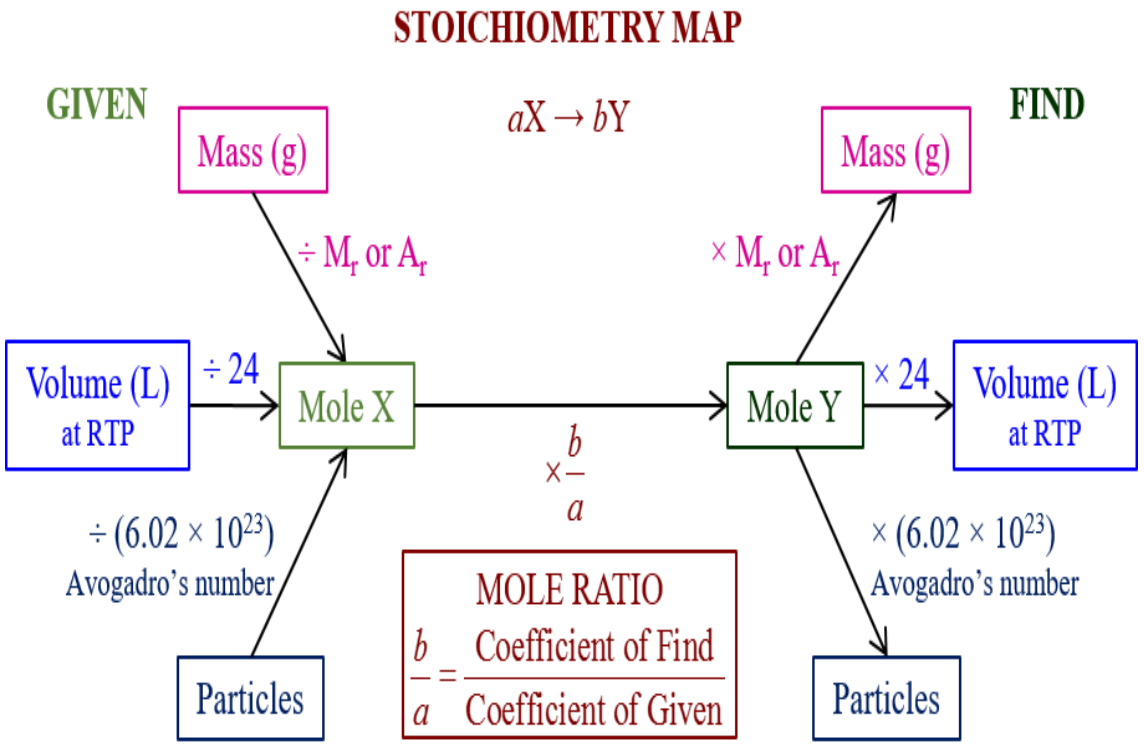
PROF: ZUBAIR AHMED SHAIKH

CLASS: XI

STOICHIOMETRY

CHAPTER NO. 1



BASIC DEFINITIONS OF CHEMISTRY

SCIENCE:- It is a systematic knowledge or education in which whatever is said, is proved with the help of experiments and practical.

CHEMISTRY:- It is the branch of science that deals with matter, its properties, structure and composition. The change that takes place in matter and the hypothesis, theories, laws and principles that governs these changes.

MATTER:- It is a thing, stuff or substance of which whole of the universe is made.
It is defined as anything that occupies space and has mass.

ENERGY:- It is the capacity of a material body to do work. It is found in many forms as heat, sound, light, electricity etc

MASS:- It is the quantity of matter present in anybody or substance. Its S.I unit is kilogram.

WEIGHT:-It is the force of attraction between any material body and the earth. It is directly proportional to the mass and is variable at different places.

ATMOSPHERE: - It is a layer of air that encircles whole of the earth from its surface upto 200 miles above approx.

ELEMENT:- A pure substance that cannot be simplified is called an element.
OR

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A substance in which all the atoms are chemically identical having same atomic number is called an element.

METALS:- These are the elements which have a lustre (shine). They are good conductors of heat and electricity. Some are ductile (can be drawn into wires), some are malleable (can form thin sheets). For example; copper, silver, aluminum and tin etc.

NON METALS:- These elements are poor conductors of heat and electricity. They cannot be drawn into wires and sheets because they are brittle (breakable).
For example; sulphur, carbon, phosphorus and iodine etc.

COMPOUND:- Compounds are pure substances which consist of two or more elements chemically combined in fixed proportion by mass. For example; zinc is a grey metallic solid and sulphur, a yellow solid at room temperature, when they are heated together a white solid zinc sulphide is formed which is different from zinc and sulphur.

MIXTURE:- A substance which consists of two or more pure substances, not chemically combined with each other. For example; air, soil etc.

SYMBOL:- A symbol is an abbreviation for the chemical name of an element and represents only one atom of the element. For example;

ELEMENTS	SYMBOLS
BORON	B
CARBON	C
NITROGEN	N
SODIUM (natrium)	Na

DENSITY:- Density of a substance is defined as **mass per unit volume**.

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}}$$

Density of a solid or liquid is expressed in kilogram per metre cube (Kg/m^3) OR in gram per centimeter cube (g/cm^3).

TIME:- Time is the interval between two occurrences. The S.I unit of time is second.

TEMPERATURE:-The degree of hotness or coldness of a substance is called temperature
OR
It is the measure of the intensity of heat. Its S.I unit is Kelvin (K).

$$\mathbf{K = {}^{o}C + 273}$$

VALENCY:- Valency is the tendency of an element to combine with other elements. It is also defined as the number of electrons lost or gained during a chemical reaction.

ISOTOPE:- Atom of the same element having same atomic number but different atomic masses. OR atoms of element having same number of electron and proton but different number of neutron are called isotopes

CHAPTER # 01
STOICHIOMETRY

Q#1: What is mole? Discuss with examples.

MOLE

INTRODUCTION:- mole is Latin word mean heap or pile. Mole is the S.I unit use for measuring the amount of substance of specific number of particles.

Atomic mass, formula mass and molecular mass expressed in grams are called as gram-atomic-mass, gram formula mass and gram atomic mass. Now days these three quantities are assigned by a single name mole.

DEFINITION:- Atomic-mass, formula-mass or molecular-mass expressed in grams is called mole**.**

CALCULATION: - The number of moles may be calculated by using following relationship.

$$\text{Number of moles of element} = \frac{\text{given mass of an element}}{\text{atomic mass}}$$

$$\text{Number of moles of compound} = \frac{\text{given mass of a compound}}{\text{molecular mass}}$$

For example: 23 gram of sodium = 1 mole and 180 gram of glucose contains 1 mole

Q#02: What is AVOGADRO'S NUMBER (N_A)?

