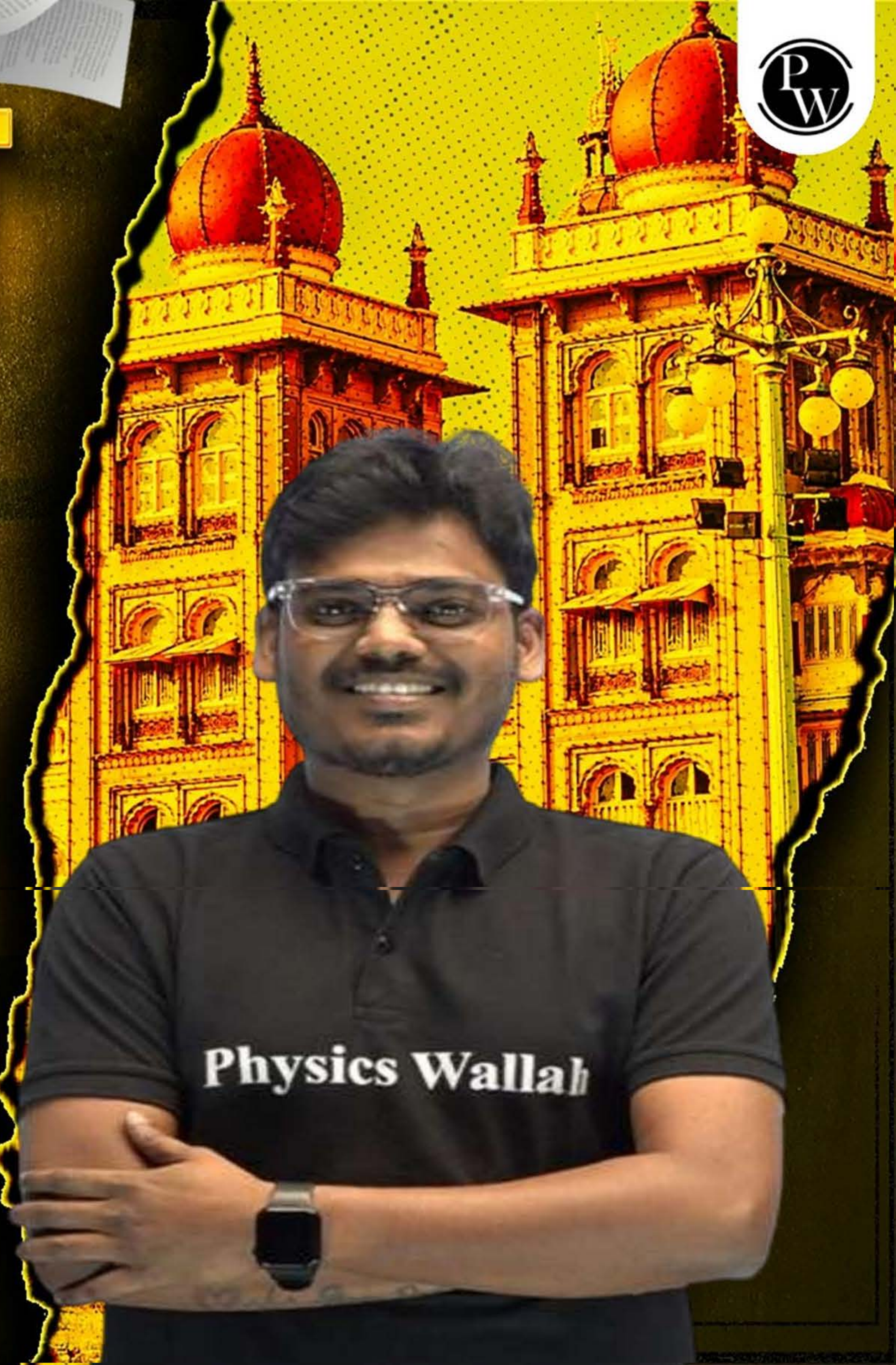
ULTIMATE KCET

CRASH COURSE 2026

PHYSICS | **Lecture :- 01**

NUCLEI

By – AK SIR



Recap *of previous lecture*

1. QUESTIONS ON PHOTOELECTRIC EFFECT
2. PARTICLE NATURE OF PHOTON
3. MATTER WAVES AND QUESTIONS
4. ATOMS

Topics *to be covered*

1. QUESTIONS ON ATOM
2. COMPOSITION OF NUCLEOUS
3. BINDING ENERGY AND B.E PER NUCLION
4. NUCLEAR FISSION AND NUCLEAR FUSION

Question

In accordance with the Bohr's model, the quantum number that characterises the Earth's revolution around the Sun in an orbit of radius 1.5×10^{11}m with orbital speed 3×10^{4} ms^{-1} is [given, mass of Earth = 6×10^{24} kg]

↑ $n = ?$

A 2.57×10^{38}

B 8.57×10^{64}

C $\boxed{2.57 \times 10^{74}}$

D 5.98×10^{86}

$$L = mvr = \frac{nh}{2\pi}$$

$$\boxed{n = \frac{2\pi mvr}{h}}$$

$$n = \frac{2 \times 3.14 \times 6 \times 10^{24} \times 3 \times 10^{4} \times 1.5 \times 10^{11}}{6.67 \times 10^{-34}}$$

$$n = 25.42 \times 10^{73}$$

$$\boxed{n = 2.54 \times 10^{74}}$$

Question

The de-Broglie wavelength associated with electron of hydrogen atom in this ground state is

$n=1$

A 0.3Å

B $\boxed{3.3\text{Å}}$

C 6.26Å

D 10Å

$2\pi r_n = n\lambda$

$2\pi r_1 = (1)\lambda$

$\lambda = 2\pi \times 0.53$

$\boxed{\lambda = 3.32\ \text{A}^\circ}$

$r_n = a_0 n^2$

$r_1 = 0.53 \times (1)^2$

$\boxed{r_1 = 0.53\ \text{A}^\circ}$

Question

$Z = 1$

Angular momentum of an electron in hydrogen atom of $3h/2\pi$ (h is the Planck's constant). The K.E of the electron is

$\hookrightarrow K.E = \frac{Ke^2}{2r}.$

$L_n = \frac{nh}{2\pi} = \frac{3h}{2\pi}$

$n = 3$

$E_n = -\frac{13.6}{n^2} = -\frac{13.6}{3^2} = -\frac{13.6}{9}$

$\boxed{E_3 = -1.51 eV}$

$K.E = |E|$

$K.E = |-1.51|$

$\boxed{K.E = 1.51 eV}$

- **A** 4.35 eV
- **B** $\boxed{1.51\ eV}$
- **C** 3.4 eV
- **D** 6.8 eV

Question

A hydrogen atom is ground state absorbs $\boxed{10.2\ \text{eV}}$ of energy. The orbital angular momentum of the electron is increased by

