structure of atom

Cathode ray and anode ray:

$\frac{e}{m}$ = charge / mass

Cathode ray	Anode ray.
- those rays which move from cathode to anode are CATHODE RAYS.	- those rays which move from anode to cathode are ANODE RAYS.
- negatively (-ve) charged.	- positively (+ve) charged.
- doesn't depend upon nature of gas.	- it does depend upon nature of gas.
- $\frac{e}{m}$ ratio is constant for different gases.	- $\frac{e}{m}$ ratio is variable for different gases.

Sub-atomic particle:

- There are 3 sub-atomic particles:

I) a negative charged ELECTRON (e^-)
II) a positive charged PROTON (p^+)
III) a neutral or no charged NEUTRON (n^0)

PARAMETER ↓	Electron	Proton	Neutron
Discovery	J. J. Thomson	Goldstein	James Chadwick
Charge	-1.6×10^{-19} C	$+1.6 \times 10^{-19}$ C	no charge
Relative charge	-1	$+1$	0
Mass (Kg)	9.1×10^{-31} Kg	1.672×10^{-27} Kg	1.674×10^{-27} Kg
Mass (amu)	$1/1837 \approx 1/2000$ amu	1 amu	1 amu
e/m ratio	$\frac{1.6 \times 10^{-19}\ C}{9.1 \times 10^{-31}\ Kg}$	$\frac{1.6 \times 10^{-19}\ C}{1.67 \times 10^{-27}\ Kg}$	0
Relative e/m	$\frac{1}{1/2000} = 2000$	1	zero

Q:1 Find e/m ratio for α-rays (alpha rays = He charge particles).

$\Rightarrow$ α-rays = +2 charged.

$$\frac{e \text{ (charge)}}{m \text{ (mass)}} = \frac{2}{4} \longrightarrow \frac{1}{2}$$

Q:2 Arrange following in increasing order of e/m ratio:
proton; neutron; electron; alpha rays.

#imp $\Rightarrow$ neutron < α-ray < proton < electron
0 $(e^- > p^+ > \alpha > n^0)$ 2000

Some atomic species:-

1) Isotope: those species which have same atomic number but, different atomic mass.

eg: $_1H^1$; $_1H^2$; $_1H^3$; $_6C^{12}$ $_6C^{13}$ $_6C^{14}$

protium deuterium tritium

Note:
$_1H^3$ radioactive in nature and is rare.

2) Isotone: number of neutrons is same but have different atomic number.

eg:

	$_1H^3$	$_2He^4$
P+	1	2
n°	2	2

3) Isobar: atomic mass is same but have different atomic number.

eg: $_{20}Ca^{40}$ $_{19}K^{40}$ $_{18}Ar^{40}$

4) Isoster: those species which have same number of atoms and electrons.

eg:

	N_2O	CO_2
atom	3	3
e^-	22	22

Th = Thorium Ur = Uranium

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v) Isodiaphers: those species which have same difference in value of neutron and proton. (n^0-p^+).

eg: $_{90}Th^{234}$ $_{92}Ur^{238}$

(n) (p) (n) (p)

⟶ 144 - 90 146 - 92

= 54 = 54

vi) Isoelectronic: those species having same number of electrons.

eg: Na^+, Mg^{2+}, F^-, O^{2-}

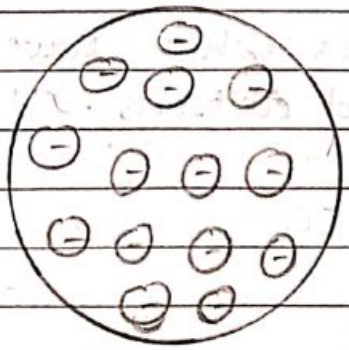
e^- 10 10 10 10

Atomic model:-

1. Thomson atomic model

(1900 yrs after Dalton)

- according to thomson; atom is a positive (+ve) sphere in which electrons are embedded and ~~make~~ neutralise the atom.



- named as 'watermelon model' or 'plum pudding model'

Dalton stated :- everything made of atoms.
:- chem. prop. can't be made / destroyed.
:- diff element ; diff. atoms.

