

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

বিস্মিল্লাহির রাহমানির রাহীম



উদ্ভাস

একাডেমিক এন্ড এডমিশন কেয়ার

Class(9-10)

Chemistry

Chapter-03

Structure of Matter

C-04

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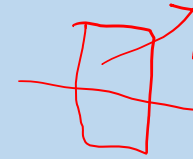
What we will learn in this chapter?

- ➔ We have already learnt about atom, proton, electron, neutron in class 8. In this chapter, we will know -
- ➔ How they are actually stays in atom and we will compare them and we will learn new concept of electron configuration etc.
- ➔ Now the question is what is matter?

resist
external
force

Can you define elements and compounds?

- In class 4, we have learnt that those who has **mass** , **volume** and resists the external force in order to remain its original shape is called **Matter**.
- Matter is of two types . They are
 - 1)Elements ✓
 - 2)Compounds



➡ Can you define elements and compounds?

- **Elements** : The matter which does not yield anything but itself if divided ,is called elements. For example - Gold bar, Silver bar etc.

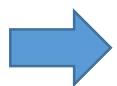
- So far, a total of 118 elements have been discovered. Out of them, 98 elements are available in nature and 20 elements are created in Laboratory.

- Our body contains 26 different elements . How strange!!!

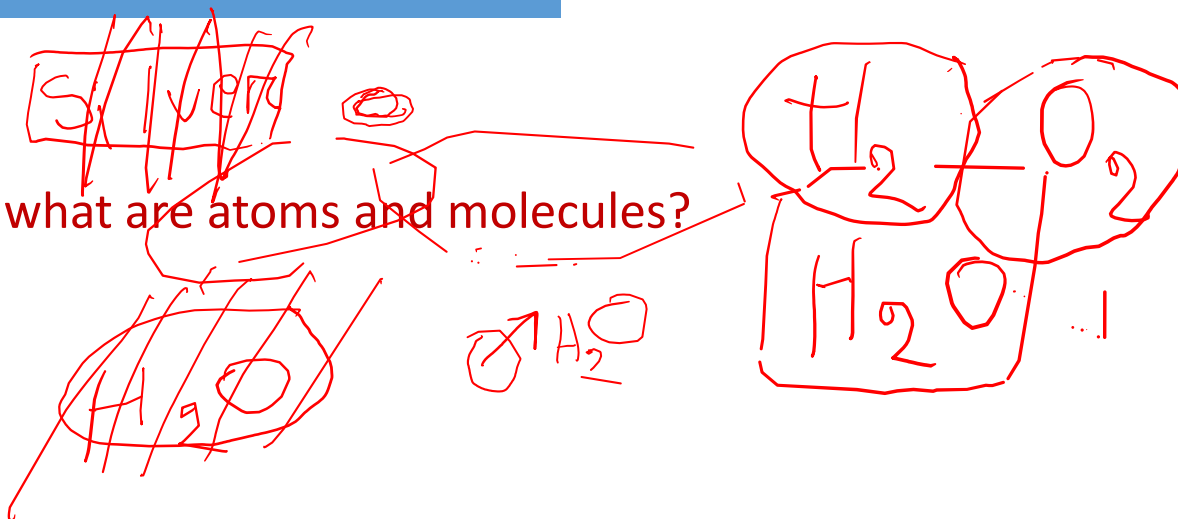
- **Compounds**: The matters which, if divided , give away two or more elements are called compounds . For example – water, HCl etc.

- In a compound , elements will always exist in the same ratio. For example-If we collect HCl , from Brazil and South Africa and if it is pure then H and Cl will be 1:1.

- Characteristics of compounds are different than those of elements they are made of.