(A) $\boxed{1.05 \times 10^{-34}\ \text{J-s}}$

(B) 2.11×10^{-34} J-s

(C) 3.16×10^{-34} J-s

(D) 4.22×10^{-34} J-s

$E_n = -\frac{13.6}{n^2}$

$n_1 = 1$

$E_1 = -\frac{13.6}{1^2} = -13.6\ \text{eV}$

$n_2 = 2$

$E_2 = -\frac{13.6}{2^2} = -\frac{13.6}{4} = -3.4\ \text{eV}$

$\Delta E = E_2 - E_1 = -3.4 - (-13.6)$

$\boxed{\Delta E = 10.2\ \text{eV}}$

$\hookrightarrow \Delta L = L_2 - L_1$

$L_n = \frac{nh}{2\pi}$

$\Delta L = \frac{n_2 h}{2\pi} - \frac{n_1 h}{2\pi}$

$\Delta L = \frac{h}{2\pi}(n_2 - n_1)$

$\Delta L = \frac{6.67 \times 10^{-34}}{2 \times 3.14} \times (2-1)$

$\boxed{\Delta L = 1.06 \times 10^{-34}\ \text{J.s}}$

Question

When electron jumps from $n = 4$ level to $n = 1$ level, the angular momentum of electron changes by

A $h/2\pi$

B $2h/2\pi$

C $\boxed{3h/2\pi}$

D $4h/2\pi$

$$\Delta L = L_2 - L_1$$

$$\Delta L = \frac{h}{2\pi}(n_2 - n_1)$$

$$\Delta L = \frac{h}{2\pi}(4-1)$$

$$\boxed{\Delta L = \frac{3h}{2\pi}}$$

NUCLEI

KCET analysis of chapter - Marks weightage

Year	Topic
2025 (2Q)	Isobars and Nuclear force
2024(3Q)	Nuclear Volume, Nuclear fission and Radio-active decay ✗
2023(3Q)	Half-Life, Beta-decay and Q-Value ✗
2022(2Q)	Binding Energy and Nuclear reactor ✗
2021(2Q)	P.E of pair of nucleons and Nuclear reactor ✗

KCET analysis of chapter - Marks weightage

Year	Topic
2020(3Q)	Comparing nuclear force with EMW force, Beta-decay and Half-Life
2019(3Q)	Graph-Mean life, Comparing nuclear force with EMW force and Decay
2018 (2Q)	Mass-Energy equivalent and Half-life
2017(4Q)	Decay, Binding energy, Nuclear reactor and Discovery of nucleus
2016(3Q)	Half-life, Decays and Gamma emission
2015 (3Q)	Radio-active decay, Half-life and Fission

Composition of Nucleus ⟹ Rutherford

The α-scattering experiments revealed that at the centre of the atom, almost the entire mass of the atom and the positive charge are confined in a space of about 10^{-15} m whereas the size of the atom is of the order of 10^{-10} m. This extremely small sized structure was called nucleus.

Atom = 10^{-10} m = 1 $\mathring{A}$

Nucleus = 10^{-15} m

= 1 fm

Nucleons = protons + Neutrons

$$\text{Nuclide} \leftarrow {}^{A}_{Z}X$$

Element

A → Mass Number ⇒ A = Z + N

Z → Atomic Number

⇓

No. of protons.

N - No. of Neutrons

photium ← H_1^1

$^1 \rightarrow A = 1$

$_1 \rightarrow Z = 1$

Duetrium ← H_1^2

$^2 \rightarrow A = 2$

$_1 \rightarrow Z = 1$

Tritium ← H_1^3

$^3 \rightarrow A = 3$

$_1 \rightarrow Z = 1$

α. particle ← He_2^4

$^4 \rightarrow A = 4$

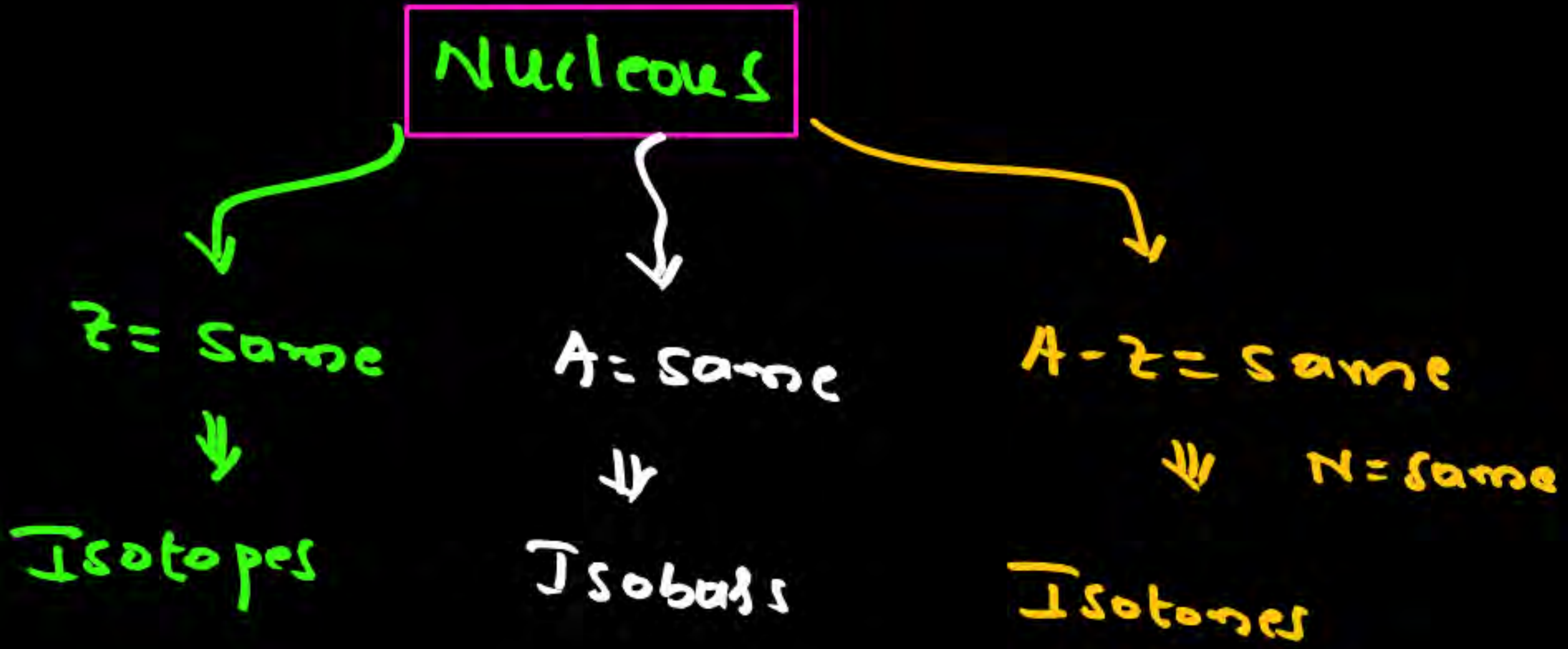
$_2 \rightarrow Z = 2$

No. of Electrons = Zero ⇒ Nucleous

No. of Electron = No. of photons

⇓

Atom



Nucleous

Z = Same ⇓ Isotopes

A = same ⇓ Isobars

A - Z = same ⇓ Isotones

N = same

Composition of Nucleus

Nucleons: Protons and neutrons which are present in the nuclei of atoms are collectively known as nucleons.