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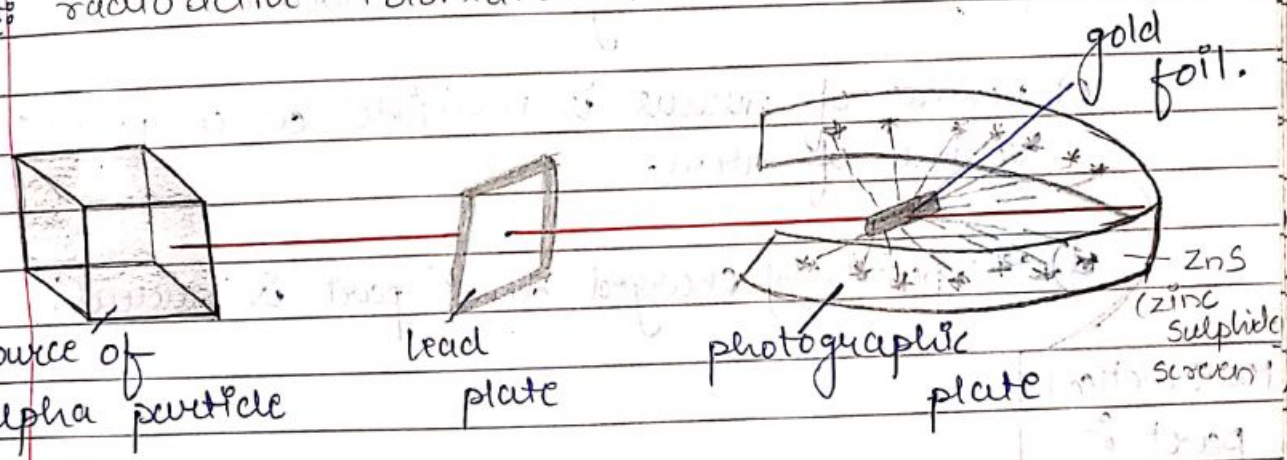
- this model was rejected after discovery of rutherford atomic model.

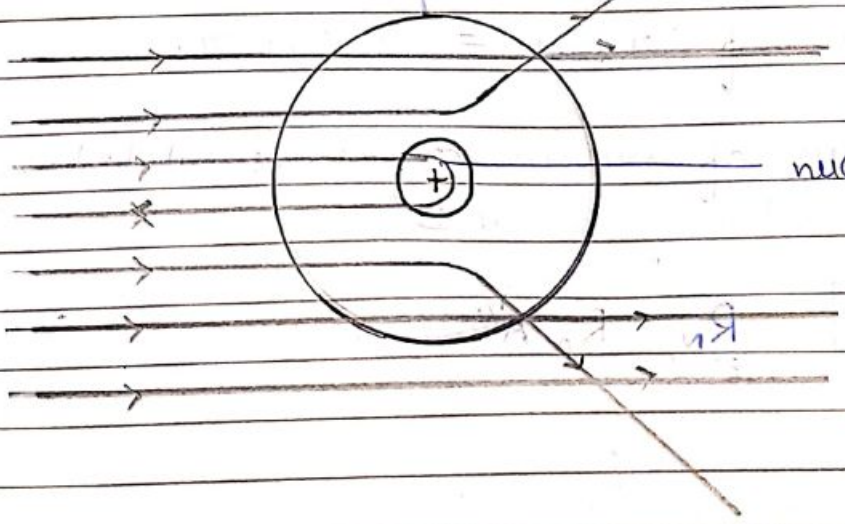
(2.) Rutherford atomic model

Experiment: radio active = Polonium (Po)



α rays = +ve Helium charge ($2^{+}He^{4}$)

Observation:



i) most of the α-rays (alpha-rays) passed through board gold-film without any deviation.

ii) some other α-rays passed with deviation of 90°, 120°, 160°.

iii) one of every twenty-thousand rays bounced back with 180° angle.

Conclusion: a) most of the part of an atom is vacant. in which electrons are distributed.

b) number of electron in orbit is equal to number of protons (true charge in the nucleus).

c) volume of nucleus is negligible as compared to the volume of atom.

d) the positively charged dense part is 'nucleus'.

Mathematical part :-

a) Radius of nucleus $= 10^{-15}$ meter.

b) Radius of atom $= 10^{-10}$ meter.

c) Radius of nucleus can be calculated by following formulae :-

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

R_N : radius of nucleus

R_0 : constant ($4/3 \times 10^{-13}$)

A : atomic wt.

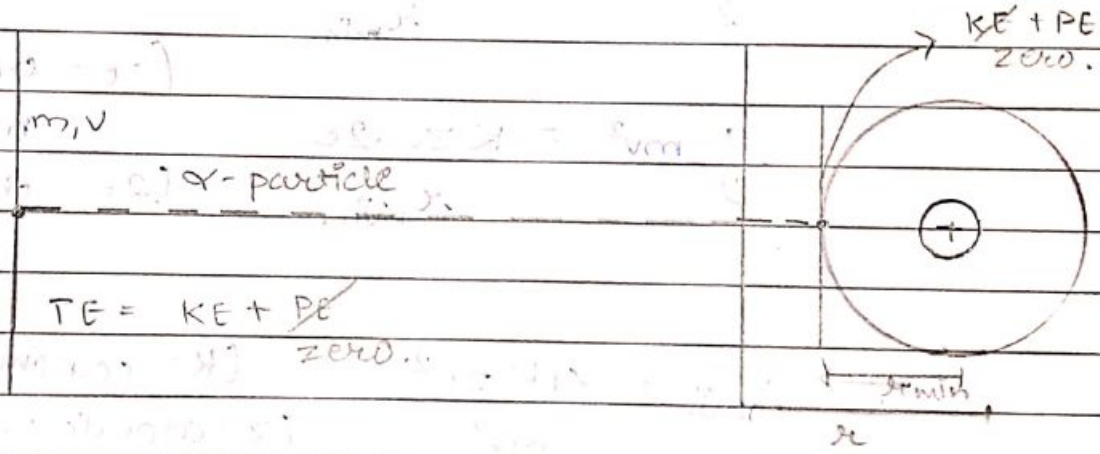
$$R_N = \frac{4}{3} \times 10^{-13} \times A^{1/3}$$