INTRODUCTION:- This number was given by an Italian scientist Amado Avogadro, so it is known as Avogadro's number.

DEFINITION:- It is a number of atoms or molecules or ions which are present in one mole of an element or one mole of a compound. Its value is constant which is equal to 6.02×10^{23} atoms, molecules or ions.

REPRESENTATION:- It is represented by a symbol (N_A).

EXAMPLE:-

1 mole of C = 12 grams

12 grams of C contains = 6.02×10^{23} atoms.

1 mole of $CaCO_3$ = 100grams

100 grams of $CaCO_3$ contain = 6.02×10^{23} molecule.

Q# 03: Define stoichiometry. Discuss its relationships.

STOICHIOMETRY
(CALCULATIONS BASED ON CHEMICAL EQUATTION)

INTRODUCTION:- Stoichiometry is a Greek word which means study and measurement of elements. It is derived from stoicheum which means element and metric means measurement.

DEFINITION:- The calculations of amounts of reactants and products in a balanced chemical equation are called as stoichiometry

OR

The quantitative study of the relationship between the amounts of the reactants and products taking part in a chemical reaction as given by its balanced chemical equation

EXAMPLE:-

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

In the above reaction one mole of zinc reacts with two moles of hydrochloric acid to give one mole of zinc chloride and one mole of hydrogen gas or we can say that (65.4g) by mass of zinc reacts with (73g) by mass of HCl to give (136.4g) by mass of zinc chloride and (2g) by mass of hydrogen.

USES:- We can determine the unknown mass or volume of a reactant or product from the given mass or volume of the remaining substances.

RELATIONSHIP FOR STOICHIOMETRIC CALCULATIONS:-

There are three relationships involved in the stoichiometric calculations. They are:

1. Mass-Mass-relationships.
2. Mass-Volume relationships.
3. Volume- Volume relationships.

MASS-MASS-RELATIONSHIP:- In this relationship the mass of one compound is given and the mass of another compound which is taking apart in same chemical reaction is calculated. This relationship is applicable to solid, liquid and gases.

MASS-VOLUME RELATIONSHIP: - This relationship is used for the determination of unknown mass or volume of either a reactant or a product from the given mass or volume of remaining substances involved in a chemical reaction.

VOLUME- VOLUME RELATIONSHIP:- In this relationship the volume of one gas is given and the volume of another gas which is taking part in the same chemical reaction is calculated .

MOLAR VOLUME:- According to Avogadro's law one mole of any gas at standard temperature (0^0C) and standard pressure (1 atm or 760 torr) occupies a volume of (22.4 dm^3), this volume is called molar volume.

Q#04: What is limiting reactant? How does it control the amount of product formed in a chemical reaction?

LIMITING REACTANT

DEFINITION:- The reactant which is consumed first in chemical reaction is called as limiting reactant.

EXPLANATION:- In Stoichiometry, there are some chemical reactions in which the quantities of all the reactants are fixed, but one of these reactants consumes earlier than the others and thus the chemical reaction stops. Such reactant is called a limiting reactant.

EXAMPLE:- Suppose we have four pieces of butter and 6 slices of bread and we want to prepare sandwiches. Each sandwich requires 2 slices of bread and one piece of butter. Here we can make only three sandwiches because after making three sandwiches, the slices of bread are consumed completely but pieces of butter still left behind, It means bread is the "limiting reactant" and butter is "excess reactant". Amount of product (sandwiches) is determined by the limiting reactant.

DETERMINATION:- Following steps are used in determination of limiting reactants.1

1 Convert amount of all reactant into no: of moles.
2 Find out no: of moles of products from moles of reactant.
3 Find out limiting reactant

Q# 05 define rounding off data. Write down the rules for rounding off data with examples.

ROUNDING OFF DATA

DEFINITION:-The reduction of digits in a figure to desired digits is called rounding off data

OR

Dropping off one or more digits In a figure from its extreme right side.

EXPLANATION:- Any figure can be reduced to a desired number by retaining the required digits on left hand side of the figure and dropping the remaining digits from the right hand side.

RULES OF ROUNDING OFF THE DATA:-

1 If dropped digit is more than 5, then add 1 to the next digit.
E.g:- 6.58 = 6.6
7.58556 = 7.6
9.99 = 10.0

2 If dropped digit is less than five, then next digit remains same.
E.g:- 6.54 = 6.5
7.53433 = 7.5

3 If dropped digit is exactly five, then there are two possibilities.
(a) Possibility-1:- If next digit is odd (1, 3, 4, 7, 9) then add 1 to it.
E.g.:- 7.35 = 7.4
9.75 = 9.8
(b) Possibility-2:- If next digit is even (2, 4, 6, and 8) then nothing is added to it.
E.g.:- 7.45 = 7.4
9.85 = 9.8

Q#06: How can you describe the exponential notation with examples?

EXPONENTIAL NOTATION:-

DEFINITION:- The numbers expressed as power of one base (as 10) are called exponential notation.

OR

The short hand description of number containing large number or very small number of digits is known as exponential notation. This is a scientific way of writing such numbers.

PARTS: - There are three parts of such notations:

1 Coefficient.
2 Base.
3 Exponent.

COEFFICIENT: This is first part of the number which is between 1 to 9 and is positive.
BASE:- It is mostly 10.
EXPONENT It is the power over 10 which may be positive or negative.
This shows the number of places the decimal has been moved.

RULES:-

(a) If decimal is moved to left, exponent will be positive.
(b) If decimal is moved to right exponent will be negative.

FOR EXAMPLE;

$5200000 = 5.2 \times 10^{6}$
$0.0000052 = 5.2 \times 10^{-6}$

USES:- It is used to solve problem numbers with very large number of digits. It is also the basis of logarithm.

Q#07: Defines theoretical yield, actual yield, and percentage yield. Why the practical yield is often less than theoretical yield?

YIELD: The amount of product obtained as a result of chemical reaction is called yield

THEORETICAL YIELD: The amount of product calculated from balance chemical equation is called theoretical yield.

ACTUAL YIELD OR PRACTICAL YIELD: The amount of product that is actually obtained in reaction is called actual yield.

PERCENT YIELD: the efficiency of chemical process id judged by calculating the ratio of practical yield and theoretical yield. This ratio is called percent yield.