Atomic number(Z): The number of protons in the nucleus is called the atomic number of the element. It is denoted by Z.

Mass number(A): The total number of protons and neutrons present in a nucleus is called the mass number of the element. It is denoted by A.

Number of Neutrons (N) : Number of neutrons in a nucleus i.e N $= A - Z$

$$A = Z + N \Rightarrow N = A - Z$$

Composition of Nucleus

Nuclear mass: The total mass of the protons and neutrons present in a nucleus is called the nuclear mass.

$\rightarrow \boxed{M = mA}^{*}$

$A = Z + N$

$m_p \simeq m_n = m$

Nuclide: When an atom is talked of with particular reference to its nuclear composition, it is called a nuclide. Thus a nuclide is a specific nucleus of an atom characterized by its atomic number Z and mass number A.

It is symbolically represented as

X_Z^A

Where,

X = chemical symbol of the element,

Z = atomic number, and

A = mass number.

Nuclear Forces

→ Strong Nuclear.

These are the strongest attractive forces which hold protons and neutrons together in a tiny nucleus.

$r_0 = 0.8\ \text{fm} = 0.8\times10^{-15}\ \text{m}.$

$r < r_0$ → Repulsion } Next slide

$r > r_0$ → Attractive

Important Characteristics of Nuclear Forces

(i) Nuclear forces are very short range forces. They are operative up to distances of the order of a few fermi. (1 fm = 10^{-15} m)

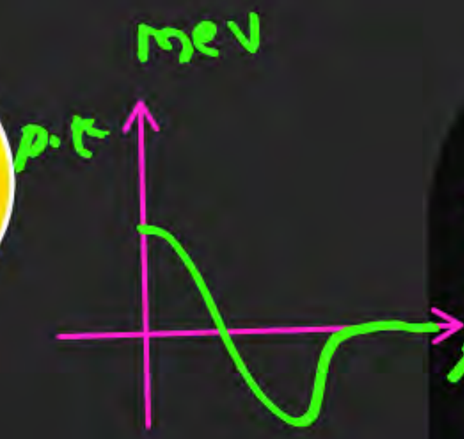
$F_{PP} = F_{PN} = F_{NN}$

(ii) Nuclear forces are independent of charge.

(iii) Nuclear forces show saturation effect, i.e., each nucleon can interact with only a limited number of nucleons very close to it.

(iv) Nuclear forces are the exchange forces, i.e., this force is due to exchange of mesons.

Nuclear Forces



$r_0 = 0.8$ fm.

$r < r_0 \rightarrow$ Repulsion $\Rightarrow$ Nuclear (F_n)

$r > r_0 \rightarrow$ Attraction

↳ Electrostatic Force (F_e)

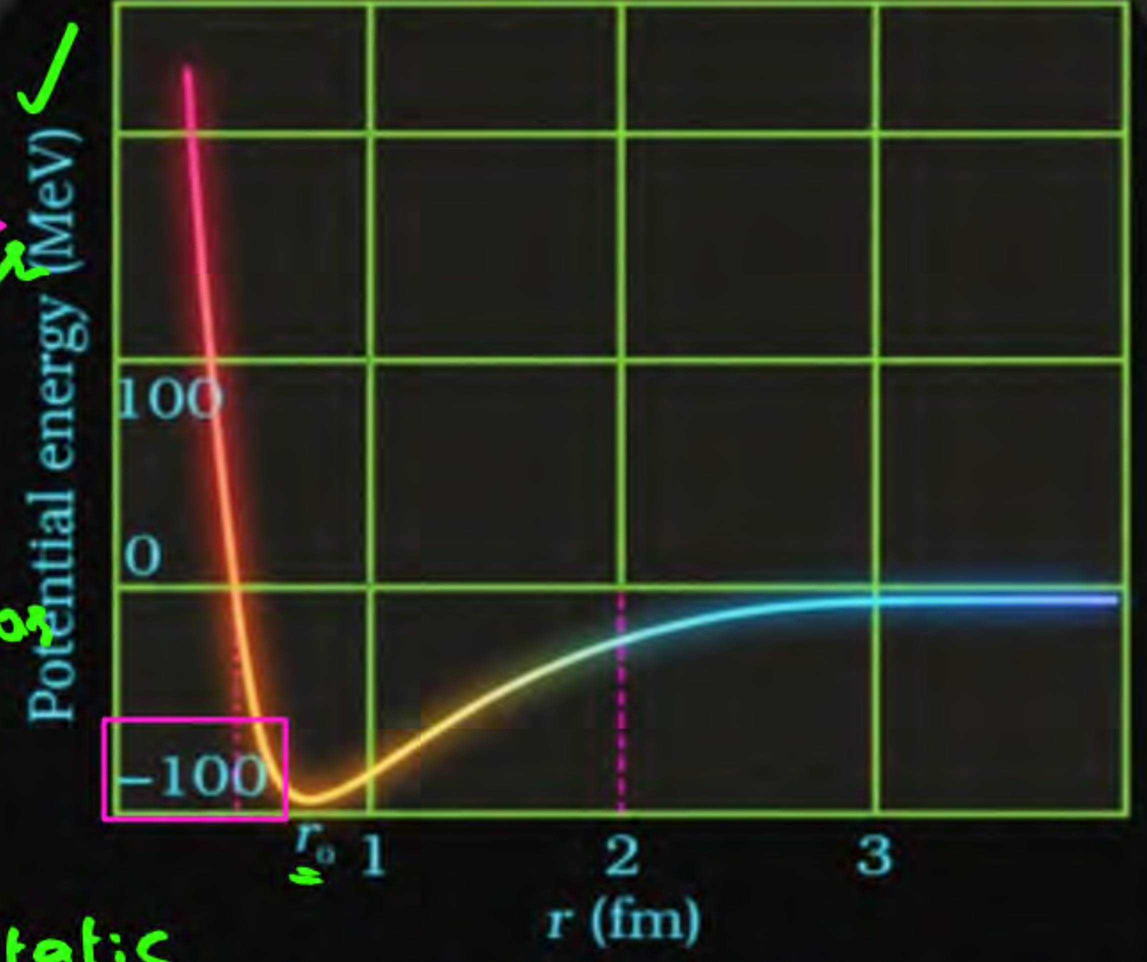


FIGURE 13.2 Potential energy of a pair of nucleons as a function of their separation. For a separation greater than r_0, the force is attractive and for separations less than r_0, the force is strongly repulsive.