d) Density of nucleus = $\frac{\text{mass}}{\text{volume}}$,

$$D = \frac{mA\,H}{\frac{4}{3}\cdot\pi\left[1.33\times10^{-13}\,(A)^{1/3}\right]^3}$$

e) closest approach of α-particles:-

(I) ↳ it is applicable only for those alpha-particles which are bounced back at 180°.



(II) ↳ when an α-particle having kinetic energy ($\frac{1}{2}mv^2$) enter into the electric field of nucleus, its kinetic energy is converting into potential energy.

(III) ↳ at particular point its kinetic energy should be zero and at that particular point potential energy should be maximum.

$F = \frac{Kq_1q_2}{r^2}$

=

(IV) → that particulare point α-particle should be in rest condition. and that point is closest distance of α-particle with nucleus of target metal.

f) closest approach distance of α-particles can be calculated by:

r_{min} = closest approach

$$KE = PE$$

$$\frac{1}{2}mv^2 = \frac{Kq_1q_2}{r_{min}}$$

$$\frac{1}{2}mv^2 = \frac{K \, ze \cdot 2e}{r_{min}}$$

(ze = charge on target metal nucleus)

(2e = charge on α-pasticles)

$$\longrightarrow r_{min} = \frac{4Kze^2}{mv^2}$$

(K = coulomb constant $= 9 \times 10^9$) $= \frac{Nm^2}{c^2}$

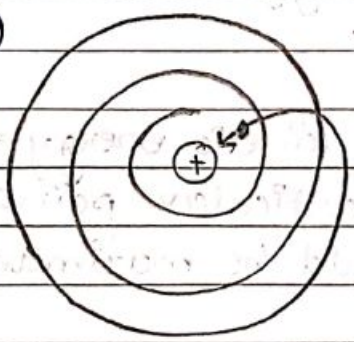
(z = atomic no.)

(e = charge $= 1.6 \times 10^{-19} C$)

(v = velocity α-past) (m/s)

(m = mass of α-particle) (kg)

Drawback: 1)



i) it does not explain stability of atom.

ii) it does not explain H-spectrum.

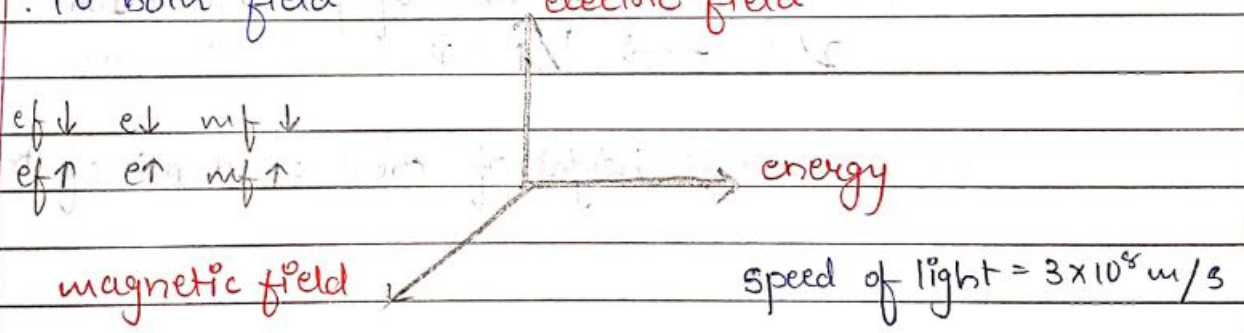
iii) this atomic model does not based on classical theory of electromagnetism (proposed by maxwell

Electromagnetic Radiation [EMR]:-

- EMR or electromagnetic radiation shows dual natures : a) wave nature
  b) quantam nature

1) Maxwell's wave theory of EMR:

- according to maxwell EMR have wave nature
- he explained his experiment by interferance and ~~diffe~~ diffraction properties that is showed by light.
- when a charged particle move under acceleration alternatively electric field and magnetic field produce
- these are in phase and oscillating mutually perperdicular (⊥) to each other.
- direction of energy propagation in perpendicular to both field



- EMR travel with speed of light and it can travel in vacuum due to its own electric field and magnetic field.