Energy
X-Ray complete
0-1 — Complete
Race —

Modern Physics — 2

18/09/17

* Nuclear Physics *

Nucleus:
* Discovered by Rutherford.

* **Constituents:**
neutron and Protones

* **neutron:**
chargless Particle, discovered by chadwick.

* **Protone:** Positive charge, discovered by Wold's Stern.

$M_N = 1.6749286 \times 10^{-27}$

* $M_P = 1.6726231 \times 10^{-27}$

$$\boxed{E = \Delta m c^2}$$

$R_0 = 1.1 \times 10^{-15}$ m
= 1.1 Fermi

* Radius of nucleus depends on $\boxed{R = A^{1/3} R_0}$

A ⇒ Atomic mass no
(neutron + Protone)

* **Representation of Atom**

X_Z^A

where A = no. of Protone + no. of neutron.

Z = no. of Protone.

Iso → to P → Protone.

Same

Iso tones → neutron

same

Iso bar

same. # Same.

$$D = \frac{M}{V} = \frac{A\,[M_N]}{\frac{4}{3}\pi R_0^3 A}$$

Density of all element are same

* Density of nucleus Remains Same for all the elements.

Qu: Calculate Radius of nucleus of Ge_{32}^{70}

$$R = A^{1/3} R_0$$

$$= 70^{1/3} \times 1.1 \times 10^{-15}$$

$$= R = 4.23 \times 10^{-15}.$$

Q. Calculate the electrical Pot. Energy of Putrosion due to Electric Repulsion b/w two nuclei of C^{12} when they touche each other at the surfaces.

$$\Rightarrow R = 12^{1/3} \times 1.1 \times 10^{-15} = 2.1 \times 10^{-15}$$

$$U = \frac{KQ_1Q_2}{r}$$

$$= \frac{9 \times 10^{9} \times 256 \times 10^{-38}}{24 \times 10^{-15}}$$

$$= (10 \times 10^{-14})$$

Mass Defect:

It has been observed that their is a difference b/w expected mass of the nucleus and observed mass of the nucleus. this diff. is known as mass defect.

$$\Delta m = M_{expected} - M_{observed}$$

$$\Delta m = [n_p m_p + n_n M_N] - M_{observed}$$

$$= [Z m_p + (A-Z) M_N] - M_{observed}$$

$M_{observed}$ → $(M_{observed} - nM_e)$ → Atomic mass

$\frac{h}{\lambda} = p \Rightarrow \lambda = \frac{h}{p}$ de-Broglie matter waves

* **Binding energy** :- It is the minimum energy required to break the nucleus into its constituent particles

OR.

Energy Released during the formation of nucleus is known as Binding energy.

$$\boxed{E = \Delta m c^2}$$

$\Delta m = 1\ amu = \frac{1}{12}(wt) = \frac{1}{12} C^{12} M_p$

$\boxed{E \Rightarrow 931.5\ MeV.}$ Corresponding to 1 Amu

$$= \frac{1.6 \times 10^{-27} \times 3 \times 3 \times 10^{16}}{1.6 \times 10^{-19}}$$

* Binding energy Corresponding to mass of $e^{\ominus}$ is $\boxed{0.531\ eV}$

$M_p = 1800\ M_e$.

Que: A nucleus have a Binding energy of 100 MeV it captures a neutron and releases 10 MeV energy find new Binding Energy of nucleus.

Ans:-

$100 + 10 = 110$ E Release

J-H - Comp.
0-1 ⇒ 60 upto
S-1 — cw
0-2 — st (5)

Ratio of Binding Energy per nucleon :

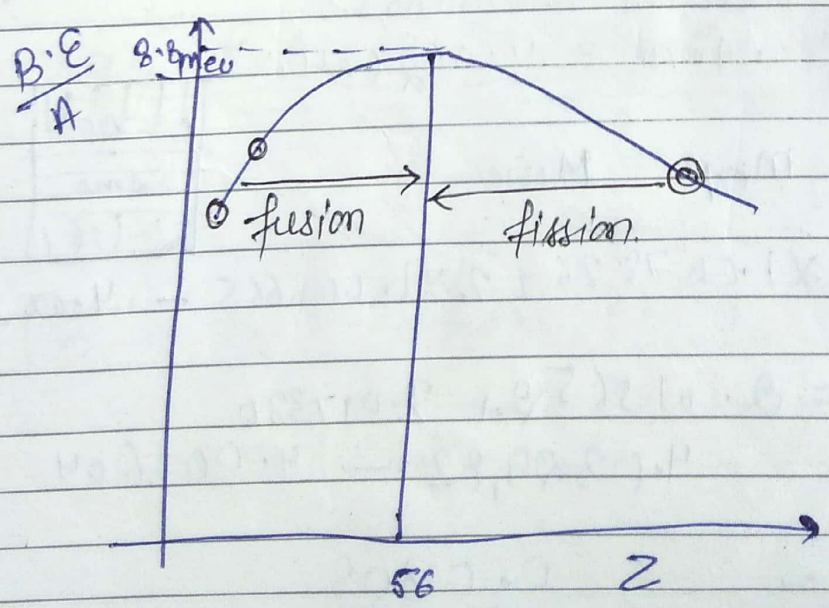
Ratio of Total Binding energy to that of mass no. (A) is known as Binding Energy per nucleon.

Binding Energy per nucleon $B.E = \frac{B.E}{A[\text{mass no}]}$

for Stability of a nucleus Binding Energy per nucleon must be high.

* Binding Energy per nucleon is maximum for Fe^{56} and it is 8.8 Mev.

It is small for Elements having less atomic no (H, He etc) therefore these elements fues to achieve stability This process is known as nuclear fusion.



* Atom having higher atomic no. also have less binding energy per nucleon therefore they break into middle size nucleus to achieve stability this process is known nuclear fission

Que: Elements B.E for 3 element P, Q, R are shown arrange them in decreasing order of stability

	P	Q	R
A	10	6	5
B.E	100	90 eV	50 eV
B.E/A	10	15	10

Ans

Stability ⇒ define

Q > P = R.

Que: Calculate the B.E of α particle from the following data

Mass of $_1H^1$ atom = 1.007826

Mass of neutron = 1.008665

Mass of Atom = 4.002604

α - 2 Proton & Neutron.

$_2He^4$

$\Delta m = m_{exp} - M_{observed}$

$= 2 \times 1.007826 + 2 \times 1.008665 - 4.002604$

$\Delta m = 2.015652 + 2.017330$

$= 4.032982 - 4.002604$

$= 0.0303$

S

931.2

8 - 8 x 56

Read

Chem. Radicaach.

$B.E = 931.2 \times 0.03$ for 1 AMU

$= 28.736.$

Que: find B.E of Iron and its B.E Per Neculen if

$^{56}_{26}Fe \rightarrow 55.9349$

Protene Mass $^{1}H \rightarrow 1.00783$

mass of neutron = 1.00867

= Ans: $26 \times 1.00783 + 30 \times 1.00867] - 55.9349$

$= 56.4636 - 55.934$

1.00783

$= 00.529.$

$\frac{B.E}{A} = \frac{0.529}{56} = 8.8$ Ans

* Energy Release in nuclear Rx^n:-

$\overset{100}{A + B} \longrightarrow \overset{120}{C + D}$

$\Delta E \; [B_C + B_D] - [B_A + B_B)$

$\Delta E = (M_{Pro.} - M_{Rea.}) c^2$