Question

The scientist who is credited with the discovery of 'nucleus' in an atom is

- **A** Rutherford
- **B** Niels Bohr
- **C** Balmer
- **D** J.J Thomson

Question

Size of nucleus is of the order of

A 10^{-10} m → Atom

B $\boxed{10^{-15}\ \text{m}}$ → Nucleus

C 10^{-12} m

D 10^{-19} m

Question

Atomic number of a nucleus is Z and Atomic mass is A. The number of neutron is

$A = Z + N$

$\boxed{N = A - Z}$

A $\boxed{A - Z}$

B A

C Z

D A + Z

Question

In a nucleus is represented by $_6C^{13}$, Then number of proton and neutron in nuclei will be

$\Downarrow$

X_Z^A

$Z = 6$

$N = A - Z = 13 - 6 = 7$

A 6p and 6n

B [✓ 6p and 7n]

C 7p and 6n

D None

Question

In $_6C^{14}$ Nuclei, There are

$Z = 6$

$N = 14 - 6 = 8$

A 6p and 6n x

B 6p 8n, and $6e^-$ x

C 8p, 6p and $8n^-$ x

D None

Question

α–particle consist of

He_2^4

$Z = 2$

$N = 2$

A 2 Protons only ✗

B 2 Protons and 2 neutrons only

C 2 electrons, 2 Protons and 2 neutrons ✗

D 2 Electrons and protons only ✗

Question

A force between two protons is same as the force between proton and neutron. The nature of the force is

$F_{PP} = F_{NN} = F_{PN}$

- A weak nuclear force
- B [✓ strong nuclear force]
- C electrical force
- D gravitational force

Question

Two protons are kept at a separation of $\boxed{40\ \text{Å}}$. F_n is the nuclear force and F_e is the electrostatic force between them. Then

$r_0 = 0.8\times10^{-15}$ m

$r = 40\times10^{-10}$ m

$r > r_0 \Rightarrow$ Attractive

$\Downarrow$

F_e

$$\boxed{\begin{array}{c} F_e > F_n \\ F_n < F_e \end{array}}$$

A $F_n \gg F_e$

B $F_n = F_e$

C $\boxed{F_n \ll F_e}$

D $F_n \approx F_e$

Question

Two protons are kept at a separation of 10 nm . Let F_n and F_e the nuclear force and the electromagnetic force between them

↳ $r = 10 \times 10^{-9}$ m

$r_0 = 0.8 \times 10^{-15}$ m.

$r > r_0$ $F_e > F_n$.

A $F_e = F_n$

B $\boxed{F_e \gg F_n}$

C $F_e \ll F_n$

D F_e and F_n differ only slightly

Question

$a_0 = 0.53$ Å → Bohr's Radius

$R_0 = 1.2$ fm → proportionality

r_0 → separation b/w nucleons.

F_{pp}, F_{pn} and F_{nn} are nuclear force acting between p-p, p-n & n-n respectively, then

(A) $F_{pp} < F_{pn} = F_{nn}$

(B) $F_{pp} > F_{pn} = F_{nn}$

(C) $\boxed{F_{pp} = F_{pn} = F_{nn}}$

(D) $F_{pp} < F_{pn} < F_{nn}$

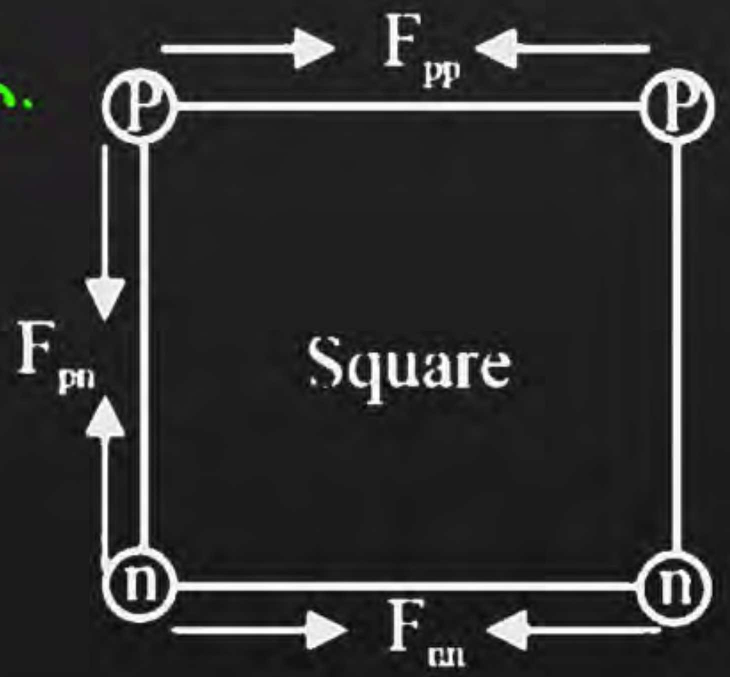
$r_0 = 0.8$ fm $= 0.8 \times 10^{-15}$ m.

$r > r_0$ → Attractive

↳ $F_e > F_n$

$r < r_0$ → Repulsion

↳ $F_n > F_e$



Question

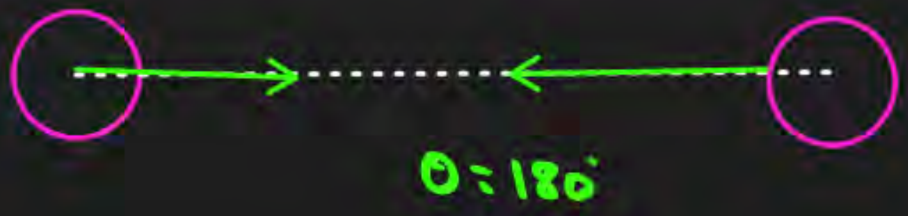
In Rutherford experiment, for head-on collision of α-particles with a gold nucleus, the impact parameter

A Zero

B of the order of 10^{-14} m

C of the order of 10^{-10} m

D of the order of 10^{-6} m



Question

Which graph in the following diagram correctly represents the potential energy of a pair of nucleons as a function of their separation?

A

B

C

D

Question

Which of the following statements is incorrect with reference to 'Nuclear force'?

$r > r_0$ → Attractive → $F_e > F_n$

$r < r_0$ → Repulsive → $F_n > F_e$

A Nuclear force is always attractive ✓

B Potential energy is minimum if the separation between the nucleons is 0.8 fm

C Nuclear force becomes attractive for nucleon distances larger than 0.8 fm

D Nuclear force becomes repulsive for nucleon distances less than 0.8 fm

Nuclear Size

The experiments show that the volume of a nucleus is directly proportional to the number of nucleons in it, which is its mass number A. Thus, if R is the radius of a nucleus, (assumed spherical), ↪ $A = Z + N$

Nuclear Radius (R):

$$\boxed{Vol \propto A}$$

$$\frac{4}{3}\pi R^3 \propto A$$

$$R^3 \propto A$$

$$\boxed{R \propto A^{1/3}}$$

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

$R_0 = 1.2\,fm$
$= 1.2 \times 10^{-15}\,m$

$M = mA$

$Area = 4\pi R^2$

Nuclear Shape & Nuclear density

Nuclear Shape: For almost all purposes, nuclei are regarded as ‘spherical’. Certain nuclei, however, deviate from sphericity, but the deviation is only about 10%.