OR

Actual yield divided by the theoretical yield and answer is multiplied by 100 is called percent yield.

$$\% \text{ yield} = \frac{\text{Actual yield obtian in practical work}}{\text{Theoretical yield}} \times 100$$

The practical yield is often less than theoretical yield because we know that many chemical reactions do not produce the amount of products expected theoretically. The reasons are:

(a) .either some amount of reactant may not react
(b) Reactions are reversible.
(c) Mechanical loss of product during the physical process like distillation, filtration, crystallization, washing etc
(d) Side reaction products bye – products

Q# 08: Define the following term:

(a) **STOICHIOMETRY:** The calculations of amounts of reactants and products in a balanced chemical equation are called as stoichiometry

OR

The quantitative study of the relationship between the amounts of the reactants and products taking part in a chemical reaction as given by its balanced chemical equation.

(b) EXPONENTIAL NOTATION: The numbers expressed as power of one base (as 10) are called exponential notation.

OR

The short hand description of number containing large number or very small number of digits is known as exponential notation. This is a scientific way of writing such numbers.

(C) MOLAR VOLUME: MOLAR VOLUME:- According to Avogadro's law one mole of any gas at standard temperature (0^0C) and standard pressure (1 atm or 760 torr) occupies a volume of (22.4 dm^3), this volume is called molar volume

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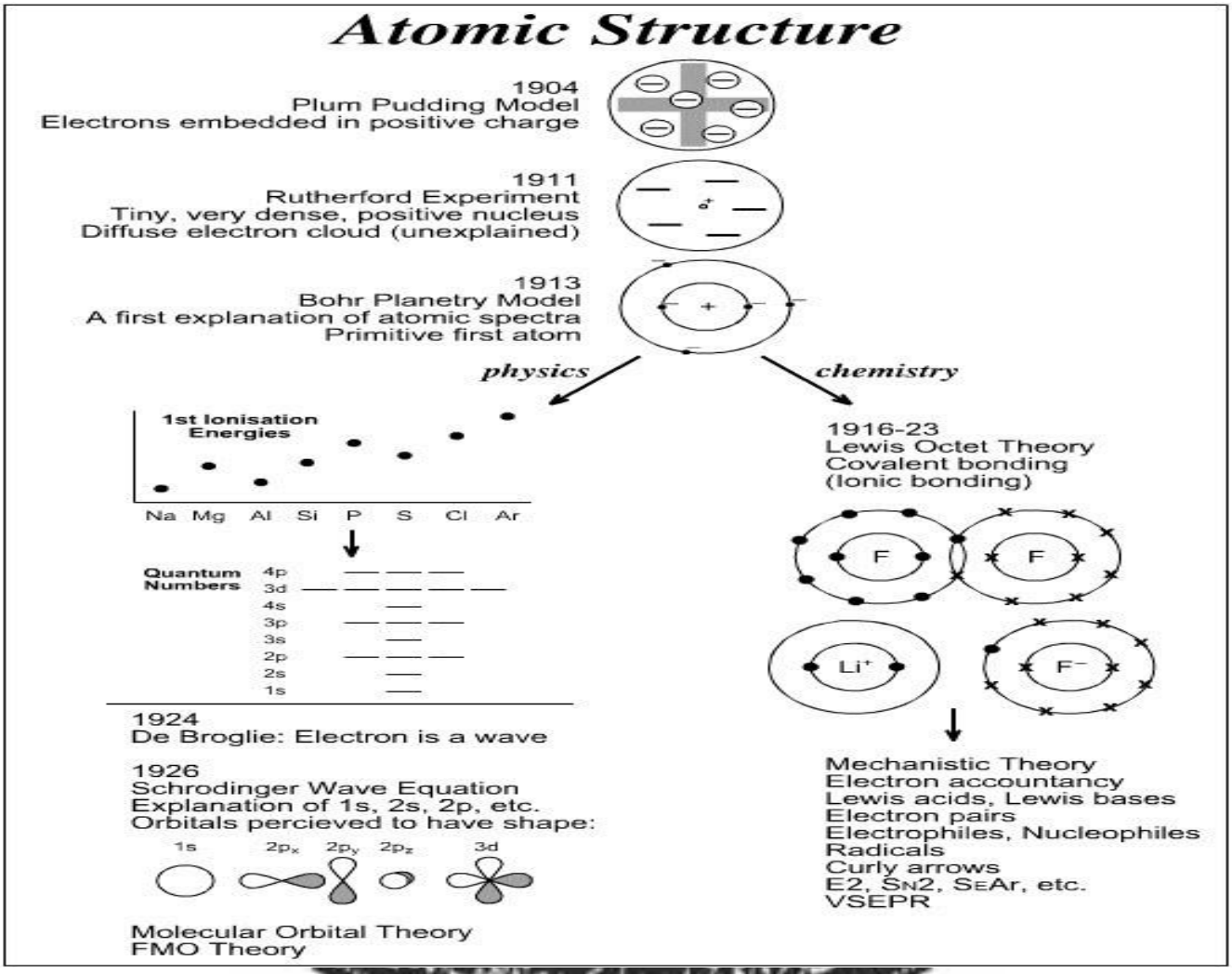
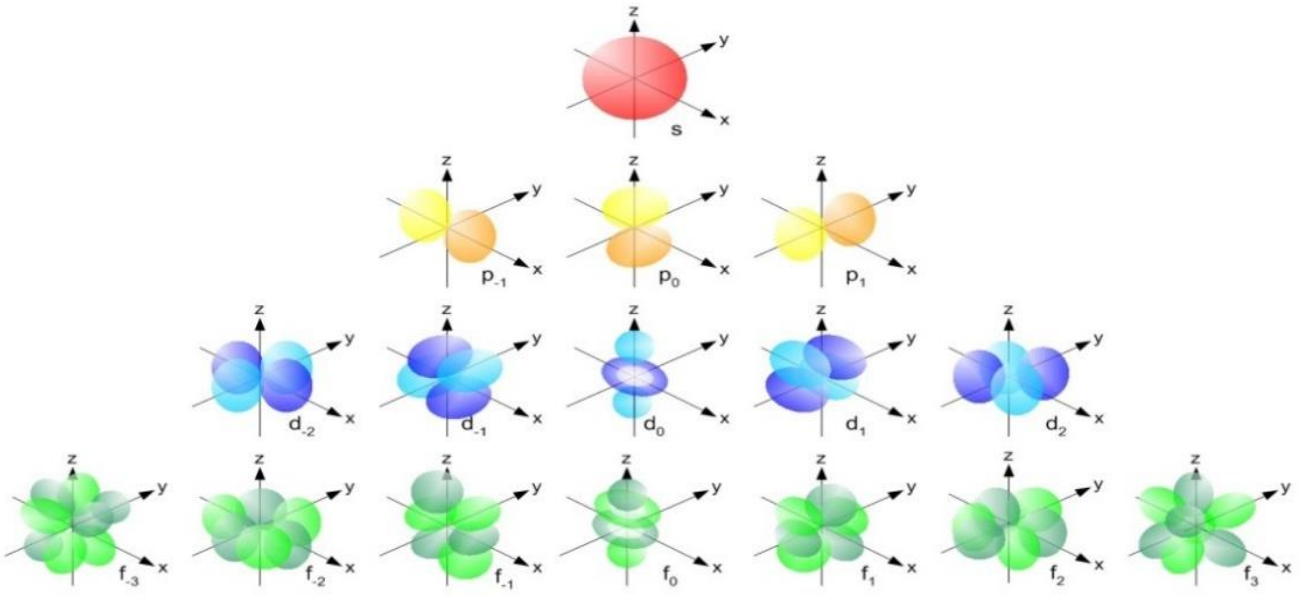
ATOMIC STRUCTURE

CHAPTER NO. 02





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SHORT QUESTION

Q#1: Differentiate between continuous and line spectrum.

