

- Wassup my gang!!!!
wlc to the lec
let's understand not learn...



Myself – Nikhil Ramesh Jaya Tirgul.

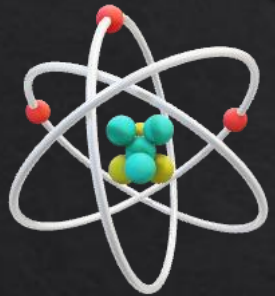


One shot lecture

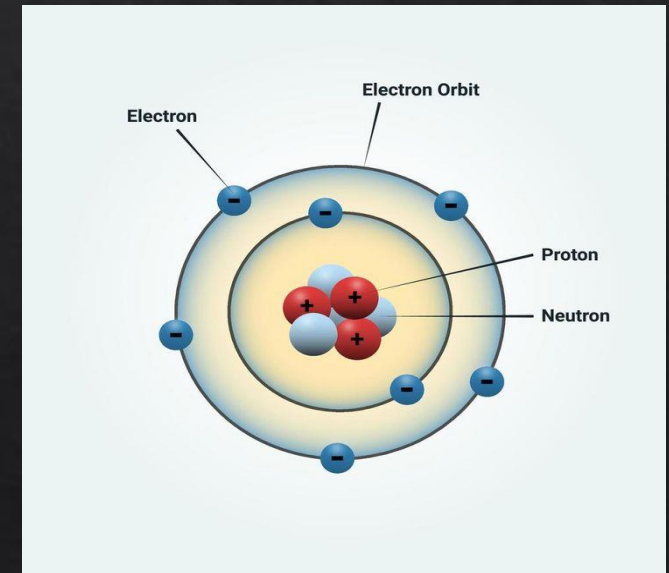
-By Nikhíl.



STRUCTURE OF ATOM



CBSE CLASS 9



#topics to be covered :

- What is atom and molecule
- Charges and particles in a atom
- Diagrammatic representation of str of atom
- Various models of str of atom by
 - Dalton uncle
 - J.J Thomson
 - E Rutherford
 - Niels Bohr
- Orbits / shell and electron distribution
- Valency and valence electrons
- Atomic number and mass number
- Isotopes and its applications
- Isobars.

this too would cover the NCERT book line to line

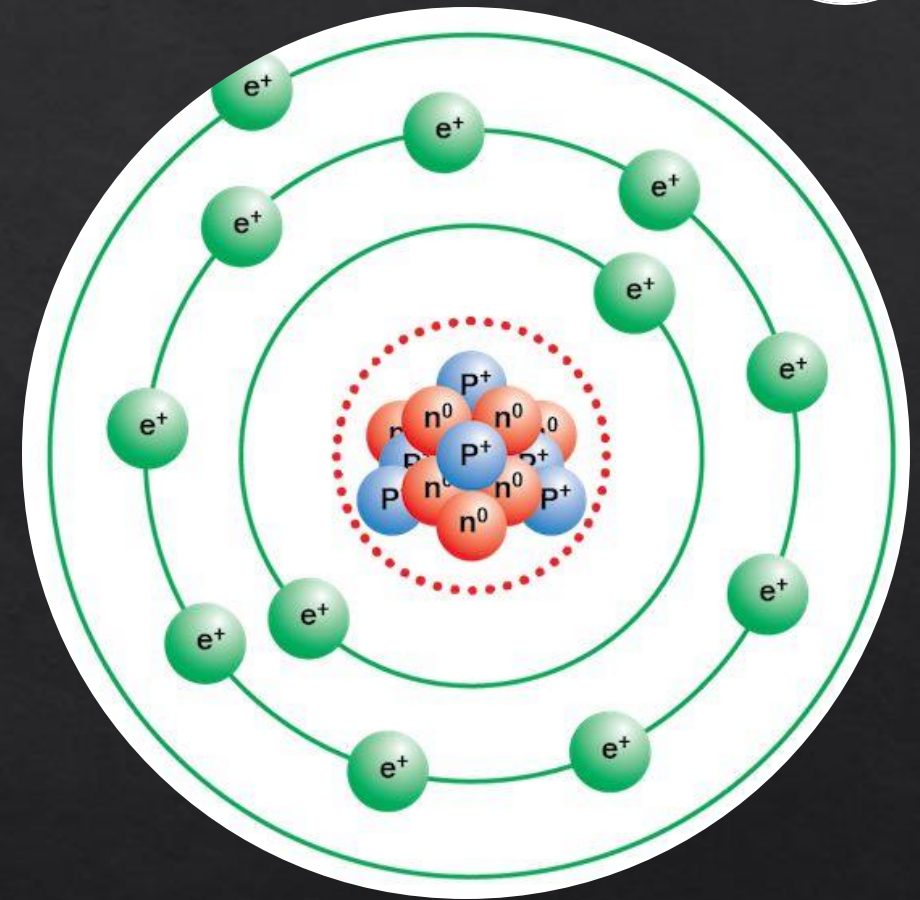
And chpt khatam...
Vishay close...