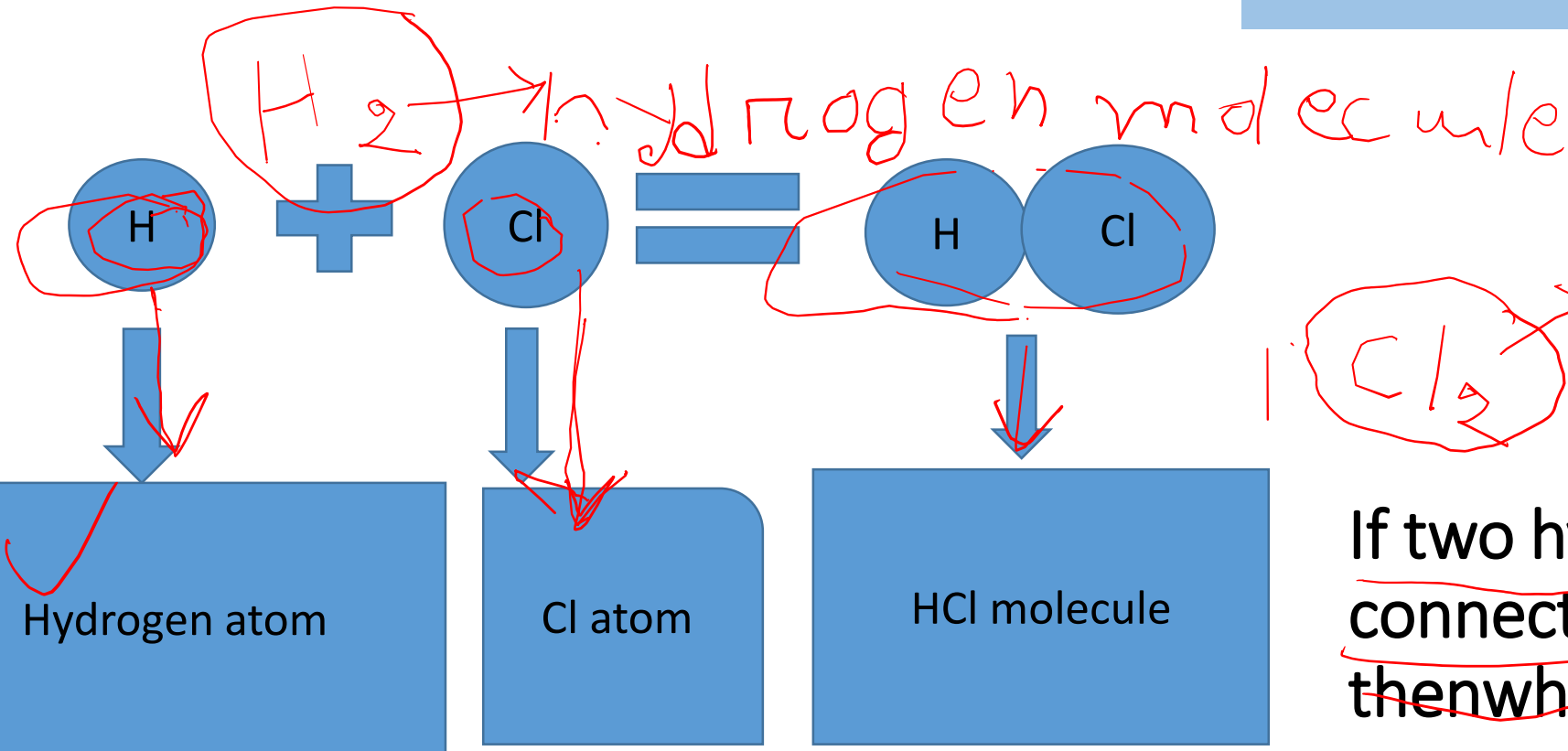


Can you define what are atoms and molecules?



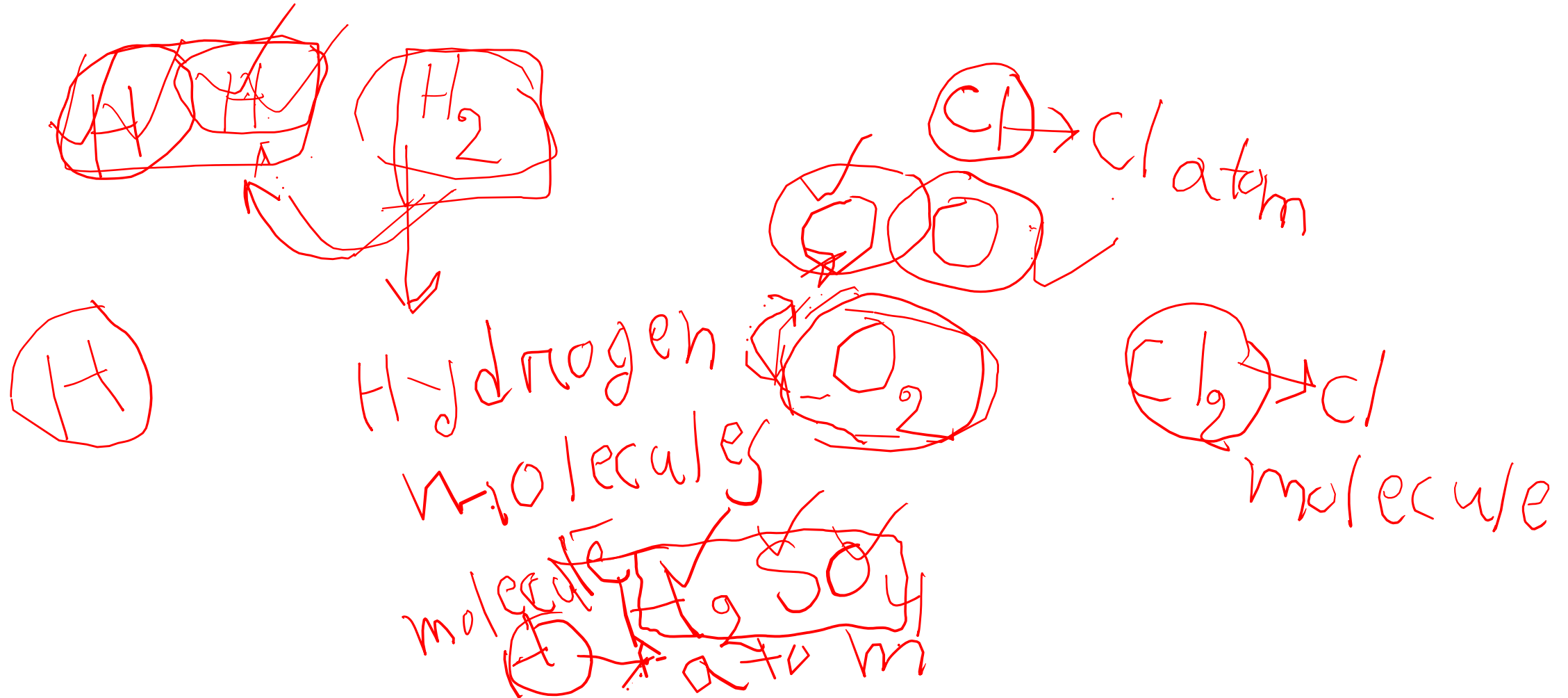
- **Atoms:** The smallest particles of elements that contain the characteristics of elements are called atoms.