Nuclear Density: Let m be the average mass of a nucleon and A the mass number (number of nucleons) of a nucleus. Then, the mass of the nucleus is

$$D = \frac{M}{Vol} = \frac{mA}{\frac{4}{3}\pi R^3} = \frac{mA}{\frac{4}{3}\pi (R_0 A^{1/3})^3} = \frac{3m\cancel{A}}{4\pi R_0^3 \cancel{A}} \Rightarrow * \boxed{D = \frac{3m}{4\pi R_0^3}} = \text{constant}$$

Note : It means that the density of the nuclei of all atoms is almost same.

Mass-Energy Equivalence

Einstein Mass-Energy : According to Einstein, the energy equivalent of mass Δm is given by

$$E = \Delta m c^2 \qquad c = 3 \times 10^8 \text{ m/s}$$

Trick

* $\boxed{E = \Delta m c^2}$ → mass → kg, g

* $\boxed{E = \Delta m \times 931.5 \text{ MeV}}$ → mass → u, amu

Classification of Nuclei

Isotopes: The atoms of an element which have the **same atomic number but different mass number** are called isotopes. Such atoms contain the same number of protons and electrons but different number of neutrons.

Hydrogen $^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$

Oxygen 816O, $^{17}_{8}O$, $^{18}_{8}O$

Neon 1020Ne, $^{21}_{10}Ne$, $^{22}_{10}Ne$

Chlorin 1735Cl, $^{37}_{17}Cl$

Uranium 92235U, $^{238}_{92}U$

Classification of Nuclei

Isobars: The atoms having the **same mass number but different atomic number** are called isobars. Such atoms contain different number of protons and electrons. So they differ in the chemical properties and occupy different positions in the periodic table.

Some examples of isobars are :

$^{3}_{1}\text{H}$ and $^{3}_{2}\text{He}$, as both have same $A = 3$.

$^{37}_{17}\text{Cl}$ and $^{37}_{16}\text{S}$, as both have same $A = 37$.

$^{40}_{20}\text{Ca}$ and $^{40}_{18}\text{Ar}$, as both have same $A = 40$.

Classification of Nuclei

Isotones: The nuclides having **the same number of neutrons** are called isotones.

For example,

$^{37}_{17}\mathrm{Cl}$ and $^{39}_{19}\mathrm{K}$ are isotones, as both contain the same number of neutrons i.e., for both

$$N = A - \mathrm{Z} = 20.$$

$^{198}_{80}\mathrm{Hg}$ and $^{197}_{79}\mathrm{Pu}$ are isotones, as for both

$$N = A - Z = 118$$

Question

The volume of a nucleus is directly proportional to (where A= mass number of the nucleus)

- **A** A
- **B** A^3
- **C** $\sqrt{A}$
- **D** $A^{1/3}$

$$\boxed{\begin{array}{l} \text{Vol} \propto A \\ \text{Radius} \propto A^{1/3} \end{array}}^{*}$$

Question

The energy equivalent to a substance of mass $\boxed{1\ \text{g}}$ is

- **A** 18×10^{13} J
- **B** $\boxed{9 \times 10^{13}\ \text{J}}$
- **C** 18×10^{6} J
- **D** 9×10^{6} J

$$E = \Delta m c^2$$

$$E = 1 \times 10^{-3} \times (3 \times 10^{8})^2$$

$$E = 10^{-3} \times 9 \times 10^{16}$$

$$\boxed{E = 9 \times 10^{13}\ \text{J}}$$

Question

The energy equivalent of one atomic units is

A 1.6×10^{-19} J

B 6.02×10^{23} J

C 931 MeV

D 9.31 MeV

$$E = \Delta m \times 931.5 \text{ mev}$$

$$E = 1 \times 931.5$$

$$\boxed{E = 931.5 \text{ mev}}$$

Question

$1\,\text{kwh} = 3.6\times10^{6}\,\text{J}$

The amount of energy released when one microgram of matter is annihilated is

A 25 kWh

B 9×10^{10} kWh

C 3×10^{10} kWh

D 0.5×10^{5} kWh

$\Delta m = 1\times10^{-6}\,\text{g}$

$\Delta m = 1\times10^{-6}\times10^{-3}\,\text{kg}$

$E = \Delta m c^2 = 10^{-9}\times(3\times10^{8})^2$

$E = 9\times10^{16}\times10^{-9}$

$E = 9\times10^{7}\,\text{J} = 9\times10^{7}\times1\,\text{J}$

$E = 9\times10^{7}\times\frac{1\,\text{kwh}}{3.6\times10^{6}} = 2.5\times10^{1}\,\text{kwh}$

$\boxed{E = 25\,\text{kwh}}$

Question

Match the following types of nuclei with examples shown

Column-I		Column-II	
(A)	Isotopes ⇒ Z = same	(I)	Li^7, Be^7
(B)	Isobars	(II)	$^{18}_{8}O, ^{19}_{9}F$
(C)	Isotones	(III)	$^{1}_{1}H, ^{2}_{1}H$

A [✓ A - iii, B - i, C - ii]

B ✗ A - ii, B - iii, C - i

C ✗ A - ii, B - i, C - iii

D ✗ A - i, B - iii, C - ii

Question

$$A^{1/3} = (3^3)^{\frac{1}{3}} = 3^{\frac{3}{3}} = 3$$

The ratio of volume of Al^{27} nucleus to its surface area is (Given $R_0 = 1.2 \times 10^{-15}$ m)

$$A = 27 \Rightarrow 3 \times 3 \times 3 = 27 = 3^3$$

A 2.1×10^{-15}m

B 1.3×10^{-15}m

C 0.22×10^{-15}m

D $\boxed{1.2 \times 10^{-15}\text{m}}$

$$V = \frac{4}{3}\pi R^3$$

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

$$R^3 = R_0^3 A$$

$$\boxed{V = \frac{4}{3}\pi R_0^3 A}$$

$$\text{Area} = 4\pi R^2$$

$$= 4\pi (R_0 A^{1/3})^2$$

$$\boxed{\text{Area} = 4\pi R_0^2 A^{2/3}}$$

$$\frac{\text{Volume}}{\text{Area}} = \frac{\frac{4}{3}\pi R_0^3 A}{4\pi R_0^2 A^{2/3}}$$

$$= \frac{\cancel{4}\cancel{\pi} R_0^{\cancel{3}\,1} A}{3 \times \cancel{4\pi}\cancel{R_0^2} A^{2/3}}$$

$$= \frac{R_0}{3} A^{1-\frac{2}{3}} = \frac{R_0 A^{1/3}}{3} = \frac{R_0}{\cancel{3}} \times \cancel{3}$$

$$= \boxed{R_0 = 1.2 \times 10^{-15}\,\text{m}}$$

Question

$\rightarrow A = 64 = 4 \times 4 \times 4 = 4^3$

$A^{1/3} = (4^3)^{\frac{1}{3}} = 4^{\frac{3}{3}} = 4^1 = 4$

$A^{1/3} = 4$

The radius of ${}_{29}Cu^{64}$ nucleus in Fermi is (given $R_0 = 1.2 \times 10^{-15}$ m)

