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 → wall (blown it)

Magnets NP ↔ SP, NP ↔ NP

Plastic comb - charged body

Atom is indivisible

Charges

Plastic comb — matter — atoms.

Atom → Neutral ($e^- = p^+$)

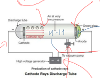
atom is divisible

Hair → matter $e^- = p^-$

Balloon → $e^- = p^-$

↳ initially neutral, after rubbing -vely charged.

Discovery of Electron | Thomson



H₂ gas

Metal plates

Fluorescent coating ZnS

Discharge tube or Transparent glass

Conducting wire

H.V Battery ← 10,000V

1mmHg (10^{-3} mmHg)

Charged particle

Cathode — -vely charged

Anode — +vely charged.

attractive force energy

Velocity, speed

Anode ray Expt | Canal ray Expt

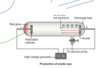
Goldstein

Discovery of proton

H_2 → e^- → H^+ → Positive ion

very heavy

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)

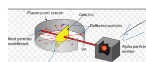
& to maintain electrical neutrality of the atom, positive charges were also present within the atom.

Q) 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 (Gun) for shooting α particles

Gold foil

α-particles → charged particles

loses an e^- — +vely charged

Gains an e^- — -vely charged

He → 2

$2p^+$, $2n$, $2e^-$ → He^{2+} α particle

Initially Neutral

Physics

accn

speed is constant

Ions

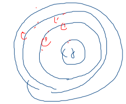
accn — change in velocity (Mag + direction)

atom would be highly unstable

Circular motion

Bohr's model of the atom

(11th)

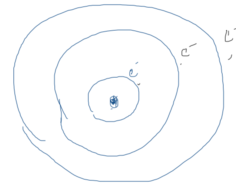


discrete orbits

Distinct,

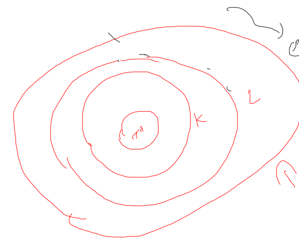
Postulates of Bohr's

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

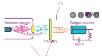
Atom is divisible

Discovery of Neutrons

Cathode ray expmt → electrons → J J Thoms

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

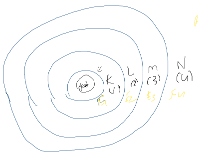
mass → $^{0}_{-1}e$ $^{1}_{1}p$ $^{1}_{0}n$ ← charge

	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



$E_1 < E_2 < E_3 < E_4$

✓ $2n^2$ 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 — 18th Shell — 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. (^1H, ^2He)

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 is participate in chemical reaction

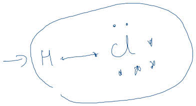
Valency — Combining capacity of an element.
↳ Valence e^-s.

→ 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

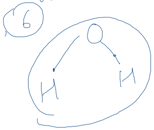
$_{17}Cl$ → 2, 8, 7
$_{11}Na$ → 2, 8, 1 — 1e^-

NaCl — Na & Cl both octet got completed

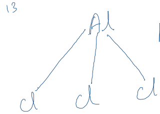


e^- Sharing happened.

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

Happy Hen Lives behind boring Can Near office

New Sodium (Na) Many (Mg) Also Phosphorus

Sulphur Clue (Cl) Air (Ar) part (K) Cal (Calcium)

Atomic number

Atom's number

118 elements

Why we are assigning atom a number?

Can I assign no of e's 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, Z Atomic number

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

Al $Z = 13 = p = e$

Neutron 27 − 13 = 14

Al → K L M 2 8 3 → Al^{3+}

P 15, 2, 8, 5 (3)

2 → superscript

1 → subscript

He^{2+} Donates

e^-, p^+ & neutron

Na, A = 23

atomic no 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 valency

valency = 1

Na^+ 11 − 1 = 10

α one He^{2+} → Helium is cation

2p 2e

anion

✓ Na element has mass no 23, what type of ion will be formed by it, how you'll represent it. Calculate no of e's, p's, neutrons in the ion formed as well as neutral atom of Na. Valency will be what?

11p, 12n, 10e

Na = A = 23

11p = 11e

23 − 11 = 12n

Na − 11

2 8 1

Cation Na^+

S: 40 − S: 45

ion

$_{17}Cl$

K L M

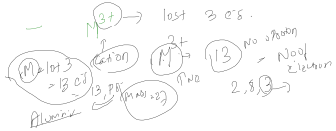
2 8 7

anion

1e⁻

Electronic config

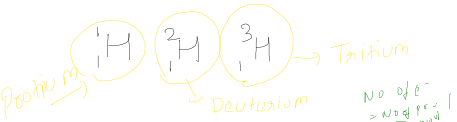
Q) An ion M^{3+} contains 10 e⁻s & 14 neutrons. What are atomic no & mass no of the element M. Name the element.



Q) An ion X^{2-} contains 10 e⁻s & 8 neutrons. What are Atomic no & mass no of the element X? Name of the element.

Isotopes

↳ atoms of same elements which have same atomic no but different mass no.



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

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

Characteristics of Isotopes

- ✓ Same atomic no, no of protons / no of electrons.
- ✓ Different mass number / number of neutrons.
- ✓ Same chemical properties. — Valence electrons
- ✓ Different physical properties — melting point, boiling point

Isobars → same mass but different atomic nos.

	p	e	n
Ar	18	18	22
Ca	20	20	20

$^{40}_{18}Ar$ $^{40}_{20}Ca$

Isobars

Q) $^{235}_{92}U$ $^{238}_{92}U$, $^{3}_{1}H$ $^{3}_{2}He$

Isotopes

$^{40}_{19}K$ $^{40}_{20}Ca$ - $^{16}_{8}X$ $^{18}_{8}X$