# NUCLEI

mass no° ← A
Atomic no° ← Z → X
↳ Protons (2004)

n×n → P×P → (1991)

$10^{-15}$ m (Strong nuclear force, short range).

## #Size :-

Radius ⇒ $R = R_0 (A)^{1/3}$

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

## # density :-

$\rho = \frac{m}{volume}$

independent of A

$Z \times m_p$
$(A-Z) m_n$

$m_p \approx m_n$ ;

$\rho = \frac{A m_p}{\frac{4}{3}\pi r^3}$ (2008)

$\rho = \frac{3 M_p}{4\pi r_0^3} = 3 \times 10^{17}$ kg/m³

## # Mass energy :-

$\{E = mc^2\}$

$m = Zm_p + (A-Z)m_n$

Theoritical Value

$m_{Actual} < m_{Total}$

## = Mass defect :-

$\Delta M = m_T - m_p$

= Nuclear density :
independent of A
order = $3 \times 10^{17}$

## #Binding energy

$BE = \Delta m c^2$

$BE = \Delta m \ 931.5$ MeV
(in amu)

$\Delta M = M_{expected} - M_{actual}$

$\Delta M = M_{nucleous} - M_{nucleus}$

Q.

$\Delta M = [ZM_p + (A-Z)M_n] - 14.00307$

$^{14}_{7}N$

$\Delta m = 7 \times 1.00783 + (7 \times 1.00867) - 14.00307$

$\Delta M = 0.11243$ amu Ans

## # BE = $(BE)_{Product} - (BE)_{react}$

Q. A → 7.6
B → 8.1
C → 8.1
} Per nucleon

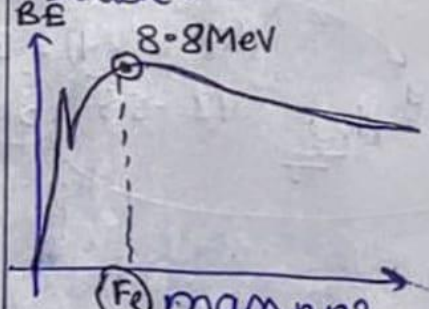
$A_{Total} = 7.6 \times 240 =$
$B_T = 8.1 \times 140 =$
$C_T = 140 \times 8.1 =$

$A^{240} \rightarrow B^{140} + C^{140} + Q$(energy)

∴ BE = 120 Ans

## #STABILITY OF NUCLEUS :-

If binding Energy per nucleon is more for nucleus than it is more stable.




most stable

## #DECCAY :-

### 1- Alpha decay :-

$^{A}_{Z}X \rightarrow ^{A-4}_{Z-2}Y + ^{4}_{2}He$

### 2- Beta decay :- $e^{\ominus}$

$^{A}_{Z}X \rightarrow ^{A}_{Z+1}Y + e^{-} + \bar{\nu}$

$n \rightarrow p + e^{-}$ anti-neutrino

### 3> $B^{+}$ Decay :- $e^{\oplus}$

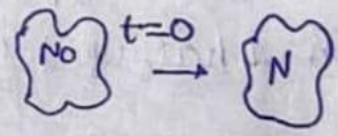
$^{A}_{Z}X \rightarrow ^{A}_{Z-1}Y + e^{\oplus} +$ Neutrino

$p \rightarrow n + e^{\oplus}$

### 4) gamma emmision

Nothing changes, only some photons moves out.

## #Radio-active Decay




$N = N_0 e^{-\lambda t}$

$\lambda$ = decay constant

*Activity of sample :-

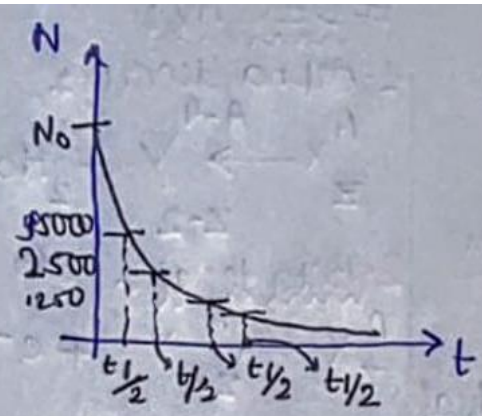
$\uparrow A = \lambda N \uparrow$

$A = A_0 e^{-\lambda t}$

* Half life :-

$T_{1/2} = \frac{0.693}{\lambda} \Rightarrow \frac{\ln 2}{\lambda}$

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$$N = \frac{N_0}{2^n}$$

$n^{th}$ half life

$$N_1 = \frac{10000}{2} = 5000$$

$$N_2 = \frac{10000}{4} = 2500$$

*Average life :

$$T_{avg} = \frac{T_{1/2}}{0.693}$$

Q:- A radioactive substance decays $1/16^{th}$ of its initial activity in 40 days. The half life of the radio active substance expressed in days is —

$$\frac{N}{N_0} = \frac{1}{16} \qquad N = \frac{N_0}{2^n}$$

40 days mein 4 half life guzar gyi.

$$\frac{N}{N_0} = \frac{1}{2^n} \Rightarrow \frac{1}{16} = \frac{1}{2^n} \quad \therefore n = 4$$

$$\frac{1}{2^4} = \frac{1}{2^n}$$

Toh 1 half life $\Rightarrow \frac{40}{4} = 10$ Ans

#Fission type questions

$$_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{144} + \ldots\ldots + 3\,{}_0n^1$$

236

$144 + 89 = 236$

$92 - 56 = 36$

$\therefore {}_{36}Kr^{89}$ Ans

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