S #	CONTINUOUS SPECTRUM	LINE SPECTRUM
1	It is produced when white light e.g sunlight tungsten bulb is passed through a prism	It is produced when light from a gaseous source metal elements in excited state is passed through a prism
2	It consists of many colours which are diffused and there is no demarcation between different colours	It consists of single colours and there is demarcation between different colours
3	It has no dark spaces between colours	It has dark spaces between colours
4	It consists of polychromatic light	It consists of monochromatic light
5	It does not help in determining structures of elements	It helps in determining structures of elements

Q#2 Give three properties of $\propto, \beta$ and γ rays.

PROPERTIES OF ALPHA RAYS:

1. These rays are composed of helium nuclei and carriers two positive charge. (He^{++})
2. The velocity of these rays is $1/10^{th}$ of the velocity of light
3. The penetrating power of these rays is very small. They can move few cm in air and can be stopped by 0.1 mm thick Aluminum foll.

.

PROPERTIES OF BETA RAYS:

1. These rays are fast moving beta particles, composed of electrons and carriers negative charge.
2. The velocity of these rays is equal to velocity of light.
3. The penetrating power of these rays is greater than alpha rays and they can pass through 5cm thick Aluminum foil.

PROPERTIES OF GAMMA RAYS: (killer rays)

1 They are high energy electromagnetic radiation.
2 The travel of it velocity of light and have strong penetration power. These rays will pass through lead sheet of thickness 15-20cm.
3 They carry no charge so they are not deflected by magnetic and electric field

.

Q#3: What is the shape of orbital for which l = 0 and l =1.

Ans: The shape of orbital can be find with the help of Azimuthal quantum numbers (l). When value of l = o the orbital is called s orbital and shape is spherical. When value of l = 1 it is p orbital and shape is dumb bell shape.

Q#4: How does an orbital different from orbit?

SNO	Orbit	Orbital
1	It is well defined circular path around the nucleus in which the electron revolve	It is region in three dimensional space around the nucleus where the probability of finding electron is maximum
2	It is a circular in shape	Orbital like s, p, d are spherical, dumb bell and double dumb bell in shape respectively
3	It represents that an electron moves around the nucleus in one plane	It represents that an electron moves around the nucleus along three dimensional space
4	It does not take part in hybridization	It takes part in hybridization
5	The maximum number of electrons in an orbit is $2n^2$, where n is the number of orbit	The maximum number of electron in an orbital is two with paired spins

6	An orbit means that the position as well as momentum of an electron can be known with certainty	An orbital does not represent the position and momentum of an electron with complete certainty

Q#5: Explain why the filling of electrons in 4s orbital takes place prior to 3d?
Ans: According to the Aufbau principle, electrons are filled progressively to the various sub shell in the order of increasing energy. The energy of 4s orbital is less than 3d orbital because (n+l) = ((4+0) value of 4s is 4 while (n+l) = (3+ 2) value of 3d is 5 that's why filling of 4s orbital take place prior to 3d.

Q#6: mention the Defects of Bohr atomic model.
There are many defects in Bohr atomic model which are given below
(i) It does not explain the spectra of atoms having more than one electron.

(ii) Bohr's atomic model failed to account for the effect of the magnetic field (Zeeman Effect) or electric field (Stark effect) on the spectra of atoms or ions. It was observed that when the source of a spectrum is placed in a strong magnetic or electric field, each spectral line further splits into a number of lines. This observation could not be explained on the basis of Bohr's model.

(iii) De Broglie suggested that electrons like light have a dual character. It has particle and wave characters. Bohr treated the electron only as a particle.

(iv) Another objection to Bohr's theory came from Heisenberg's Uncertainty Principle. According to this principle "It is impossible to determine simultaneously the exact position and momentum of a small moving particle like an electron". The postulate of Bohr that electrons revolve in well-defined orbits around the nucleus with well-defined velocities is thus not tenable.

Q# 07 Write down the electronic configuration of the following

(a) Fe (Z = 26) **(b) Br^- (Z = 35)** **(c) Ca^{+2} (Z = 20)**

Element	**Electronic Configuration**
Fe (Z=26)	$1S^2 2S^2 2p^6 3S^2 3p^6 4S^2 3d^6$
Br^- (Z=35)	$1S^2 2S^2 2p^6 3S^2 3p^6 4S^2 3d^{10}\ 4p^6$
Ca^{+2} (Z=20)	$1S^2 2S^2 2p^6 3S^2 3p^6$

DESCRIPTIVE QUESTION

Q#1: State the postulates of Bohr atomic theory.

POSTULATES OF BOHR'S THEORY:

1. Electrons revolve around the nucleus in circular path of definite energy which are called stationary orbits or shells or energy levels

2. The electron does not absorb or emit energy as long as it remains revolve in the same orbit.

3. It can gain or lose energy only when it jumps from lower to high or higher to lower energy levels.

4. When an electron jumps from higher energy level (E_2) to lower (E_1), it emits energy equal to the energy difference between the two orbits.

$$\Delta E = E_2 - E_1 = h\nu$$

Where h is Planck's constant and ν is the frequency.

5. The transitions of electron between two orbits yield a single unique spectral line

6. Stationary orbits are those in which product of momentum and circumference is equal to Planck's constant or integral multiple of it.

