) u.
 - Therefore Nuclear mass of ($^{16}_8\text{O}$) = $(15.9949 - (8 \times 0.00055)) = 15.99053$ u.
 - Nuclear mass is less than sum of the masses of its constituents.
 - This difference in mass is known as mass defect.
 - It is also known as excess mass.

- Relation between Mass defect and Nuclear binding energy:-
 - Nuclear binding energy is denoted by E_b .
 - **$E_b = \Delta Mc^2$**
 - Where E_b = nuclear binding energy, ΔM =mass defect.
 - As there is difference in the mass so there is energy associated with it. This energy is known as nuclear binding energy.
 - Nuclear binding energy is a measure of how well a nucleus is held together.