Structure of Atom

- Thomson's model
- Rutherford's model
- Bohr's model of atom
- Neutron
- valency
- Atomic no & Atomic mass
- Isotopes & Isobars.

Matter → Smallest particle → atom

Dalton's Atomic Theory

1895 — balloon blown it → wall

Magnets NP ↔ SP, NP ←→ NP

Plastic comb - charged body — Atom is indivisible

Charges — Plastic comb — matter — atoms.

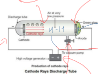
Atom → Neutral ($e^- = p^+$) — ↑ atom is divisible

Hair → matter $e^- = p^-$

Balloon → $e^- = p^-$

↳ initially neutral, after rubbing -vely charged.

Discovery of Electron — Thomson



H_2 gas; Metal plated; Fluorescent coating (ZnS); Discharge tube or Transparent glass; Conducting wire; Charged particles; H.V. Battery ← 10,000V; 1mmHg (10^{-3} mmHg)

Cathode — -vely charged

Anode — +vely charged

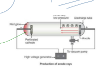
Valence shell — attractive force energy

Anode ray Expt | Canal ray Expt — Goldstein

↑ Discovery of proton

H_2 → e^- → H^+ (Very heavy) → positive ion

Neutral $e^- = p^+$



- e^- mass negligible — 2000 times heavier
- Proton mass = 1.67×10^{-22} kg

charge unit — Coulomb

$e^- = -1$, $p^+ = +1$ } charge

Thomson's Atomic Model

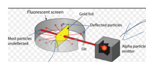
✓ It had been well established that atom contains -vely charged particles (i.e. electrons) & to maintain electrical neutrality of the atom, positive charges were also present within the atom.

Qs. How these -ve charges & positive charges are distributed within the atom.

J.J. Thomson, in 1904, proposed that an atom was a sphere of +ve electricity in which were embedded no of electrons sufficient to neutralize the +ve charges.

Plum pudding

Rutherford Model of atom / Gold-foil experiment



Lead box (Lead) — For shooting α particles; Gold foil

α-particles → charged particles

loses an e^- — +vely charged; Gains an e^- — -vely charged

He → 2

$2p^+$, $2n$, $2e^-$ (Initially Neutral) → He^{2+} ↑ α particle

Physics — accn — Speed is constant

accn — change in velocity (Mag + direction)

atom would be highly unstable

Bohr's model of the atom

11th

discrete orbits — Distinct.

Postulates of Bohr's

2 properties ← Radius, Energy

Energy ↑ move outwards from the nucleus.

K, L, M — Atom

Arrangement of e^-s & proton
↳ Thomson's model
↳ Gold foil expmt ↳ Rutherford
↳ Bohr's model

Atom is divisible

Discovery of Neutrons

Cathode ray expmt → electrons → J J Thomson

Anode ray expmt → proton → Goldstein

Neutrons
Chadwick

doesn't have any charge but had mass

light materials

e^-, proton, Neutron
↑
doesn't have any charge mass

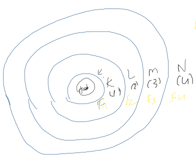
mass → $^{0}_{-1}e$ ← charge $^{1}_{1}p$ $^{1}_{0}n$

	Charge on the particle	Mass of the particle	Symbol
Electron	−1 unit (-1.602×10^{-19} coulomb)	9.11×10^{-31} kg	$^{0}_{-1}e$
Proton	+1 unit (1.602×10^{-19} C)	1.67×10^{-27} kg (1u)	$^{1}_{1}p$
Neutron	No charge	(1.602×10^{-19}) (1u)	$^{1}_{0}n$

Distribution of Electrons

✓ Electronic configuration of element — Distribution or arrangement of the electrons in the different shells of the atom.

✓ How we can make stable by arranging electrons



As $E_1 < E_2 < E_3 < E_4$

✓ $2n^2$ rule → Shell's capacity to accomodate e^-s.
↑
Shell can accomodate only fixed no of electrons

$K = 2 \times (1)^2 = 2$
$L = 2 \times (2)^2 = 8$
$M = 2 \times (3)^2 = 18$
$N = 2 \times (4)^2 = 32$

(ii) The maximum number of electrons that can be accommodated in the outermost orbit is 8.