For first orbit

$$mv \times 2\pi r = h$$

For any orbit

$$mv \times 2\pi r = nh$$

7. The angular momentum of electron in stationary orbit is given as follows

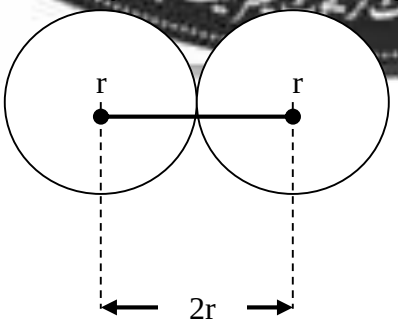
$$mvr = \frac{nh}{2\pi}$$

Q# 02 Derive the following expressions

(a) Radius
(b) Energy
(c) Frequency
(d) Wave number

DERIVATION OF RADIUS

Let electron of charge "e" and mass "m" revolve around the nucleus whose positive charge is "Ze". In an orbit of radius "r" with velocity "v" as shown in figure.



Therefore the centripetal force i.e. the force of attraction between nucleus and electron will.

Be $$F = \frac{KZexe}{r^2} = \frac{KZe^2}{r^2}$$ ----------(a)

But centrifugal force i.e. the force of electron to fly away from nucleus is equal to $\frac{mv^2}{r}$.

But electron is revolving in same orbit therefore both forces are equal.

$$\therefore \frac{KZe^2}{r^2} = \frac{mv^2}{r}$$

$KZe^2 = mv^2 r$

$$r = \frac{KZe^2}{mv^2} \text{ ---------- (b)}$$

In this equation all other factors are constant except "V". The value of "V" may be calculated from the 3rd Bohr's Postulate. According to Bohr's theory

$$mvr = \frac{nh}{2\pi} \qquad \text{Or} \qquad v = \frac{nh}{2\pi mr}$$

But putting the value of "v" in equation b we get.

$$r = \frac{KZe^2}{m \times \frac{(nh)^2}{(2\pi mr)^2}} \qquad \text{OR} \qquad r = \frac{KZe^2}{\frac{m \times n^2h^2}{4\pi^2m^2r^2}}$$

$$\therefore r = \frac{KZe^2 \times 4\pi^2mr^2}{n^2h^2}$$

OR $n^2h^2r = KZe^2 \times 4\pi^2mr^2$

OR $n^2h^2 = KZe^2 \times 4\pi^2 mr$

$$\therefore r = \frac{n^2h^2}{4\pi^2mKZe^2} \text{ --------- (c)} \qquad K = 1/4\pi\epsilon_o$$

$$\therefore r = \frac{n^2h^2}{4\pi^2mZe^2 \frac{1}{4\pi\epsilon}}$$

$$\therefore r = \frac{\epsilon_o n^2h^2}{\pi mZe^2}$$

This equation gives the radii of all the possible stationary orbitals. By putting the values of constants we can calculate the radius of 1st orbit of hydrogen and values of constant are following.

$\varepsilon_0 = 8.84 \times 10^{-12}$ C²/ j.s h = 6.625×10^{-34} j. Sec m = 9.11×10^{-31} Kg

e = 1.602×10^{-19} C π = 3.14 n = no of orbit z = atomic number

$$\boldsymbol{a_0 = \frac{\epsilon_0 n^2 h^2}{\Lambda m ze^2} = 0.59A^o}$$

$$\boldsymbol{r = 0.529A^o \times n^z}$$

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DERIVATION OF ENERGY

E = K.E + P.E ---------- 1

K.E = $\frac{KZe^2}{2r}$

P.E = - $\frac{KZe^2}{r}$

Fc	=	Fg
$\frac{KZe^2}{r^2}$	=	$\frac{mv^2}{r}$
$\frac{KZe^2}{r}$	=	mv^2

But putting the value of K.E and P.E in equation 1 we get,

$$E = \frac{KZe^2}{2r} + \left(-\frac{KZe^2}{r}\right)$$

$$E = \frac{KZe^2}{2r} - \frac{KZe^2}{r}$$

$$E = \frac{KZe^2 - 2KZe^2}{2r} - \frac{-KZe^2}{2r}$$

$$E = \frac{-KZe^2}{2r} \text{ ----------2}$$

By putting the value of r in equation 2 we get,

$$r = \frac{Eon^2 h^2}{\pi m Ze^2}$$

$$E = \frac{-KZe^2}{2\left(\frac{Eon^2h^2}{\pi mZe^2}\right)}$$

$$E = \frac{-KZe^2 \times \pi mZe^2}{2Eon^2h^2}$$

Now put the value of k = $^1/_{4\pi Eo}$

$$E = \frac{-Z^2 e^4 m}{\theta \in_o^2 n^2 h^2}$$

K (bohr constant) = $\frac{e^4 m}{\theta \epsilon o^2 h^2}$ = 2.18 x 10^{-18} J/S

$$E = -k\frac{z^2}{n^2}$$

DERIVATION OF FREQUENCY = υ = neu

$$h\upsilon = \Delta E$$

$$h\upsilon = E_2 - E_1$$

$$h\upsilon = \left(\frac{-Z^2e^4m}{\theta\varepsilon o^2 n_{2^2} h^2}\right) + \left(\frac{-Z^2e^4m}{\theta\varepsilon o n_{1^2} h^2}\right)$$

$$h\upsilon = \frac{-Z^2e^4m}{\theta\varepsilon o^2 n_{2^2} h^2} + \frac{Z^2e^4m}{\theta\varepsilon 0^2 n_{1^2} h^2}$$

now we shuffle the + $\in_1$ – value

$$h\upsilon = \frac{-Z^2e^4m}{\theta\varepsilon o^2 n_1{}_2 h^2} + \frac{Z^2e^4m}{\theta\varepsilon 0^2 n_2{}_2 h^2}$$

now we take the common values

$$\upsilon = \frac{-Z^2e^4m}{\theta\varepsilon o^2 h^3}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\upsilon = \frac{k\,(bohr)}{h}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Wave Number:

We know that the equation of wave velocity is

$$c = \lambda\upsilon$$

$$\lambda = \frac{c}{\upsilon}$$

$$\frac{1}{\lambda} = \frac{\upsilon}{c}$$

We know that wave number is =

$$\upsilon = \frac{1}{\lambda}$$

Put the value of eq in $\frac{1}{\lambda}$

$$\upsilon = \frac{\upsilon}{c} = \frac{k\,(bohr)}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

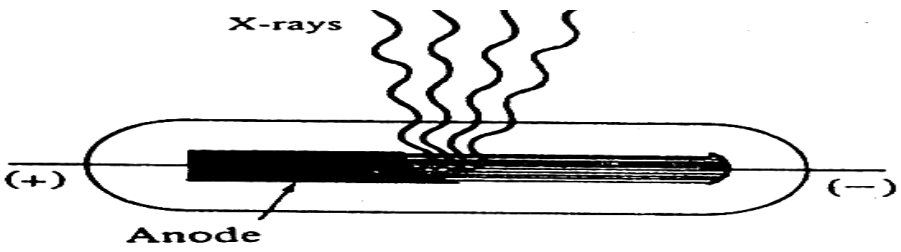
$$\upsilon = RHZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