- **Molecule:** If two or more atoms remain connected with each other in chemical bond, it is known as molecule.



If two hydrogen atoms are connected with each other then what will we call it?

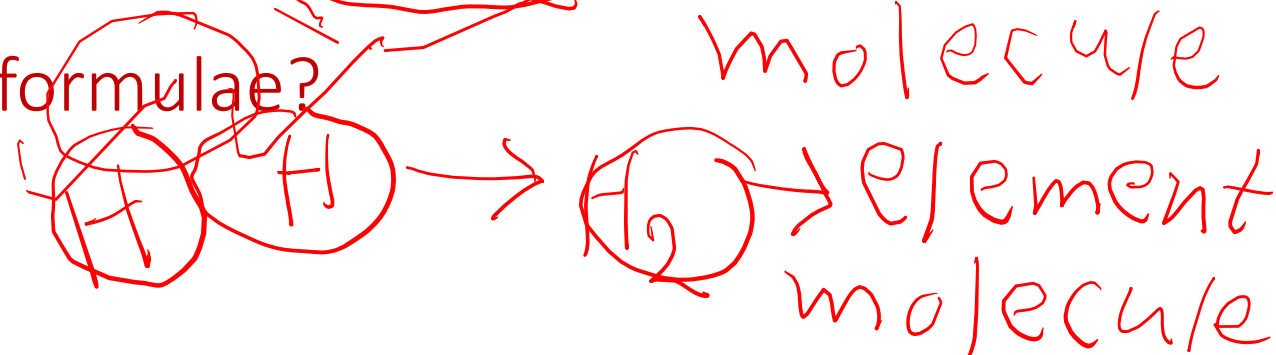
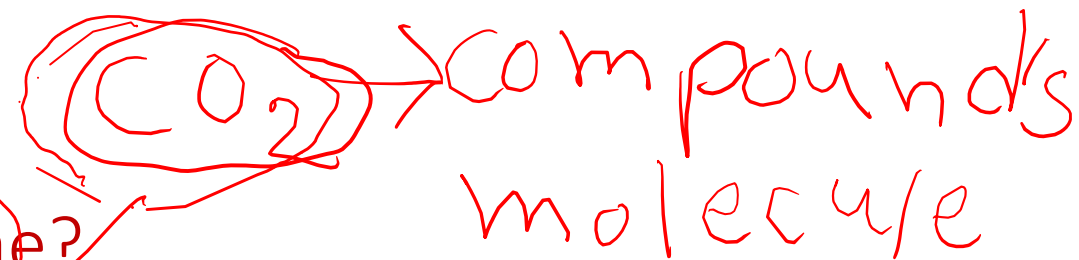
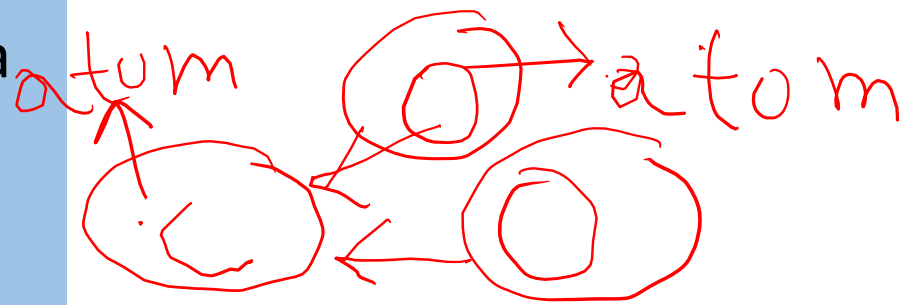
Example:



- When atoms of different elements bond together to produce a molecule, it is called molecule of compound. CO_2 , HCl etc. are called compound's molecule.

- When more than one atoms of a specific element bond each other, they produce that element's molecule. H_2 , O_2 etc. are called element's molecule.