➤ What is an atom!? Atom exactly ky hay!?



➤ What is a molecule?



charges and particles in an atom:



- Charge is an intrinsic property of matter (just like mass is one property), this property causes particles to experience an electrostatic force in the presence of an electric or magnetic field.
- Charges – positive, negative and neutral
- Positive positive repels, negative negative repels and opposite charges attract each other while neutral charges just possess gravitational force of attraction.
- Atom consists of:
protons and neutrons in the nucleus and electrons in the orbit outside the nucleus.
- In an atom protons are positively charged, electrons are negatively charged and neutrons are neutral.
- Bachpan may khele hue static electricity ke games...and their reason !!!
- What are positively and negatively charged bodies- a body with negative charge is said to have excess electrons while a positively charged body is deficient of electrons (we always talk in terms of electrons and don't refer the protons for the same)

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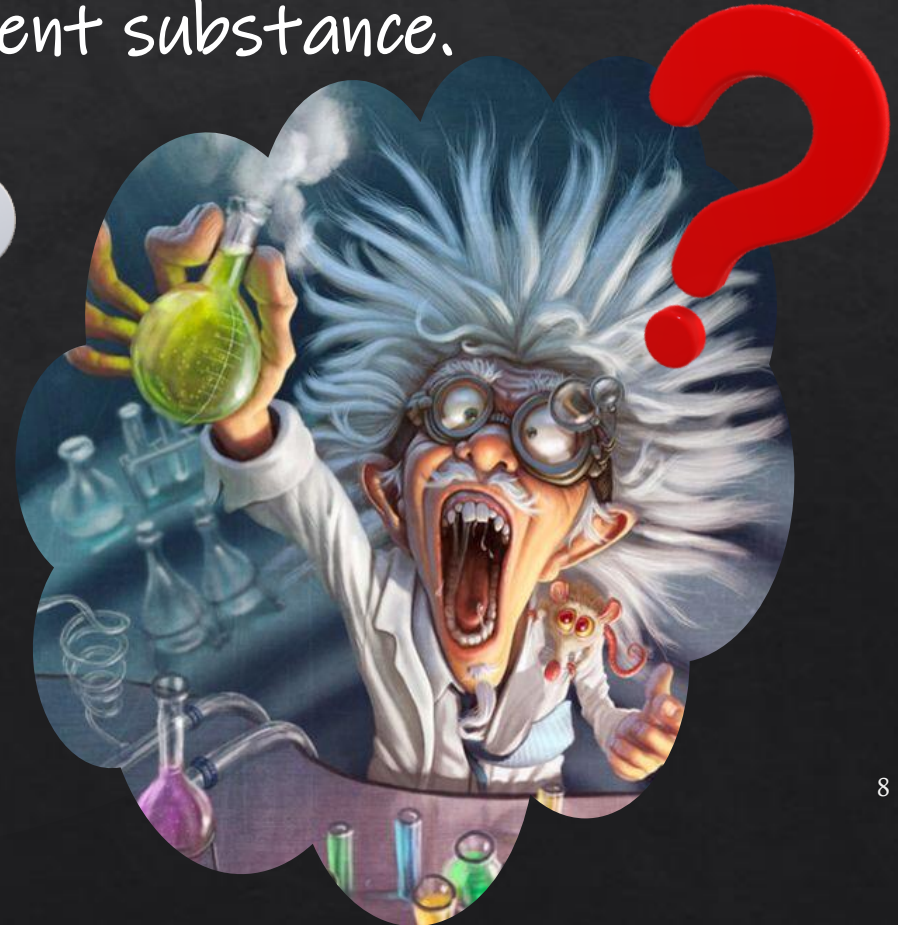
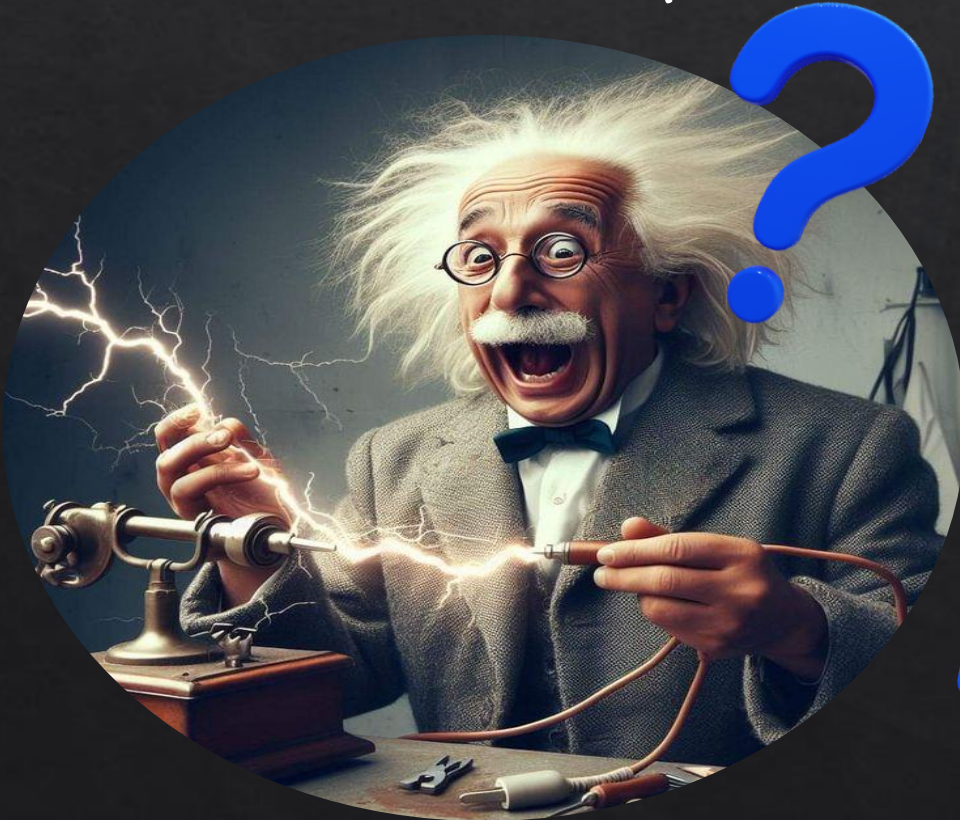
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Q) Are atoms really indivisible ? Explain !

-> 1st ly understand the meaning of indivisible -> it means divisible.

-> No, atoms are not indivisible, and the indications that atoms are not indivisible (divisible) comes from studying static electricity and the condition under which electricity is conducted by different substance.



discoveries:



- Electrons were discovered by \rightarrow JJ Thompson (1897)
- Protons were discovered by \rightarrow E Rutherford (1917)
- Neutrons were discovered by \rightarrow James Chadwick (1932)
- and many more particles too.... But not for syllabus till 12th

- E Goldstein IDENTIFIED \rightarrow canal rays (protons) but remember that Rutherford's experiment made the win and hence he is regarded as the discoverer (not inventor) of the protons.

Hence yadd may rakho... koi bhi kam karo tho 100% karo.

Canal rays are the rays or particles that run in opposite direction to that of the cathode rays.