- **A** 9.6
- **B** $\boxed{4.8}$
- **C** 1.2
- **D** 7.7

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

$R = 1.2 \times 10^{-15} \times 4$

$$\boxed{\begin{aligned} R &= 4.8 \times 10^{-15}\, m \\ R &= 4.8\, fm \end{aligned}}$$

Question

Ration of nuclear radius of Al^{27} and Cu^{64} will be

$$R \propto A^{1/3}$$

$$\boxed{\frac{R_{Al}}{R_{Cu}} = \frac{A_{Al}^{1/3}}{A_{Cu}^{1/3}} = \frac{(27)^{1/3}}{(64)^{1/3}} = \frac{3}{4}}$$

A 1 : 1

B $\boxed{3 : 4}$

C 4 : 3

D 9 : 8

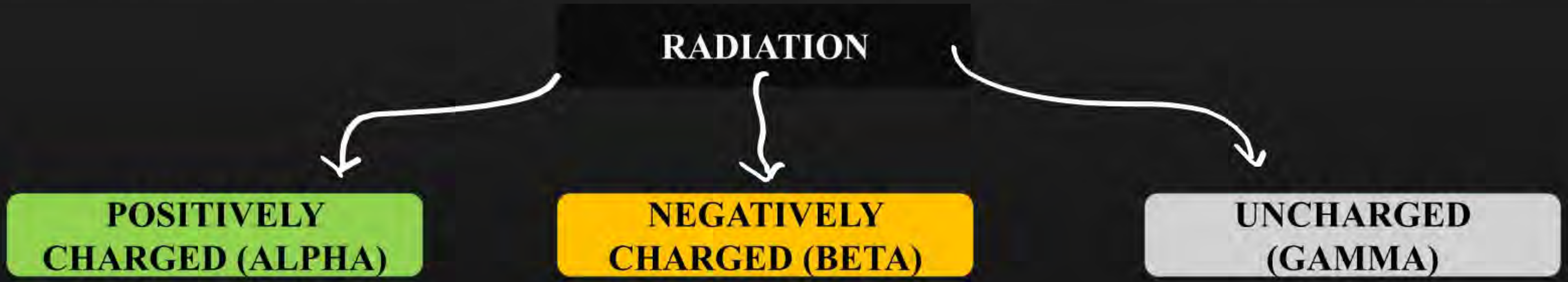
RADIATION

stable Nucleus => $N = Z$

unstable " => $N \neq Z$.

$N > Z$.

In radioactivity, **radiation** is the energy or particles (alpha, beta, or gamma) released when an unstable atomic nucleus undergoes **radioactive decay** to become more stable.



RADIATION

- **POSITIVELY CHARGED (ALPHA)**
- **NEGATIVELY CHARGED (BETA)**
- **UNCHARGED (GAMMA)**

The substances which emit these radiations were called the radioactive substances

RADIOACTIVITY

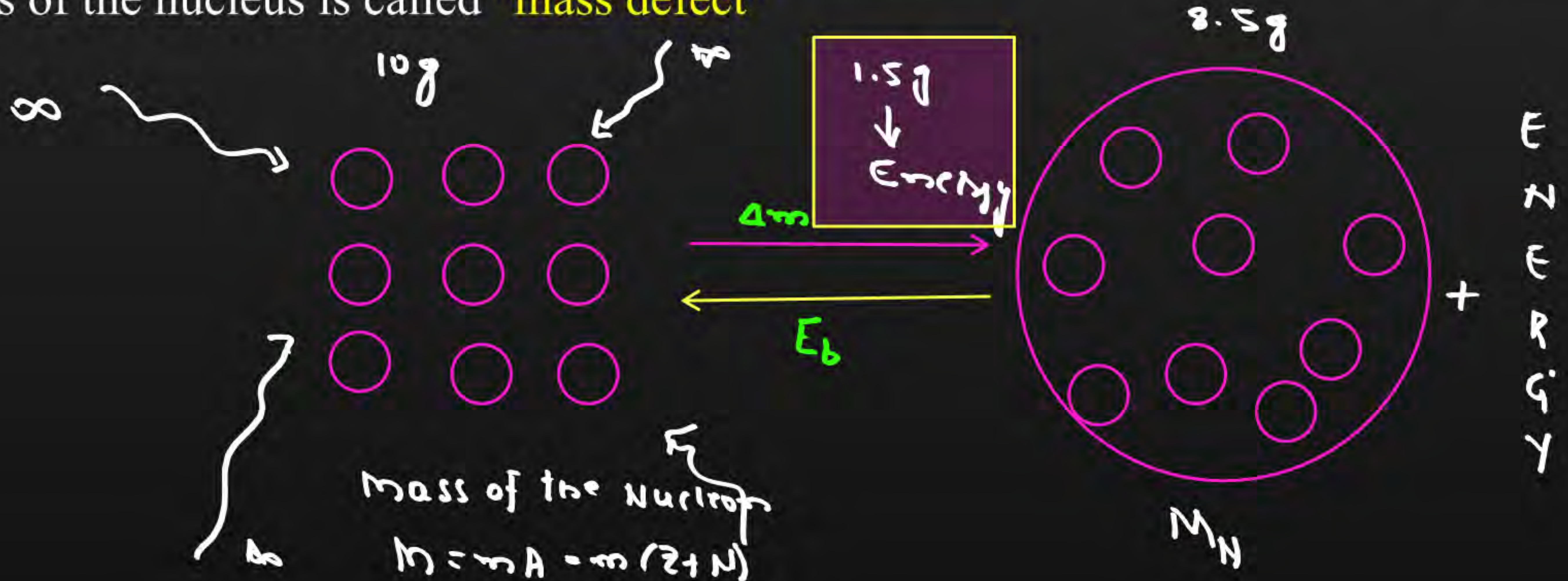
The substances which disintegrate (or decay) by the spontaneous emission of radiations, are called the radioactive substances e.g. uranium, radium, polonium, thorium, actinium, etc.

The isotopes of nearly all the elements of atomic number higher than 82 (i.e., after lead in the periodic table) are radioactive because in their nucleus, the number of neutrons is much more than the number of protons. These are called the natural radioactive substances.

