ATOMIC STRUCTURE

TOPICS

① Atomic Number (Z)

② Mass Number (A)

③ Calculation of At. No (Z), Mass No. (A), e^-, p^+, n.

④ Isotopes

⑤ Isobars.

⑥ Examples of Isotopes & Isobars.

⑦ Bohr's Theory.

ATOMIC NUMBER (Z) & MASS NUMBER (A) OF ELEMENTS

ELEMENTS	ATOMIC NO. (Z)	MASS NO (A)
Hydrogen (H)	1	1
Helium (He)	2	4
Lithium (Li)	3	7
Beryllium (Be)	4	9
Boron (B)	5	11
Carbon (C)	6	12
Nitrogen (N)	7	14
Oxygen (O)	8	16
fluorine (F)	9	19
Neon (Ne)	10	20
Sodium (Na)	11	23
Magnesium (Mg)	12	24
Aluminium (Al)	13	27
Silicon (Si)	14	28
Phosphorus (P)	15	31
Sulphur (S)	16	32
Chlorine (Cl)	17	35
Argon (Ar)	18	40
Potassium (K)	19	40
Calcium (Ca)	20	40

ATOMIC NUMBER (Z) & MASS NUMBER (A)

ATOMIC NUMBER

① DEFINITION :— "The number of protons present in the nucleus of the atom of an element is called its Atomic Number."

OR

"The number of protons or electrons present in an atom is known as Atomic Number."

② It is denoted by letter 'z'

③ Atomic No. = No. of e^- = No. of p^+.

$$Z = e^- = p^+$$

MASS NUMBER (A)

① DEFINITION :—

"The Total number of protons & neutrons present in the nucleus of an atom is called its Mass No. (A)."

② Nucleons :— Protons plus Neutrons collectively called nucleons present in the nucleus.

③ It is denoted by letter (A).

④ Mass No. (A) = No. of protons + No. of neutrons.

⑤ No. of neutrons = Mass No. (A) — Atomic No (Z).

$$A = p + n$$
$$n = A - Z$$
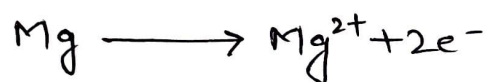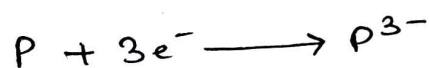
Q. Calculate the mass of 1 mole of neutrons.

A Mass of neutron = 1.675×10^{-27} kg

Mass of 1 mole of neutron = $1.675 \times 10^{-27} \times 6.023 \times 10^{23}$

$$= 1.0088 \times 10^{-3} \text{ kg}.$$

Q The At. No and Mass No. of Calcium are 20 & 40 respectively. find out the number of e^-, p^+, n in Ca^{2+} ion.

Q. The atom of an element contains 11 electrons. Its nucleus has 12 neutrons. What will be the Atomic mass of the element?

Q Calculate the no. of e^-, p^+, n in each of the following-

① H_3PO_4 ② NH_4^+ ③ ClO_3^-

A ① H_3PO_4

Mass No (A) of — $H = 1$, $P = 31$, $O = 16$

Total Mass No. of $H_3PO_4 = 3 \times 1 + 31 + 4 \times 16$

$$= 98.$$

Total At. No. of $H_3PO_4 = 3 \times 1 + 15 + 4 \times 8$

$$= 50$$

$$Z = p^+ = e^-$$
$$50 = 50 = 50$$

$$n = A - Z$$
$$= 98 - 50 = 48$$

NH$_4^+$ (Ammonium Ion).

Total At. No. of NH$_4^+$ = 7+4×1 = 11

Total Mass No. of NH$_4^+$ = 14+4×1 = 18

p^+ (protons) = 11

Z (At. No) = 11

n = A - Z = 18 - 11 = 7

e^- = 11 - 1 = 10

③ ClO$_3^-$

Z = 17 + 3×8

= 17 + 24 = 41

A = 35 + 3×16

= 35 + 48

= 83

Z = p^+ = 41

e^- = 41 + 1 = 42

n = A - Z

= 83 - 41

= 42

Q Calculate the total no. of e- in 1 mole of NH$_3$.

A 1 mole of NH$_3$ contains →
1 mole of N & 3 mole of H

Each N atom contains 7 e's.
"   H   "   "   1 e^-

No. of e's in 1 mole

= 7 × 6.023×10^{23} + 3 × 6.023 ×10^{23}

= 6.023×10^{23} (7+3)

= 6.023×10^{23} × 10

= 6.023 × 10^{23+1}

= 6.023 × 10^{24}
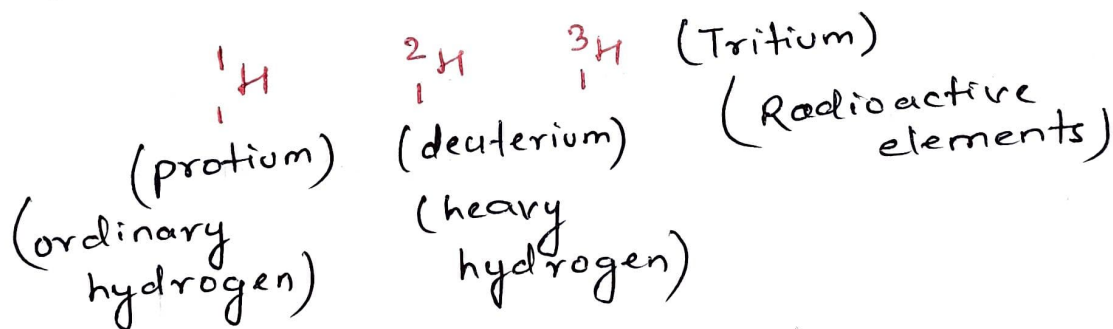
ISOTOPES AND ISOBARS

ISOTOPES :-

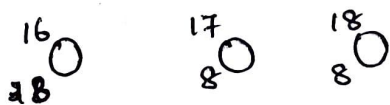① **DEFINITION :-** Isotopes are atoms of the same element having same Atomic no. but different mass no.s.