- Electrons were discovered by using cathode ray experiment

- An atom is said to be electrically neutral.
- What discoveries led to describe Dalton's atomic theory (an atom is the smallest and indestructible particle of any matter) as a failure!?
-> discoveries of protons and electrons.
- 1st person to propose the structure for a atom -> J.J. Thompson (the same person who discovered the electrons...)

#diagrammatic representation of the str of an atom



- An atom consists of protons and neutrons in the center place of the atom called the nucleus and the electrons revolving round the nucleus
- The arrangement is just like the planets and the sun in our solar system
- It is the str of atom that allows entry and removal of electrons from the orbit while the protons can't be added or removed as they are present inside the nucleus

(Bohr's atomic model for a sodium atom)

- Before the final str of atom that we today have, many scientists attempted to give the structure but the str that we today use or study is the one given by Bohr.

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various models:

➤ Dalton unaware of presence of sub atomic particles just gave a circular shaped str for the atom

➤ Then comes J J Thompson who gave plump pudding model that looked similar to the chrimas pudding.

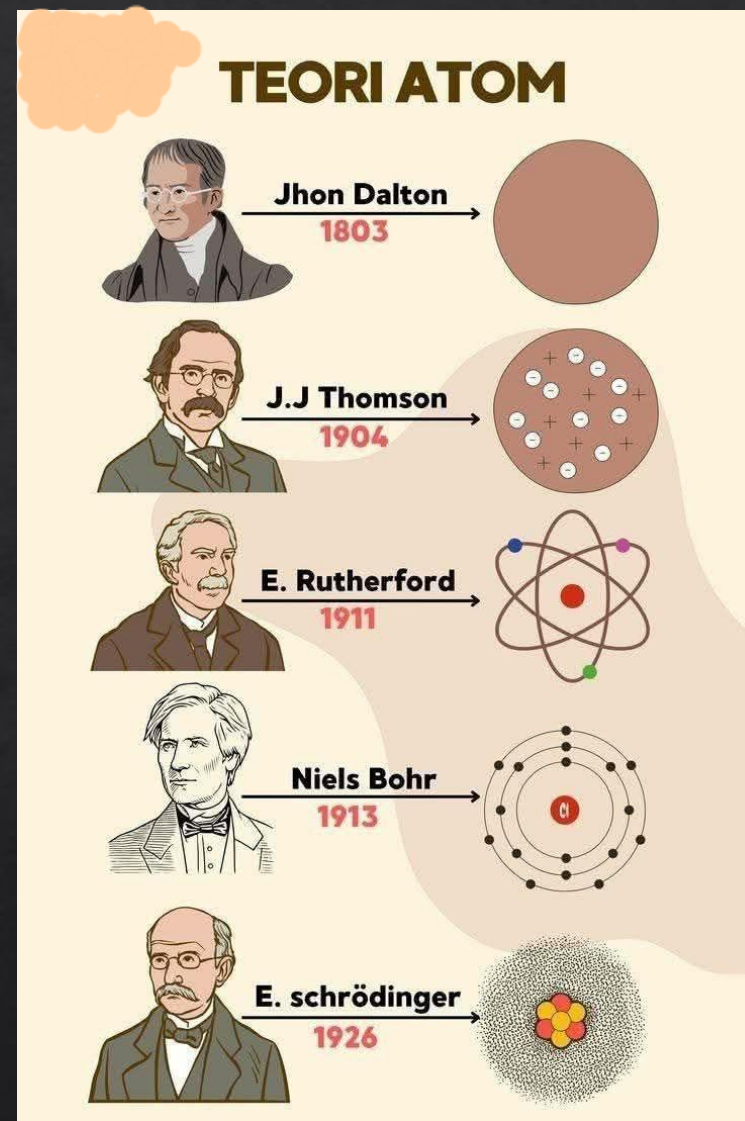


According to which the electrons like dry fruits spread over the cake(positive charge...)

or

the watermelon where the edable red part is the positive charge and the electrons spread over like the seeds in the watermelon

➤ j j Thompson won the noble prize in physics for the discovery of electrons.