RH= 1.09678 x 10^7 m^{-1}

$$\upsilon = 1.09678 \times 10^7\ m^{-1} z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Q#03 what are the X rays? How are they produced? Give their properties and uses

(a) INTRODUCTION:- These rays were discovered by Roentgen in 1895.
(b) PRODUCTION:- When cathode rays strike the anode, then some unknown rays were produced. These unknown rays were called as X-rays ("X" for unknown)



(c) PROPERTIES:

(i) These are short wavelength, high energy electromagnetic rays

(ii) These rays possess high penetrating power. They penetrate through paper, rubber, glass, metal and human flash etc.
(iii) These rays travel in straight line
(iv) Different elements produce X-rays of different wave-lengths.
(v) They affect the photographic film
(vi) These rays are unaffected by electric and magnetic field
(vii) these rays damage and destroy the living cells

Uses Of X – Rays: x rays are used to

1. Analysis of metallic substance (bullets in flesh)
2. Examine the defective or damage teeth by dentist
3. Destroy the cancer cells
4. Scanning the luggage in airport containing illegal goods
5. Determine the structure of crystals (x ray diffraction)

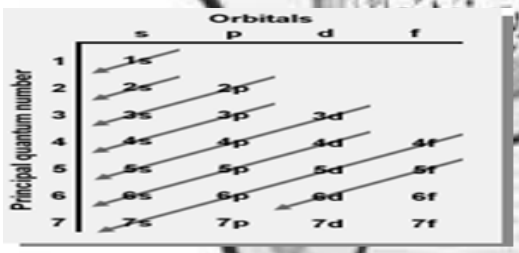
QNO : 4 state and illustrate the following rules for electronic configuration

1- AUFBAU PRINCIPLE:-

(a) INTRODUCTION:- This principle decides the configuration of electrons of this rule decides the filling of electrons in sub energy levels.

(b) DEFINITION:-The rule states that "The lower sub-energy levels are filled first then higher and higher".

(c) SCIENCE:- The scheme of filling sub-energy levels is given below.



(d) Sequence: The sequence of filling of sub energy levels is following.
1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6, 4f, 5d, 6p, 7s.

(e) CONFIGURATION:

H = 1 = $1s^1$	F = 9 = $1s^2, 2s^2, 2p^5$
He = 2 = $1s^2$	Ne = 10 = $1s^2, 2s^2, 2p^6$
Li = 3 = $1s^2, 2s^1$	Na = 11 = $1s^2, 2s^2, 2p^6, 3s^1$
Be = 4 = $1s^2, 2s^2$	Cl = 17 = $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
B = 5 = $1s^2, 2s^2, 2p^1$	Ca = 20 = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
C = 6 = $1s^2, 2s^2, 2p^2$	Mn = 25 = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
N = 7 = $1s^2, 2s^2, sp^3$,	O = 8 = $1s^2, 2s^2, 2p^4$

(2) WISS WESSER RULE = (n + *l*) RULE

(a) INTRODUCTION:- This rule guides the filling of sub-energy levels.

(b) DEFINITION: The sub-energy levels of lowest sum of n+*l* will be filled first.

For example: Out of 4s and 3d, 4s will be filled first because its n+*l* sum is smaller then 3d.

4s = 4 + 0 = 4
3d = 3 + 2 = 5

(ii) If sum of n + *l* for two sub-energy levels is same than the sub energy level, whose principle quantum number (energy level) is lowest will be filled first.

FOR EXAMPLE:- Out of 3p and 4s, 3p will be filled first because the value of its energy level lowest but sum in same.

3p = 3 + 1 = 4
4s = 4 + 0 = 4

(3) HUND'S RULE:

(a) INTRODUCTION: This rule decides the filling of degenerate orbitals where degenerate orbitals means orbitals of equal energies px, py, py.

(b) DEFINITION: If the orbitals of same energy are empty, then the electron will live in separate orbitals with clock wise direction of spin.

e.g N = 7 = $1s^2$, $2s^2$, $2px^1$, $2py^1$, $2pz^1$ and O = 8 = $1s^2$, $2s^2$, $2px^{1\downarrow}$, $2py^1$, $2pz^1$

(4) PAULI-EXCLUSION PRINCIPLE

INTRODUCTION: The rule was enunciated by Pauli in 1925

STATEMENT: "**In an atom, no two electrons can have the same set of four quantum members OR four quantum numbers of two electrons in an atom can never be equal.**

Example: Therefore in an atom two electrons may have a maximum of three quantum numbers of same value but the fourth quantum number would be different.

e.g. He = 2 = $1s^2$.

Electron	n	L	m	s
1st	1	0	0	+1/2
2nd	1	0	0	-1/2

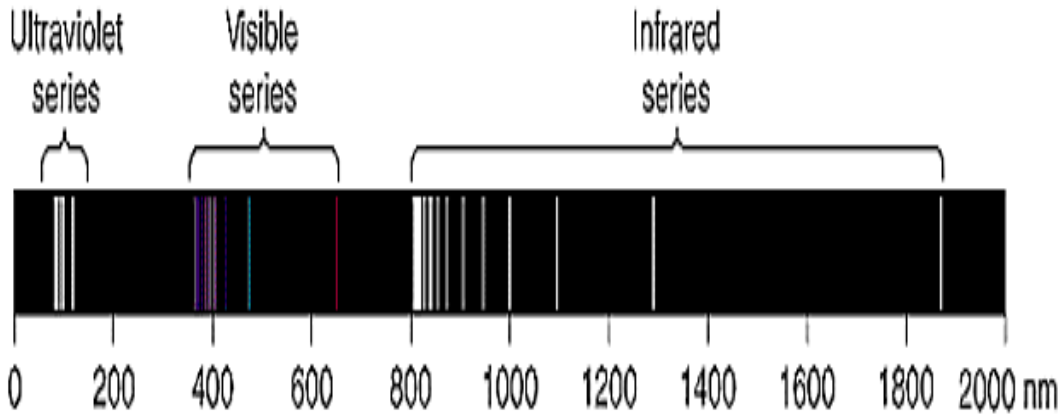
It means in any orbital when the values of n, *l*, m of two electrons are same then these electrons can occupy same orbital with opposite spins (means spin quantum numbers will be different).

Q# 04 explain hydrogen spectrum in terms of Bohr theory.