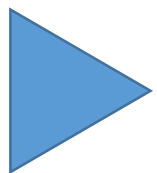
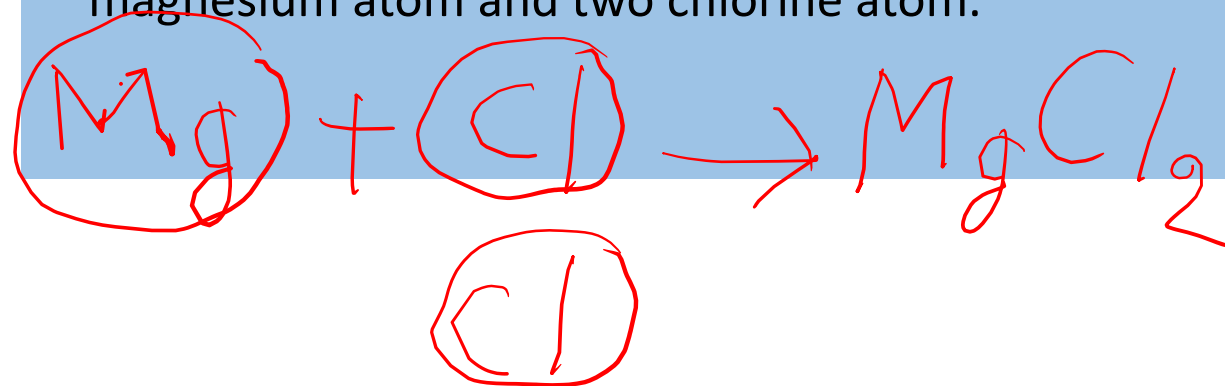
- A famous question for SSC is **what are the differences between atom and molecule? Write down yourself.**



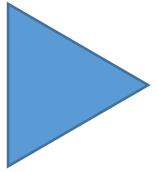
What is symbol and what is formulae?

- **Symbol:** The abbreviated form of English or Latin name of element is called its **symbol**. For example – The symbol of Chlorine is Cl.
- Why symbol is used?
- Symbol is used to save time and to minimize writing chemical reaction.
- The symbol of Carbon(C), Hydrogen(H) etc. has come from the English words.
- On the contrary, the symbol of Sodium, Copper etc. has come from Latin words. For example - Sodium whose latin word is *Natrium* and the symbol is **Na**.

- **The difference between symbol and formulae is very important for exam. Formulae:** In a compound if the amount of each atom is expressed with their symbols then the whole expressed thing is called a **formulae**. For example –
- MgCl_2 is the formulae of magnesium chloride. It means magnesium chloride consists of one magnesium atom and two chlorine atoms.



The rules for writing symbols and the chart where the latin names are given are very important for School Exam.



Let's jump into the deep ocean named atom and see what we get?

From class 8 we have learned that every atom consists of 3 permanent particles named proton, electron and neutron.

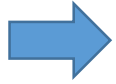
In future we will know that proton and neutron are not permanent!!!

Now let's have a comparison among those 3 particles.

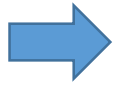
Here the mentioned (C) means coulomb which is the unit of **charge**

Relative mass and relative charge helps us to understand comparison easily

Name of particles	Symbol	Actual Charge	Relative Charge	Actual Mass	Relative mass
Electron	e	-1.60×10^{-19} C	-1C	9.11×10^{-28} g	0
Proton	p	1.60×10^{-19} C	1C	1.67×10^{-24} g	1
Neutron	n	0	0	1.675×10^{-24} g	1



Atomic Number : The number of proton presents in an atom is called atomic number . For example – Hydrogen has 1 proton. So the atomic number of hydrogen is 1. it is the identical characteristic of an element.



Mass number : the mass number of an atom means the total number of proton and neutron present in an atom. So
mass number = proton number+ neutron Number
for example, The proton number of sodium is 11 and the neutron number is 12. so mass number of sodium will be $(11+12)=23$.
if we know any two of the atomic number, mass number and neutron number, We will be able to define the third one.

$$11 + 12 = 23$$

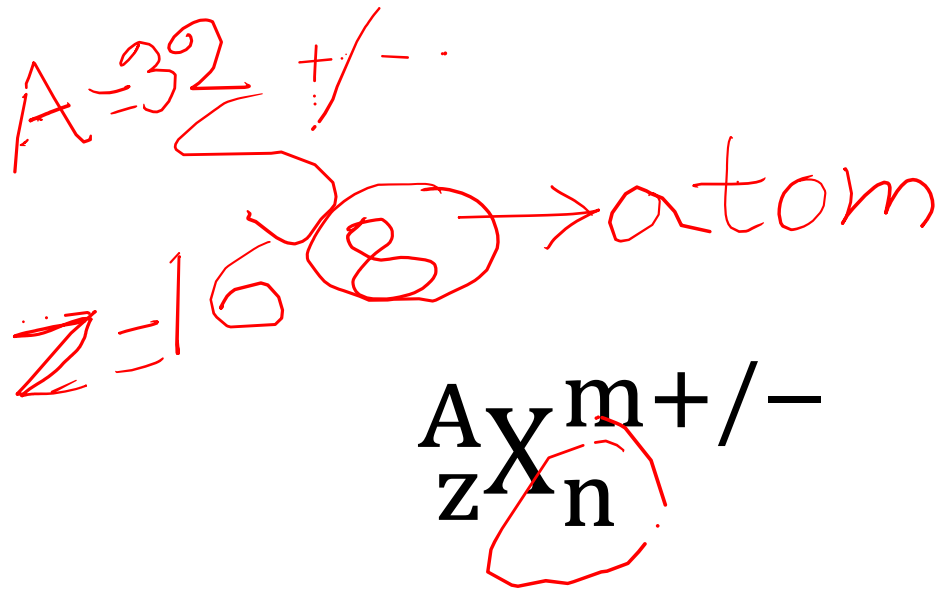
Poll Question: 01

01. Which is heavy?

(a) Proton (b) neutron (c) a + b (d) None

Math:

Expressing atomic number, mass number along with symbol :



- Here X=any symbol of element
- A=mass number
- Z=Atomic number
- n=quantity of atom
- m+ -=number of electron donated or accepted

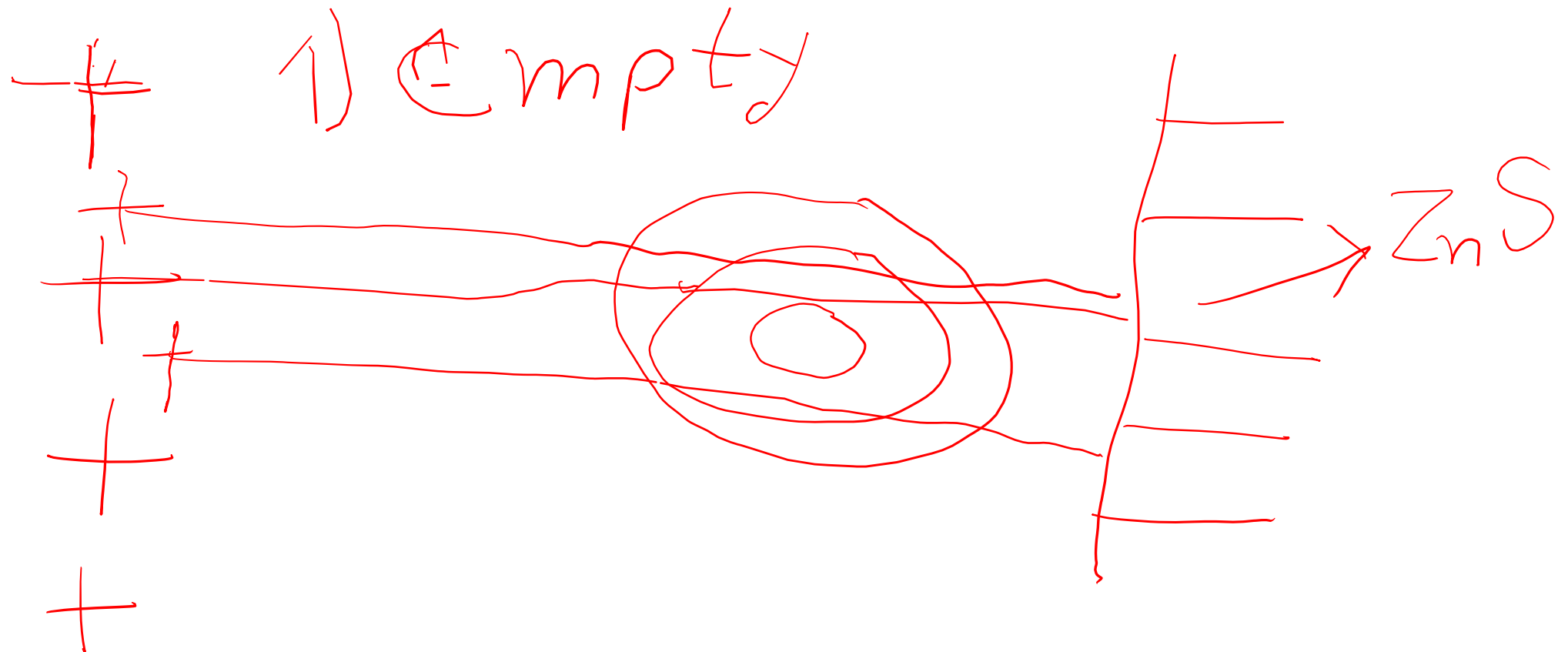
Poll Question: 02

02. The atomic number of nitrogen is 7. How will you express it?

(a) 7N (b) 7N (c) a + b (d) None

7N

Math:



Atomic model:

In class 8 we have learned about the great scientists and their valuable theories mentioned below –