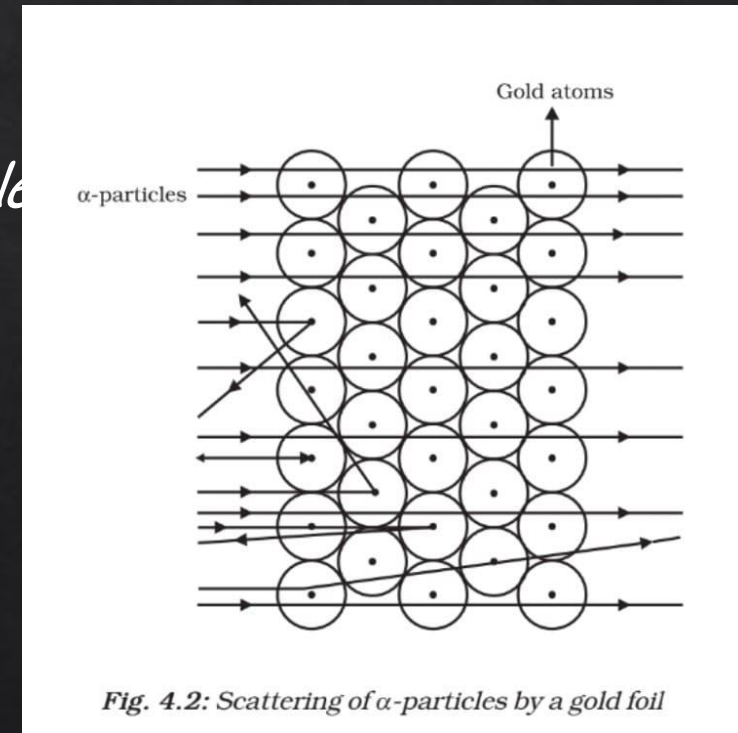
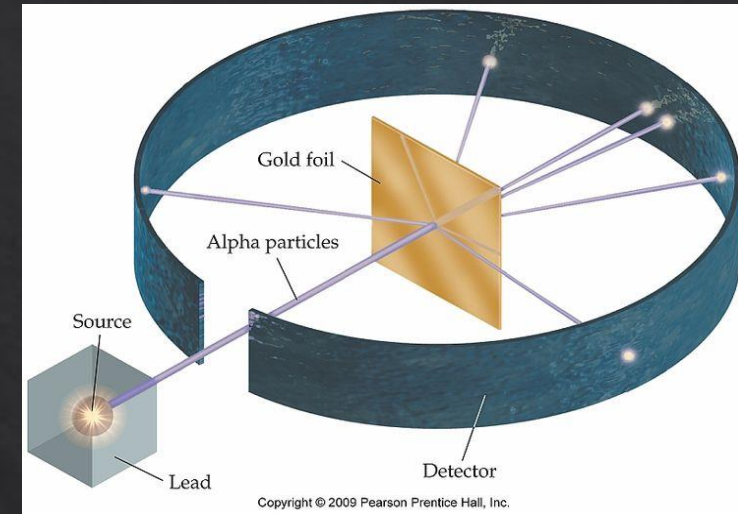




- It was J.J. Thompson for the 1st time to say that the atom as a whole is neutral and the no of electrons and the no of protons in it are equal in magnitude
- Although this model explained the electrical neutrality but it could not explain the other experiments carried out by other scientists later on – such as Rutherford's alpha scattering experiment and etc... hence the model is said to be a failed one.

Rutherford's atomic model

- sir Rutherford performed an experiment named alpha scattering exp where he made the collision of high speed alpha particles on the very thin gold foil which was just about 1000 atoms thick.
- He selected a gold foil because he wanted as thin a layer as possible. This gold foil was about 1000 atoms thick.
- α -particles are doubly-charged helium ions. Since they have a mass of 4 u, the fast-moving α -particles have a considerable amount of energy.
- It was expected that α -particles would be deflected by the sub-atomic particles in the gold atoms. Since the α -particles were much heavier than the protons, he did not expect to see large deflections.



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➤ What's an alpha particle ?