↳ Pauli Exclusion Principle

11th Std

For the stability

Na − 11 e^-

K	L	M
2	8	1

Calcium − 20 $20e^-$

K	L	M	N
2	8	8	2

M (6) → N (2)

Always follow octet rule & duplet rule. H^1, He^2

K
Potassium → (19) 19e^-

K	L	M	N
2	8	8	1

Ca → 20

K	L	M	N
2	8	8	2

Valence Electron & Valency

↳ electrons present in outermost shell

H = 1, C = 4, Cl → 17

K	L	M
2	8	(7)

Valence e^-s participate in chemical reaction

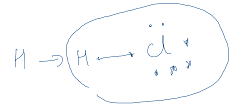
Valency — Combining capacity of an element.
↳ Valence e^-s.

→ The number of electrons gained, lost or shared by the atom of an element so as to complete it's octet (or duplet) is called valency of the element.

Why atom is combining?
Stability
To complete it's octet

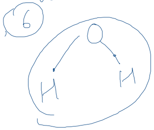
$_{17}Cl$ → 2, 8, (7) $1e^-$
$_{11}Na$ → 2, 8, (1)

NaCl
Na & Cl both octet got completed

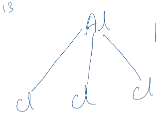


e^- sharing happend.

O → 2, (6) Va



$_{13}Al$: 2 8 (3)



$AlCl_3$

Valency — Valence e^-s 1, 2 or 3
Valency = Valence e^-s

Valence e^-s 4, 5, 6 or 7
Valency = 8 − no of valence of e^-s.

(9) Happy Hen lives behind boring car near office.

Na — New Sodium; Mg — Mango; Al — Als; P — Phosphorus; Sulphur; Cl — Chalo; Ar — Air; K — port; Ca — Cal (calcium)

Atomic number

Atom's number.

Why we are assigning atom a number?

118 elements

Can I assign a no of e^- as atomic no?

No of e's: C = 6, O = 8

Atomic No — No of protons present in the nucleus of the atom of that element.

In Neutral atom → Atomic no of element = No of protons in the nucleus = No of electrons in the extranuclear part

Properties of atomic no

(i) → Atomic no is always a whole no. (because of protons).

(ii) All atoms of same element have same no of protons & hence same atomic no.

(iii) No two element will have same atomic nos.

(iv) Represented by symbol 'Z'.

Mass number

Atom → Proton, Neutron, electron

Mass no of an element = No of Proton + No of Neutron

Nucleons → Proton & Neutron

Mass no = No of proton + No of neutron

$A = p + n = Z + n$

or

$n = A - Z$

Symbol: Mass number A, element X, Atomic number Z ($^{A}_{Z}X$)

In Neutral atom: Atomic no = No of Proton = No of electrons

$Z = p^+ = e^-$

Q) $Z = 9$, $A = 19$, Calculate e, p, n in the neutral atom & in the ion formed by it. Represent ion, give electronic config. Name the element.

e, p = 9

Neutron = 19 − 9 = 10

F^-: K L — 2 7; valency = 1

e = 10, p = 9, neutron = 10

Atomic no of Al is 13 & A = 27, Calc. e, p, n & the ion formed, Represent the ion, what will be it's valency?

P 15, 2, 8, 5 (3)

(1) → Superscript

(2) → Subscript

Al: Z = 13 = P = e

Neutron 27 − 13 = 14

Al → K L M: 2 8 3 → Al^{3+}

α and He^{2+} → Helium is cation

2p = 2e

anion

He^{2+} Donating

e^-, p^+ & neutron

Na, A = 23

Atomic No is 11

e = 11

What type of ion will be formed by it?

✓ How you will represent it?

✓ Valency of sodium?

$A = p + n$

$23 = 11 + n$

$n = 23 - 11 = 12$

$^{23}_{11}Na$

Na — 11

2, 8, 1 ✓ valence

valency = 1

$Na^+ = 11 - 1 = 10$