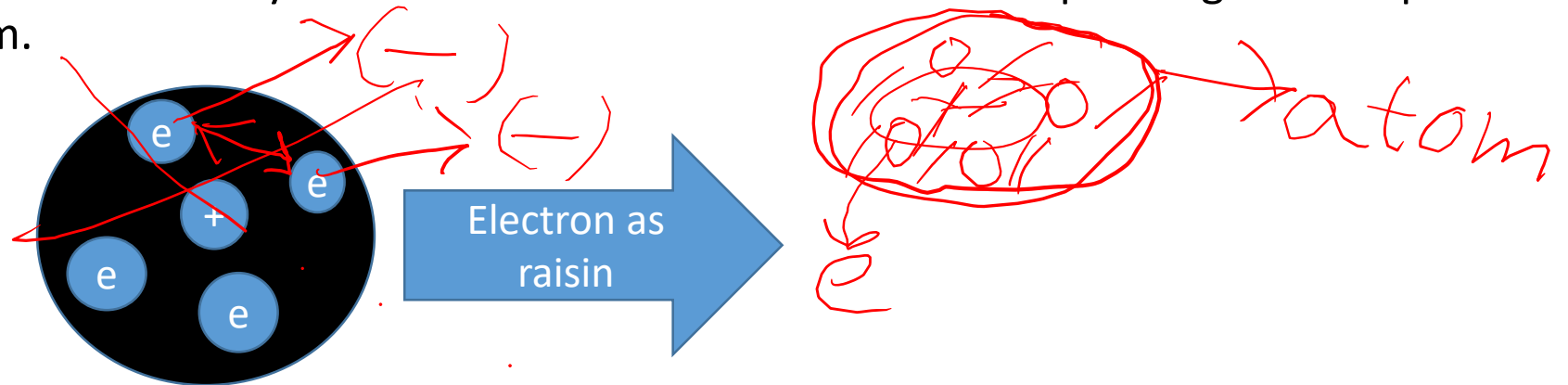
1) Democritus (Greek philosopher) said that atom was indivisible. He first used the word Atom (indivisible) derived from greek word 'atomas'.

2) At the Same time, two great scholars and philosophers PLATO and ARISTOTLE had contradicted Democritus theory and said that atom was also divisible.

3) In 1805 John Dalton (an English primary school teacher, Father of Atomic theory) experimentally said that Atom is indivisible.

Now What's happened later???

A great scientist named J.J Thompson (Discoverer of electron) first developed the atomic model called Raisin - Pudding model. He has said that electron Stays in a atom as like as raisin is found on pudding. He compared raisin as electron and pudding as atom.



There was huge amount of errors in Thompson's model. Try to find those.

In 1911 one of the greatest scientist named Earnest Rutherford has given an atomic model which is compared to the solar system. in 1913 he received nobel prize for this. So let's go and discuss Rutherford's great solar model . He did an excellent experiment called alpha gold bar experiment which we will learn in upper class.

Rutherford's solar model theory :

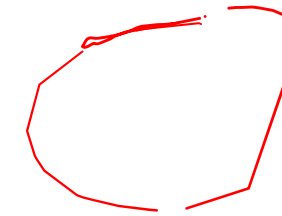
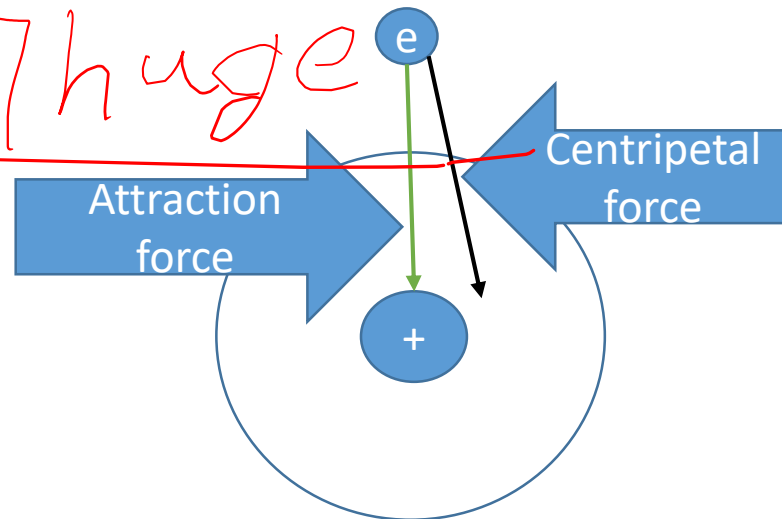
- 1) Inside the atom, there is a densely central core which is called nucleus consisting positively charged particle named proton . Outside nucleus, there is another particle consisting negative charge named electron. Electron is revolving around the nucleus just like planets revolving around the sun in fixed orbits.
- 2) The volume of nucleus is very small. Thus, maximum space of an atom is empty. The mass of electron is very low comparing with the nucleus. Thus , mass of atom is equivalent to mass of nucleus.
- 3) The number of positively charged proton and negatively charged electron is same. So, atom is electrically neutral.
- 4) The attraction between proton and electron generates centripetal force which is the reason for rotation of electron.



low proton



mass huge



Rutherford's Experiment:

Poll Question: 03

03. Rutherford has compared atomic model with solar model . Is it correct?

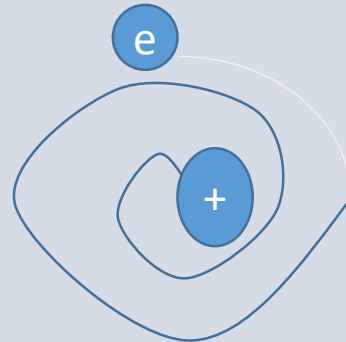
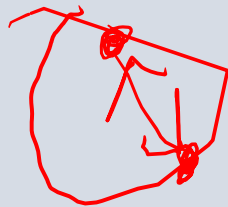
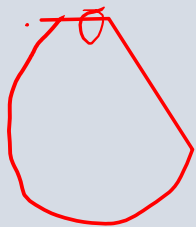
(a) Yes