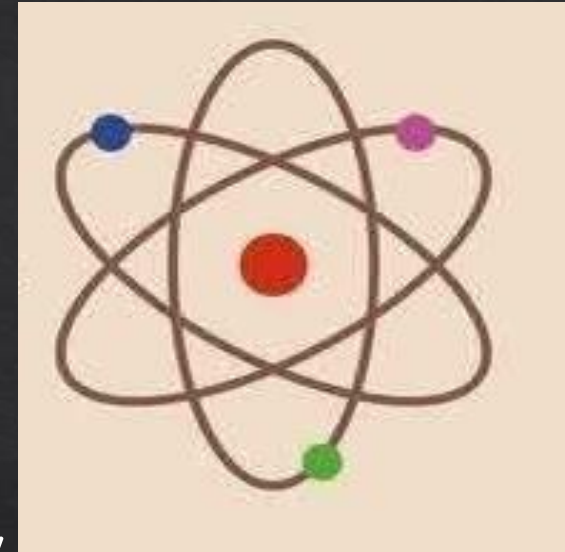
-> the particle that is similar to the nucleus of an atom of helium-4 element i.e., 2 protons and 2 neutrons in its nucleus i.e., +2 charge and 4 as its mass.

➤ Observations by Rutherford.

- most of the alpha particles passed through gold foil undeflected. A small fraction of alpha particles were deflected by small angles. Almost one alpha particle among 12,000 alpha particles bounced back, i.e. deflected nearly 180 degrees.

➤ What does it explains –

1. most of the space in an atom is empty.
2. Atoms contain a very dense and heavy core called the nucleus.
3. All the positive charge in an atom exists in the nucleus.
4. The nucleus is surrounded by electrons revolving around it.



- from this above observations and conclusions sir Rutherford also calculated the radius of the nucleus as around 10^5 times less than that of an atom.
- Hence he concluded with str as mentioned in previous slide...
- This scientist is such a great one that he being physicist, being called the "father of nuclear physics", got the noble prize in chemistry.
- Stillllllllll science advanced and one day concluded his model too as a failed one (jj Thompson laughing in the corner.....)
- Drawbacks of rutherfords atomic model that lead his model to get in the list of ex.
 - Could not explain atom's stability

Electrons moving in circular orbits should lose energy and fall into the nucleus, but real atoms are stable. (later on shells and orbits concept made the correction -by bohr...)

Bohr's atomic model



- Now Bohr got the task to clear the doubts raised on Rutherford's model and hence he concluded with the statement that Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom... Orr uss orbit may ghumte ghumte o electrons energy radiate out nahi karenge!!!

(Bohr too got the noble prize for the work on str of atom)

- total number of people who got noble prize till now in our chpt- except Dalton uncle all three scientists got!

shell	max no of electrons # capacity
-------	--------------------------------

$n=1$ or K shell	2
------------------	---

$n=2$ or L shell	8
------------------	---

$n=3$ or M shell	18	(capacity 18 ki ho tabb bhi 8 hi leta hai)
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$n=4$ or N shell	32	(capacity kitni bhi ho 8 hi lega...)
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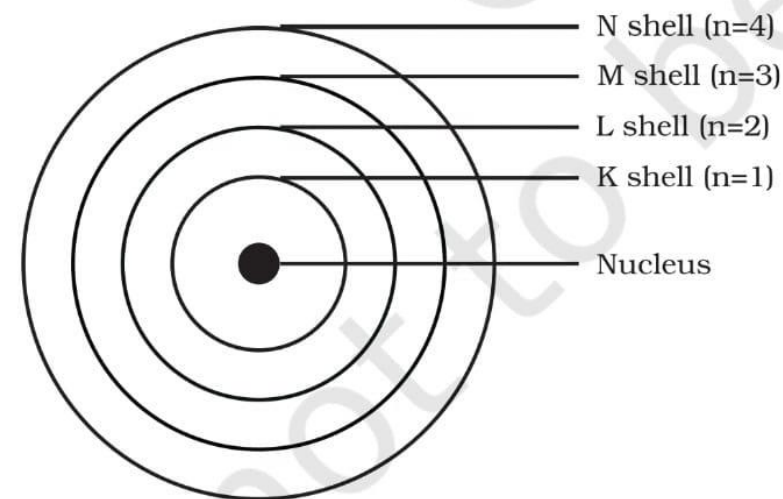