② Isotopes of an element have the same Atomic no. because they contain same no. of proton (p^+).

③ Isotopes of an element have different mass no. because they contain different no. of neutrons.

④ Mass No. (A) increases if no. of neutrons increases
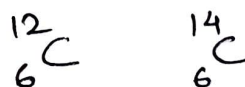   " (A) decreases " " " " decrease

A ↑se	n ↑se
A ↓se	n ↓se

⑤ **Examples :-** (a) Isotopes of Hydrogen

^1_1H ^2_1H ^3_1H (Tritium)

(protium)   (deuterium)   (Radioactive elements)

(ordinary hydrogen)   (heavy hydrogen)

(b) Isotopes of Oxygen

$^{16}_{8}O$ $^{17}_{8}O$ $^{18}_{8}O$

(c) Isotopes of Carbon

$^{12}_{6}C$ $^{14}_{6}C$

(d) Isotopes of Chlorine.

$^{35}_{17}Cl$ $^{37}_{17}Cl$

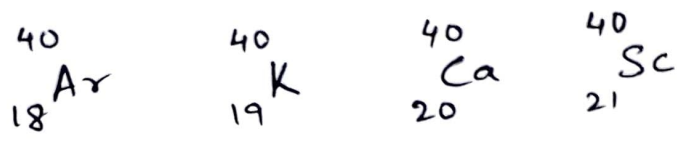(e) Isotopes of Neon.

$^{20}_{10}Ne$ $^{21}_{10}Ne$ $^{22}_{10}Ne$
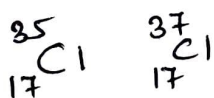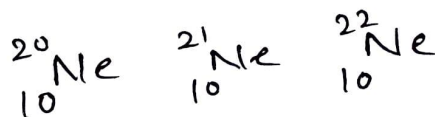
ISOBARS

DEFINITION:- "Isobars are the Atoms of different element having different At·No (Z) but same Mass No (A)."

② Examples:-

$$^{40}_{18}Ar \qquad ^{40}_{19}K \qquad ^{40}_{20}Ca \qquad ^{40}_{21}Sc$$

Q. Which of the following are isotopes of sulphur
[At· No. of Sulphur = 16]

$$^{40}_{18}Ar \quad , \quad ^{35}_{17}Cl \quad , \quad ^{40}_{20}Ca \quad , \quad ^{37}_{17}Cl \quad , \quad ^{40}_{19}K .$$

Q. Which of the following are isotopes of sulphur.
[At· No. of S = 16]

(a) 16p + 16n   (c) 19p + 16n

(b) 16n + 17p   (d) 16p + 17n

A.

Z of S = 16

A of S = 32

n = 32 − 16 = 16

e⁻ = 16

p⁺ = 16

Q.

Q. Which of the following elements are Isotopes of which are Isobars?

$$^{40}_{18}Ar \ , \quad ^{35}_{17}Cl \ , \quad ^{40}_{20}Ca \ , \quad ^{37}_{17}Cl \ , \quad ^{40}_{19}K$$

A. Isotopes → $^{35}_{17}Cl$, $^{37}_{17}Cl$

Isobars → $^{40}_{18}Ar$, $^{40}_{20}Ca$, $^{40}_{19}K$.
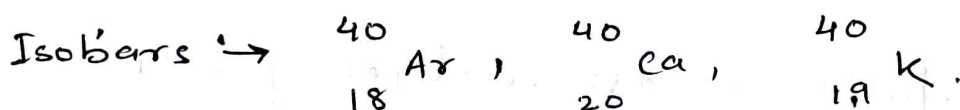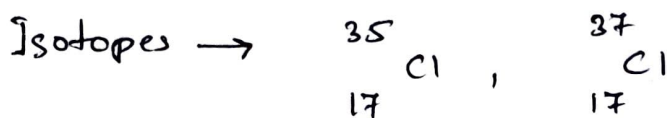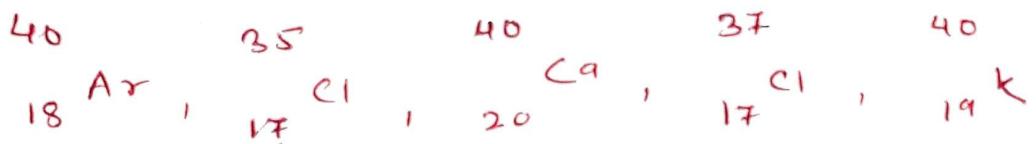
Q. From the following nuclei, choose the Isotopes & Isobars.

(a) $8p + 8n$

(b) $8p + 9n$

(c) $18p + 22n$

(d) $20p + 20n$.