MASS DEFECT

$$\boxed{\Delta m = [m_p Z + m_n(A-Z) - M_N]}$$

The difference between the sum of the masses of the nucleons constituting a nucleus and the rest-mass of the nucleus is called "mass defect"



mass of the Nucleons

$M = mA = m(Z+N)$

$M = m_p Z + m_n(A-Z)$

NUCLEAR BINDING ENERGY

The binding energy (BE) of a nucleus is defined as the minimum energy required to separate its nucleons and place them at rest at infinite distance apart.

$$E_b = \Delta m c^2 = [m_p Z + m_n(A-Z) - M_N] c^2 \rightarrow \text{Kg, J}$$

$$\left.\begin{aligned} E_b &= \Delta m \times 931.5 \text{ meV} \\ E_b &= [m_p Z + m_n(A-Z) - M_N] \times 931.5 \text{ meV} \end{aligned}\right\} \rightarrow \text{u, amu.}$$

NUCLEAR BINDING ENERGY PER NUCLEON

It is defined as the average energy required to remove a nucleon from the nucleus to infinite distance.

Note : Higher the binding energy per nucleon, greater is the stability of the nucleus.

$$\frac{E_b}{A} = \frac{\Delta m c^2}{A} \text{ or } \frac{E_b}{A} = \frac{\Delta m \times 931.5}{A}$$

BINDING ENERGY CURVE

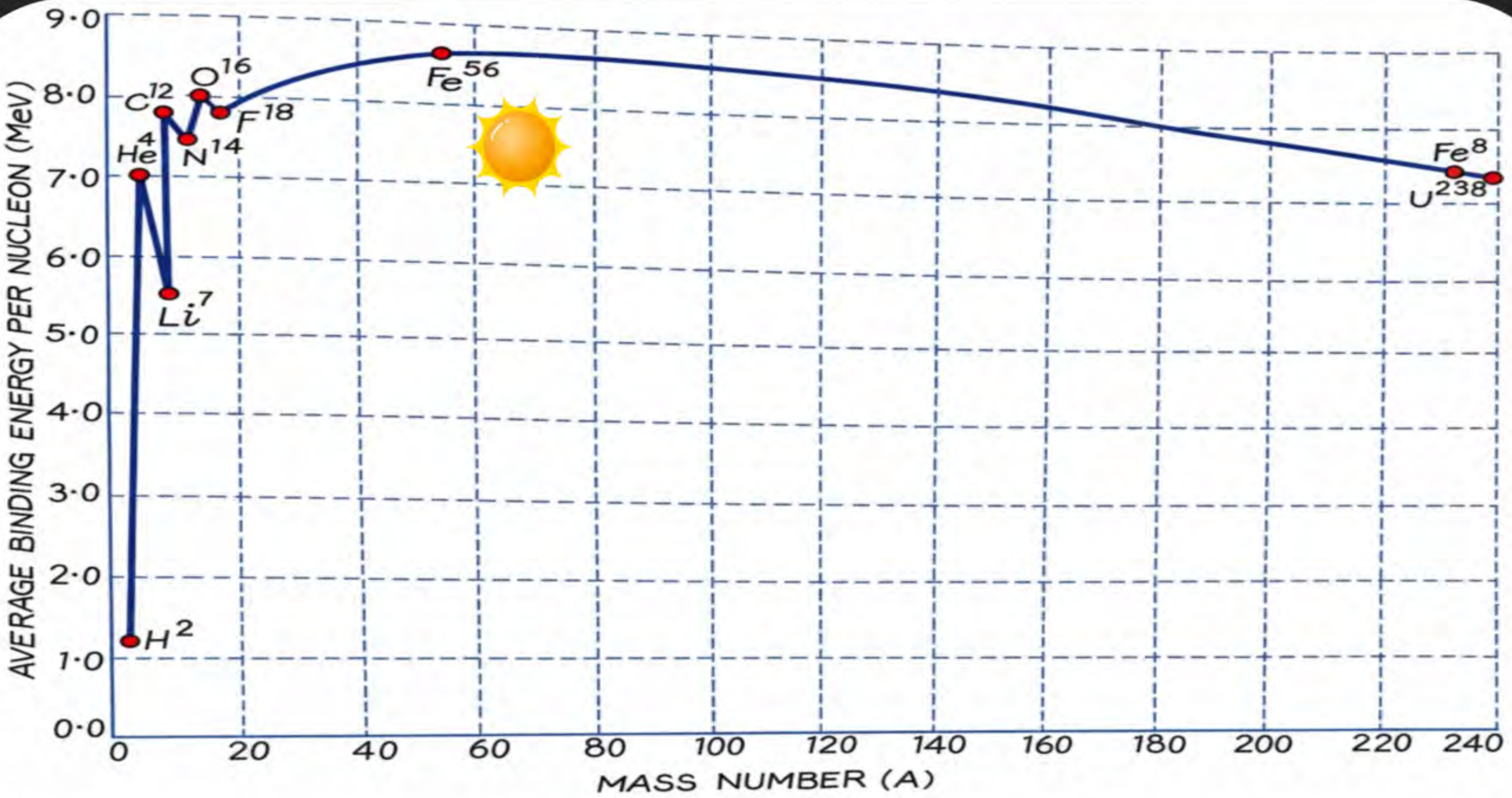


Fig. 3

BINDING ENERGY CURVE

Binding Energy Curve: A graph between the average binding energy per nucleon and the mass number A of different nuclei is a curve, called binding energy curve.

- The curve has almost a flat maximum, roughly from A = 50 to A = 80 corresponding to an average BE / nucleon of about 8.5 MeV. So, the nuclei having mass number between 50 and 80 are most stable. Iron (Fe^{56}) (A = 56), having a BE / nucleon of about 8.8 MeV has maximum stability.
- (ii) For nuclei having mass number above 80, the average BE / nucleon decreases slowly and drops to about 7.6 MeV for uranium (U^{238}). The lower value of binding energy per nucleon fails to overcome the Coulombian repulsion among protons in nucleus having large number of protons. This is why the nuclei of heavier atoms, beyond Bi^{209} are radioactive.

BINDING ENERGY CURVE

(iii) For nuclei having mass number below 50 also, the average BE / nucleon decreases and below 20, it decreases sharply. For example, for heavy hydrogen (H^2), it is only about 1.1 MeV. This shows that the nuclei having mass number below 20 are comparatively less stable.