Fig. 4.3: A few energy levels in an atom

#Str of atom of various atoms



#NCERT INTTEXT QUESTIONS



uestions

1. *On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.*
2. *On the basis of Rutherford's model of an atom, which sub-atomic particle is present in the nucleus of an atom?*
3. *Draw a sketch of Bohr's model of an atom with three shells.*
4. *What do you think would be the observation if the α -particle scattering experiment is carried out using a foil of a metal other than gold?*

If another metal foil is used, the overall pattern stays the same (most alpha particles pass through, some deflect). But the amount of deflection changes: metals with lower atomic number cause less scattering, and metals with higher atomic number cause more scattering compared to gold. (LESS ATOMIC NUMBER IMPLIES LESS SUB ATOMIC NUMBERS IN BOTH NUCLEUS AND ORBIT HENCE LESS DEFLECTION !)

#NEUTRONS by james cadwick (1932)



- No charge
- Mass equal to that of proton
- Neutrons are present in the nucleus of all atoms, except hydrogen
- hence the total mass of a nucleus must be = mass of total no of protons + that of neutrons in the nucleus
- Except hydrogen every other elements have neutrons in their nucleus,

apn aaj se exceptions ko bhoot bolenge..... Bhoot apni sapne may geli karte ye exceptions chemistry ke andar papers may so innhe kabhi bhulna nahi bauba.....)

bhoot: H has only one electron and one proton and no neutron while all other elements have the neutrons

Q) An atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

-> $4/2=2$ =mass of neutron & 1 neutron is given one unit mass so answer is 2 neutrons

#free space



➤ Theoretically The maximum number of electrons present in a shell is given by the formula $2n^2$, where 'n' is the orbit number or energy level index, 1,2,3,... Hence the maximum number of electrons in different shells are as follows: first orbit or K-shell will be $= 2 \times 1^2 = 2$, second orbit or L-shell will be $= 2 \times 2^2 = 8$, third orbit or M-shell will be $= 2 \times 3^2 = 18$, fourth orbit or N-shell will be $= 2 \times 4^2 = 32$, and so on. but while filling we do fill max no of electrons in the format of 2,8,8,8



Q) If L and M shells of an atom are full, then what would be the total number of electrons in the atom?

$$\rightarrow 2+8+8=18$$

OCTATE AND DUPLET RULE:

- the stability of an atom is seen by the arrangement or the electronic configuration of the atom of the element,
- here the atom is said to be stable if the arrangement is in such a way that the last orbit of the atom (called the valence shell) gets the 2 (duplet) or 8 electrons (octate)

valency and the valence electrons



- The last orbit of an atom is called valence shell
- The electrons present in the valence shell of an atom are called valence electrons
- The amount of electrons a atom can donate or recive or share is known as valency of that atom or the combining capacity of an atom is known as its valency
- Explanation :

Table 4.1: Composition of Atoms of the First Eighteen Elements with Electron Distribution in Various Shells

Name of Element	Symbol	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Distribution of Electrons				Valency
						K	L	M	N	
Hydrogen	H	1	1	-	1	1	-	-	-	1
Helium	He	2	2	2	2	2	-	-	-	0
Lithium	Li	3	3	4	3	2	1	-	-	1
Beryllium	Be	4	4	5	4	2	2	-	-	2
Boron	B	5	5	6	5	2	3	-	-	3
Carbon	C	6	6	6	6	2	4	-	-	4
Nitrogen	N	7	7	7	7	2	5	-	-	3
Oxygen	O	8	8	8	8	2	6	-	-	2
Fluorine	F	9	9	10	9	2	7	-	-	1
Neon	Ne	10	10	10	10	2	8	-	-	0
Sodium	Na	11	11	12	11	2	8	1	-	1
Magnesium	Mg	12	12	12	12	2	8	2	-	2
Aluminium	Al	13	13	14	13	2	8	3	-	3
Silicon	Si	14	14	14	14	2	8	4	-	4
Phosphorus	P	15	15	16	15	2	8	5	-	3,5
Sulphur	S	16	16	16	16	2	8	6	-	2
Chlorine	Cl	17	17	18	17	2	8	7	-	1
Argon	Ar	18	18	22	18	2	8	8	-	0

atomic number and mass number



- the number of protons in an atom is its atomic number denoted by Z
for ex: atomic number of H is 1 Ca is 20 and the no. of protons in their nucleus is also the same!
- Mass number of an atom (A) is the sum of numbers of proton and neutrons in the nucleus of a atom...
- Protons and neutrons are called nucleons
- "mass of an atom resides inside its nucleus"