☒ (b) no

Example:

Limitation of Rutherford's model 😞

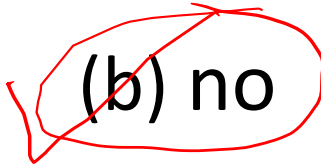
- 1) The solar planets have no charge but electron's are negatively charged. So wrong comparison.
- 2) How more than one electron will rotate in this model? No idea!!!
- 3) No idea for why spectrum is seen in atoms.
- 4) Scientist Maxwell has said that if a body is rotating, it will loose its energy and it will fall in it's center. Electrons are rotating too. According to, Maxwell's theory electron will fall into nucleus. Therefore, there will be no existence of atom . Rutherford's model had no answer for those above question.



Poll Question: 04

04. Is Rutherford's model able to explain Shape and size of electron's moving path?

(a) Yes

 (b) no

● That's all for today's lecture. Next day we will try to solve those above problems by scientist Bohr's model.

● Now the question is who is the discoverer of Proton and Neutron?

Before going to know the Bohr's model, we have to know what is momentum and angular momentum ?

Linear Momentum: Momentum means the product of mass and velocity. So, $\text{momentum}(P) = \text{mass}(m) * \text{velocity}(v)$. **Why is it necessary to measure momentum?**

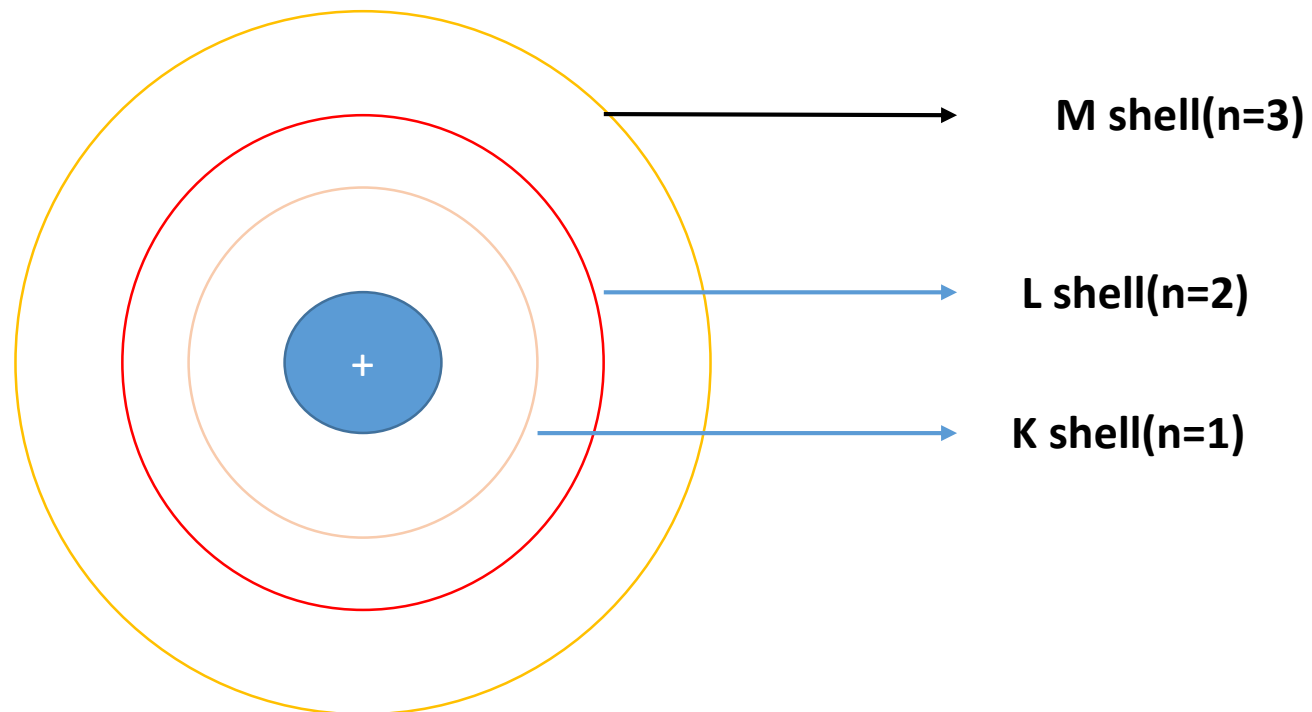
A bullet coming out from a gun has a very small mass then why does it strike so powerfully? Because its velocity is so high and the product of mass and velocity becomes very high.

Angular momentum: The product of linear momentum with radius is called angular momentum. So, $\text{angular momentum}(L) = \text{mass}(m) * \text{velocity}(v) * \text{radius}(r)$. Actually, angular momentum is the measurement of momentum when an object is rotating like electron, earth etc..