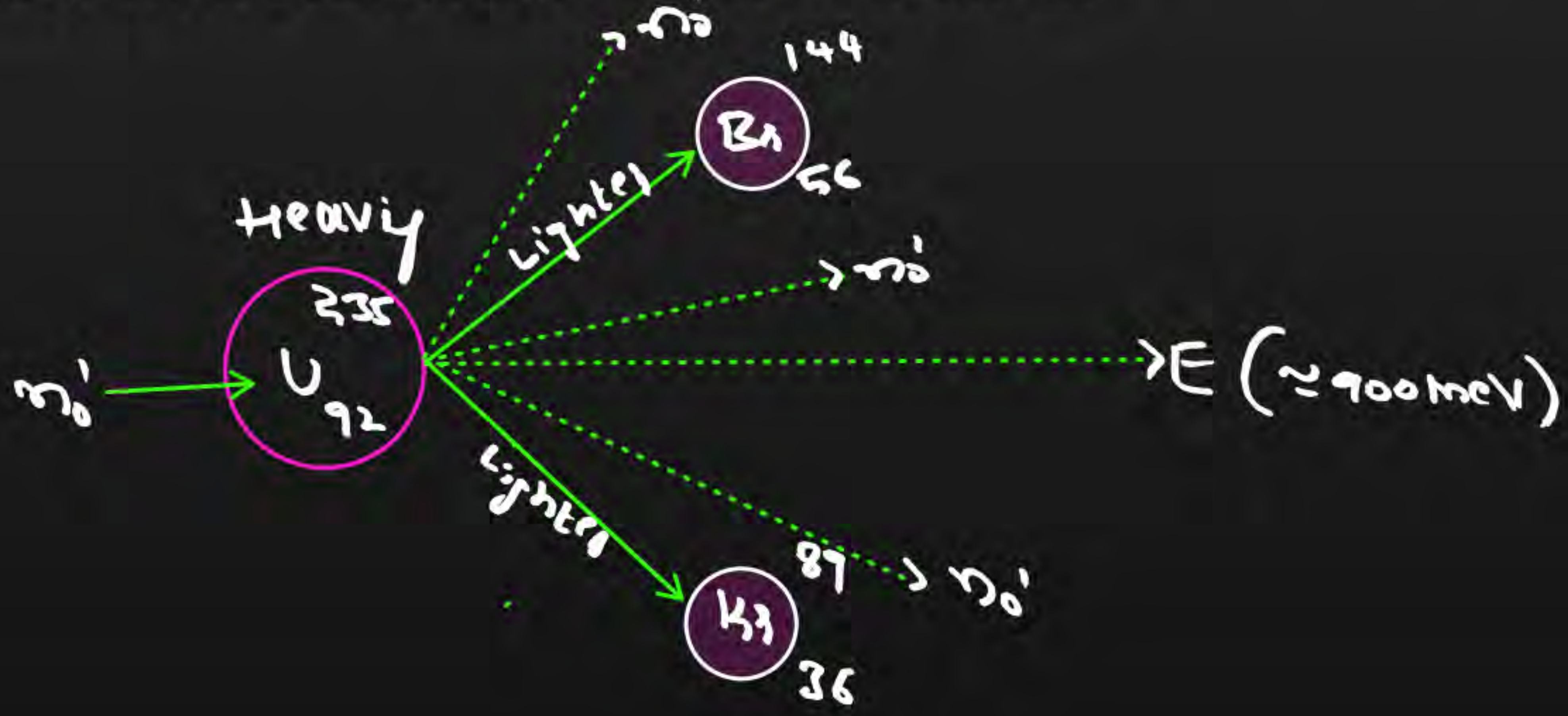
(iv) Below A = 50, the curve does not fall continuously, but has subsidiary peaks at O^{16}, C^{12} and He^4. This shows that these (even-even) nuclei are more stable than their immediate neighbours.

NUCLEAR FISSION

$n_0^1 + U_{92}^{235} = U_{92}^{236}$

↳ separate $U_{92}^{236} \xrightarrow{\quad} Ba_{56}^{144} + Kr_{36}^{89} + 3n_0^1 + E(\simeq 900 mev)$

Nuclear fission is the process in which a heavy nucleus splits into two lighter nuclei of nearly the same size, when bombarded with slow neutrons



Liquid drop Expt

NUCLEAR FUSION

→ stars → solar radiation.

↳ Together.

Nuclear fusion is the process in which two light nuclei combine to form a heavy nucleus.

$$\boxed{H_1^2 + H_1^2 \longrightarrow H_2^3 + n_0^1 + E} \; (\approx 30\,\text{mev})$$

Light Nuclei

↓ Heavy Nucleus

→ 2 Light Nuclei

→ Force of repulsion

→ High Heat Energy / High temperature

→ Increase in K.E & overcome force of repulsion

Question

Binding energy of a nitrogen nucleus[$^{14}_{7}$N], given m [$^{14}_{7}$N] = 14.00307u

A 85 MeV

B 206.5 MeV

C 78 MeV

D 104.7 MeV

$m_p = 1.00727$

$m_n = 1.00865$

$$E_b = [Z m_p + (A - Z) m_n - M_N] \times 931.5$$

$$E_b = [7 \times 1.00727 + (14-7) \times 1.00867 - 14.00307] \times 931.5$$

$$= [7.10727 + 7.06069 - 14.00307] \times 931.5$$

$$\boxed{E_b = 104.7\ \text{MeV}}$$

Question

The mass defect of ${}_{2}^{4}He$ is 0.03 u . The binding energy per nucleon of helium (in MeV) is

A 6.9825

B 27.93

C 2.793

D 69.825

$$\frac{E_b}{A} = \frac{\Delta m \times 931.5}{4} = \frac{0.03 \times 931.5}{4}$$

$$\boxed{\frac{E_b}{A} = 6.9825}$$

Question

Solar energy is due to

A Fusion reaction

B Fission reaction

C Combustion reaction

D Chemical reaction

Question

Nuclear-Fission is best explained by:

A Liquid droplet theory

B Yukawa π-meson theory

C Independent particle model of the nucleus

D Proton-proton cycle

Question

Energy is released in nuclear fission due to:

A Few mass is converted into energy ✗

B Total binding energy of fragements is more than the B.E. of parental element

C Total B.E. of fragements is less than the B.E. of parental element

D Total B.E. of fragements is equals to the B.E. of parental element ✗

Question

Which of the following are suitable for the fusion Process

- **A** Light nuclei
- **B** Heavy nuclei
- **C** Element must be lying in the middle of the periodic table
- **D** Middle elements, which are lying on binding energy curve

Question

Solar energy is mainly caused due to:

A Burning of hydrogen in the oxygen

B Fission of uranium present in the Sun

C Fusion of protons during synthesis of heavier Element

D Gravitational contraction

Question

If in a nuclear fusion process the masses of the fusing nuclei be m_1 and m_2 and the mass of the resultant nucleus be m_3, then:

A $m_1 = |m_1 - m_2|$

B $\boxed{m_3 < (m_1 + m_2)}$

C $m_1 > (m_1 + m_2)$

D $m_3 = m_1 + m_2$

Question

Fusion reaction takes place at high temperature because:

- **A** Nuclei break up at high temperature
- **B** Atoms get ionised at high temperature
- **C** Kinetic energy is high enough to overcome the coulomb repulsion between nuclei
- **D** Molecules break up at high temperature

Thank

You