Q) if mass of an atom is 27 and the no of protons in its nucleus are 13, find the number of neutrons in its nucleus ! Also tell the no of electrons in its ground state !



- the representation of any element is done in the way that includes writing the symbol of the element in the centre and writing the atomic no. (Z) on the lower left side and the mass no (A) on the upper right or left side.



Example:

Q) Find the charge on an atom of element of boron if the atom has

a) 5 electrons ->

b) 6 electrons ->

c) 4 electrons ->

isotopes and isobars



- Isotopes – atoms of same elements (same atomic no. bola ki element same)
- Isobars – atoms of different elements (diff atomic no. bola ki element change)

- Isotopes are the atoms with same atomic number but different mass number
difference in mass number is due to presence of different no of neutrons in them

example: protium deuterium tritium

: C 12 & C 14

: Cl 35 & Cl 37

mass no of protium is 1 deuterium is 2 and tritium is 3 – which means no of neutrons in them are $Z-A = 1-1 = 0$, $2-1 = 1$, $3-1 = 2$

bhoot yad haiy !!!!!!!! That it said hydrogen is the only element with no neutron in it wala
now look there protium is that isotope of the hydrogen
- hence we usually call protium as hydrogen...

- "Each isotope of an element is a pure substance"
- "chlorine in nature occurs in 2 pure isotopic forms mentioned above that too in ratio of 3:1 for 35:37....."



➤ average atomic mass of the element is find using formula

$$\text{avg} = \frac{\text{mass no of 1}^{\text{st}} \text{ isotope} * \text{percentage occurrence} + \text{mass no of 2}^{\text{nd}} \text{ or } n \text{ isotopes} * \text{percentage occurrence of it}}{100}$$

example: avg atomic mass of Cl:

$$\left[\left(35 \times \frac{75}{100} + 37 \times \frac{25}{100} \right) \right. \\ \left. = \left(\frac{105}{4} + \frac{37}{4} \right) = \frac{142}{4} = 35.5 \text{ u} \right]$$

- This does not mean that any one atom of chlorine has a fractional mass of 35.5 u. It means that if you take a certain amount of chlorine, it will contain both isotopes of chlorine and the average mass is 35.5 u.
- What's u ?
 - > u = amu = atomic mass unit (jaise gram kg etc waise amu)
- mass of a proton and neutron is considered as 1 amu while that of electron is negligible
- Mass of electrons is in 10^{-4} amu hence negligible and hence we say that mass of ₅₃a atom is made by nucleus or nucleons only





applications of isotopes :

- chemical properties of all the isotopes of an element are the same
bhai agar element hii chance nahi ho raha hai to prop kaise change hogi for example
agr gold ke do isotope leye jaye tabb bhi o rahega to gold hi na....

Applications of isotopes of some elements:

- (i) An isotope of uranium is used as a fuel in nuclear reactors.
- (ii) An isotope of cobalt is used in the treatment of cancer.
- (iii) An isotope of iodine is used in the treatment of goitre. (not all isotopes just the isotope I 131 is used to treat goiter.... It's a radioactive isotope and hence not used directly or in our iodized salts Used by skillful professionals for treatment only...)

- Isobars: isobars are the atoms of different elements with diff atomic no and same mass number

just ek nam diya hai un sare atoms ko jinka $Z+A$ same hoga

example : calcium, atomic number 20, and argon, atomic number 18. The number of protons in these atoms is different, but the mass number of both ³⁵these elements is 40.

- Yaha takk apne humko zhela iss leye apka bhout bhout dhannayad !!!!
- Aise hi physics padte raho baki ka hume kuch lena dena nahi !!!!!
- All the very best!!!





