Now let's discuss **Neils Bohr's** atomic model which he has given in 1913.

Bohr's atomic model:

1) Around the nucleus there are some circular stable axes on which electron moves around. Those axis are called **orbit or first quantum number or energy level**. Orbit is expressed by the symbol n where $n = 1, 2, 3, \dots$ Any natural number. The first orbit, second orbit is named as K shell, L shell etc..



2)An electron while rotating on an orbit does not absorb or release any energy. Moreover, the angular momentum is constant when the electron is rotating in a fixed orbit .

The angular momentum $mvr = nh/2\pi$.

Here, m = mass of electron= 9.11×10^{-31} kg

V =velocity of electron rotating on a fixed orbit

r =radius of the orbit

n =orbit number(1,2,3...)

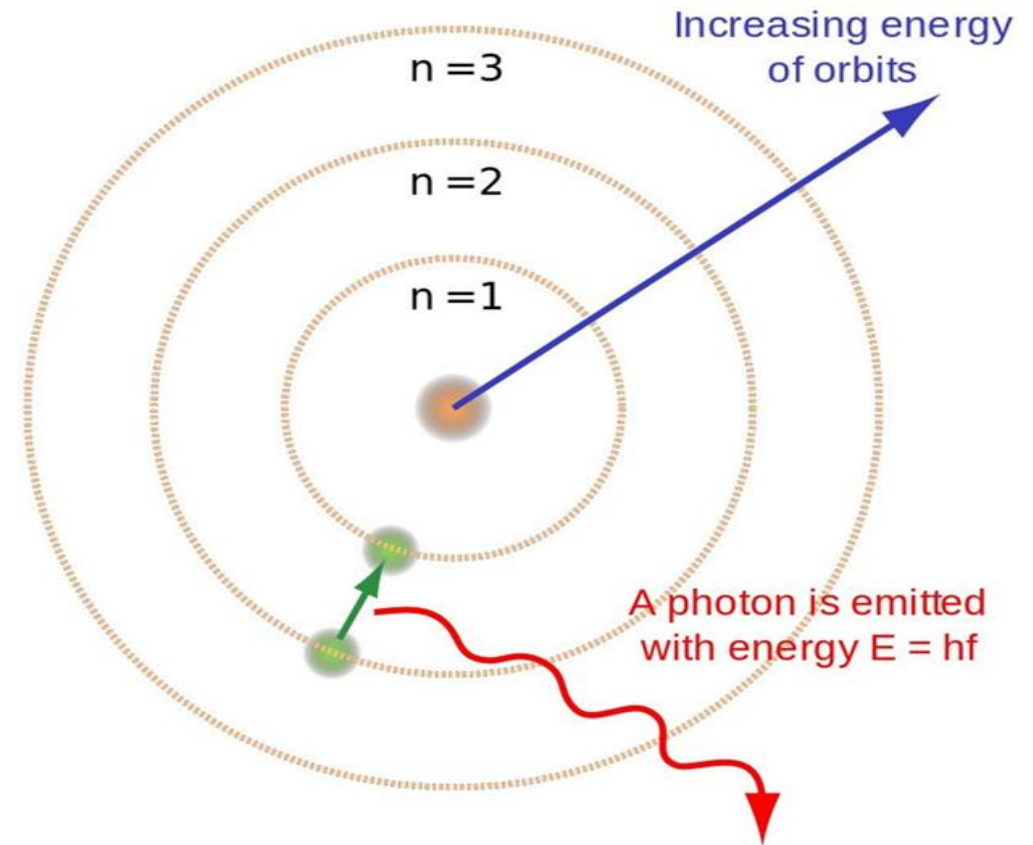
h =Plank's constant= 6.626×10^{-34} m²kg/s

$\pi = 3.1416$

Math:

3) an electron absorbs energy when it moves from lower to higher orbit . the electron emits energy when it moves from higher to lower energy level. This absorbed or emitted energy can be found through below equation . we can only see the emitted energy because emitted energy turns into different colour light energy. This colour light rays are called spectrum.

- Energy $E = hf = hc/\lambda$
- Here h =Plank's constant
- C =velocity of light= 3×10^8 m/s
- f =frequency of light
- λ =wavelength of light



Math:

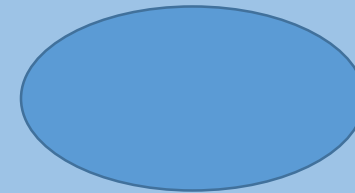
Success and limitations of bohr's model:

Success of Bohr's model

- 1) Explains the shape and size of orbit that Rutherford was not able.
- 2) Gives information about spectrum
- 3) Explains stability of atom.

Limitations of Bohr's model

- 1) Doesn't give any information if more than one electron emits energy.
- 2) The model explains that electron is rotating through the whole circular orbit. Later, we will know that electron rotates in an elliptical sub shell like below



- 3) doesn't explain spectrum of ion .

লেগে থাকো সৎভাবে,
স্বপ্ন জয় তোমারই হবে

ঔদ্যম-উন্মেষ শিক্ষা পরিবার

Thank You