FORMATION OF HYDROGEN SPECTRUM:

According to Bohr's theory, "At ordinary temperature, the electron in hydrogen atom resides in lowest energy level i.e first orbit or ground state. When electrically it is heated at low pressure in a discharge tube, the electron of different hydrogen atoms absorb different amount of energy and jump to an appropriate high energy level. They are now said to be in excited state.

All the atoms in excited state are unstable. So, they jumps back to orbit of lower energy and releases energy. These energetic waves are separated by prism according to their wavelength and thus hydrogen spectrum is obtained.



PROF: ZUBAIR AHMED SHAIKH

INTRODUCTION:

- Hydrogen is filled in a discharge at a very low pressure. A bluish light is emitted from the discharge tube when current passes through hydrogen gas.
- This light when viewed through a spectrometer shows several isolated sharp lines.
- These are called spectral lines and can be classified five groups.

LYMAN SERIES:

- Lyman discovered spectral lines series in ultraviolet region. He observed these lines in ultraviolet region when electron jumps from higher energy orbit to first orbit. Wave number of each line was found by following formula.
- $\bar{\nu} = R_H Z^2 \left(\frac{1}{1^2} - \frac{1}{n_2^2} \right)$
- n_2 = 2,3,4,5,6.

BALMER SERIES:

- He found a series of lines in visible region (i.e. having λ between 4000 to 8000 A^O). They were called Balmer series. He observed these lines in visible region when electron jumps from higher energy orbit to second orbit. He proposed on empirical formula to find wave number $\bar{\nu}$ of each line.
- $\bar{\nu} = R_H Z^2 \left(\frac{1}{2^2} - \frac{1}{n_2^2} \right)$
- n_2 = 3,4,5,6

PASCHEN SERIES:

- Paschen discovered an other such series in infrared region. He observed these lines in infrared region when electron jumps from higher energy orbit to third orbit. $\bar{\nu}$ of each line was given by:
- $\bar{\nu} = R_H Z^2 \left(\frac{1}{3^2} - \frac{1}{n_2^2} \right)$
- n_2 = 4,5,6.

BRACKETT SERIES:

- It is discovered by Brackett. He observed these lines in infrared region when electron jumps from higher energy orbit to fourth orbit.
- $\bar{\nu} = R_H Z^2 \left(\frac{1}{4^2} - \frac{1}{n_2^2} \right)$
- n_2 = 5,6

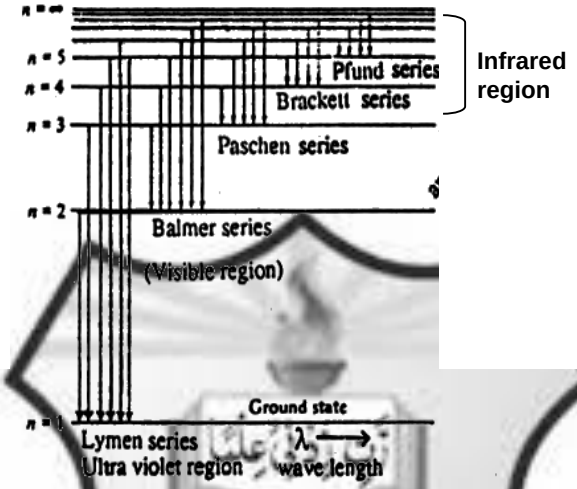
PFUND SERIES:

- It is discovered by Pfund. He observed these lines in far infrared region when electron jumps from higher energy orbit to fifth orbit.
- $\bar{\nu} = R_H Z^2 \left(\frac{1}{5^2} - \frac{1}{n_2^2} \right)$
- n_2 = 6,7,…..

GENERAL EXPRESSION:

- A general expression can give wave number of each line each series.
- $\bar{v} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$
- Value of $R_H = 109678 cm^{-1}$
- $n_2 = 2, 3, 4, 5, \ldots\ldots$

DIAGRAMMATICAL REPRESENTATION:



Q#5: describe the four quantum numbers needed to specify an electron in an atom. Write all possible value of l, m and s for n = 2

QUANTUM NUMBERS.

Each electron in an atom is completely described by four quantum numbers.

(1) PRINCIPLE QUANTUM NUMBER:

This quantum number describes the size of orbits (Energy level) and it is represented by (n). Its value are 1,2,3,4 etc.

For K, n = 1
For L, n = 2
For M, n = 3
For N, n = 4

(2) AZIMUTHAL QUANTUM NUMBER:

The quantum number governs the shape of orbits and represented by (l). This can have value l = 0 to n–1

If n = 1 l = 0 to 1-1
l = 0 to 0
l = 0 = s

It means K energy level contain one sub energy level, which is called as "s".

If n = 2 l = 2 – 1
l = 0 to 1
l = s,p

It means "l" energy level contains two sub-energy levels which are called as "s" and "l". For "s" the value of l = 0, for "p"the value of l = 1

(3) MAGNETIC QUANTUM NUMBER (M):

This quantum number gives the orientation of orbitals is space and represented by m.
The values of m = - l to + l through zero.
For example: If l = 0, m = o = s (one orbital).
l = 1 m = -1, 0, + 1 = Px, Py, Pz.

It means "P" sub energy level contains three orbitals, which are called as Px, Py and Pz.

(4) SPIN QUANTUM NUMBER = S:

This quantum number describes the spin of electron in an atom and represented by "s". There are two direction of spin namely.

(1) Clockwise = +1/2

(2) Anticlockwise = -1/2

Q#6: how can x ray help to determine the atomic number of elements?

X-RAYS AND ATOMIC NUMBER:- Moseley in 1911 studies the different wave lengths of X-rays produced from anode of different metals. On careful examination, Moseley found that the number of positive charges on the nucleus increase from atom to atom by single electronic unit. He called the number of positive charges as the atomic-numbers. Thus the atomic number of an element is the number of protons present in nucleus of that element and represented by Z.

RESULT: X-rays analysis is used in the determination of atomic numbers and relationship between atomic number and protons. It is also worth to note that Ruther-Ford theory was also supported by Moseley's experiment.

Q#07 write down the main points of planks quantum theory:

PLANK'S QUANTUM THEORY:

(a) INTRODUCTION: This theory was proposed by Max-Plank in 1900 and extended by Einstein in 1905 and Neil-Bohr in 1913. The main points of this theory are following.

(B) MAIN POINTS:-

(i). Emission or absorption of energy by an atom is not continuous.

(ii) Emission or absorption of energy takes place in the form of specified amounts called as quantum (packets of bundles).

(iii) The amounts of energy emitted or absorbed depends upon the frequency (υ) of radiation. It is given by the following equation.

$E - h\nu^-$ E = Energy,

ν^- = frequency

h = plank's constant = $.625 \times 10^{-34}$ J.s OR 6.625×10^{-27} erg. Sec.

(c) CONCLUSION: From the study of quantum theory, it is concluded that the amount of energy absorbed or emitted is quantized. It is emitted or absorbed in the form of small packets or multiple of these packets.

i.e. $h\nu^-$, $2h\nu^-$, $3h\nu^-$ etc.

Q#08 define spectroscopy, spectrum. Describe continuous and discontinuous (line) spectrum.

SPECTROSCOPY: the branch of chemistry which deals with emission or absorption of radiation is called spectroscopy.

The study of spectrum is called spectroscopy

SPECTRUM:

DEFINITION: The band produced on screen by the dispersion of radiation through a prism is called as "Spectrum"

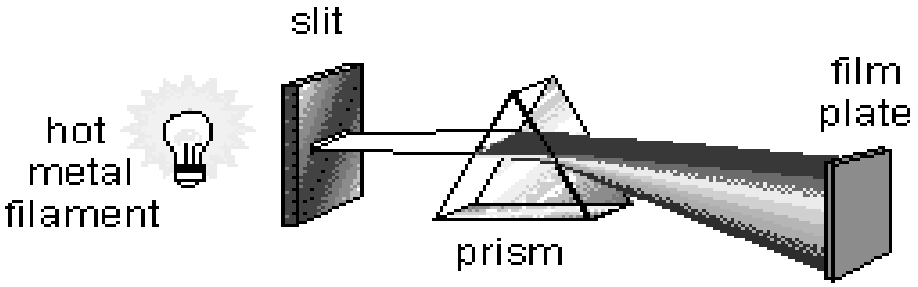
Types of spectra.

There are two types of spectra.

(i) Continuous Spectrum.

(ii) Line spectrum.

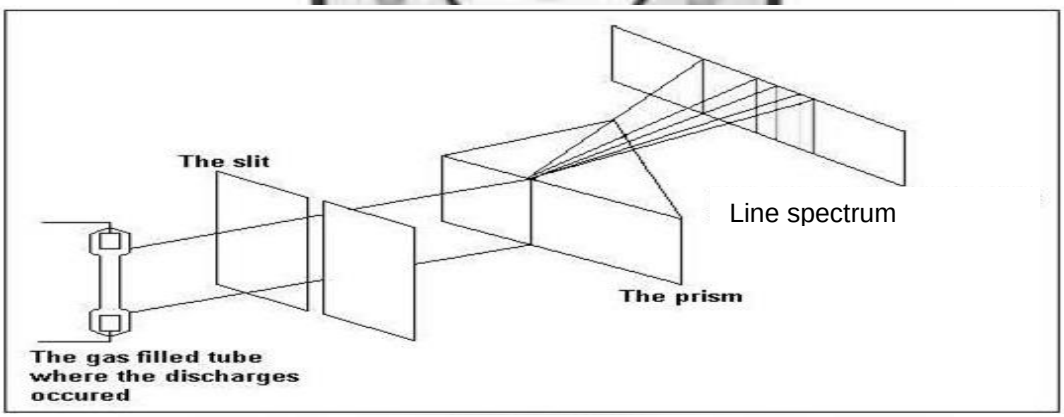
(i) CONTINUOUS SPECTRUM: When radiation emitted from sunlight is passed through prism, and then it produced a band of different colours on screen. This band is composed of seven colours which is commonly called as "Vibgyor". In these conditions, there is no demarcation between two colours, hence it is called as Continuous spectrum. Red colour has maximum wave length and violet has minimum wave length, hence at one end there is red colour and at other end is violet.



(ii) LINE SPECTRUM: When radiations emitted from hot element are passed through a prism, then it produces other types of spectrum. These types of spectrum are composed of bright lines which are separated by dark spaces. Due to formation of these bright lines, it is called as "Line Spectrum".

Characteristics:

- The spectrum consists of lines and obtained when light produce by heating a chemical substance is called **LINE SPECTRUM**.
- The line spectrum obtained by heating an element is called **ATOMIC SPECTRUM**.
- The line spectrum obtained by heating a compound is called **Molecular or band spectrum**.
- Line spectrum of each element is different from other element. Hence it serves as finger prints for the identification of element.
- Line spectrum of each chemical substance contains some unique lines by which it is identity.
- FOR EXAMPLE: Line Spectrum of sodium contains two yellow lines.
- The line spectrum which consist bright lines separated by dark spaces is called EMISSION SPECTRUM.
- The spectrum which consists of dark lines separated by bright spaces is called absorption spectrum.



Q#09 what is radioactivity? Discuss different types of radioactive rays.

RADIOACTIVITY.

(a) INTRODUCTION: This property first of all discovered by Professor Becquerel in 1895. Later on the work on this property was extended by Maric Curie and Pierre Curie in 1898.

(b) DEFINITION: Spontaneous emission of invisible radiations by an element is called as radioactivity. The elements which emit such radiations are called as radio-active elements.

For example: Actinium, Uranium, Polonium, Radium etc.

(c) COMPOSITION: These radiations are composed of these types of rays.

(i) α-rays (alpha-rays)
(ii) β-rays (beta-rays)
(iii) γ-rays (gamma-rays)

(d) PROPERTIES OF ALPHA RAYS:

1. These rays are fast moving alpha particles.
2. These rays are composed of helium nuclei and carriers two positive charge. (He^{++})
3. The velocity of these rays is $1/10^{th}$ of the velocity of light.
4. The penetrating power of these rays is very small. They can move few cm in air and can be stopped by 0.1 mm thick Aluminum foll.
5. These are good ionizer of gases i.e. they knock out electrons from gas atoms.

(f) PROPERTIES OF BETA RAYS:

1. These rays are fast moving beta particles.
2. These rays are composed of electrons and carriers negative charge.
3. The velocity of these rays is equal to velocity of light.
4. The penetrating power of these rays is greater than alpha rays and they can pass through 5cm thick Aluminum foil.
5. These are less ionizer of gases.

(g) PROPERTIES OF GAMMA RAYS:

1. They are high energy electromagnetic radiation.
2. The travel of it velocity of light and have strong penetration power. These rays will pass through lead sheet of thickness 15-20cm.
3. They carry no charge so they are not deflected by magnetic and electric field.
4. They have minimum ionizing power than α and β rays.
5. They are most dangerous than α and β rays so they are also known as death rays or killer rays.

(h) UNIT: The radioactivity is measured in "Curie" and Becquerel.

(j) Method Radioactivity is detected by electron cloud chamber method and Geiger counter

CONCLUSION: From the study of radioactivity, we come to conclusion that atom is composed of at least two particles i.e. electron and proton. It is also indicated that atom also contains neutral particles.