INTERMEDIATE STAGE CHEMISTRY

BOOK ONE

FOR CLASS XI

For

Sindh Textbook Board, Jamshoro.

CONTENTS

Chapter 1

INTRODUCTION TO THE FUNDAMENTAL CONEPTS OF CHEMISTRY

CHEMISTRY:

The branch of science that deals with the properties, compositions and structure of matter and the changes occurring in matter and the laws under which these changes occur is called as chemistry.

BRANCHES OF CHEMISTRY:

- Organic chemistry
- Inorganic chemistry
- Physical chemistry
- Bio chemistry
- Analytical chemistry
- Nuclear chemistry
- Industrial chemistry
- Environmental chemistry

BASIC DEFINITIONS:

ATOM:

The smallest particle of an element is called as an atom.

MOLECULE:

When two or more than two atoms are combined together is called as molecule.

FORMULA WEIGHT:

The total sum of the weights of the atoms present in a substance is called as formula weight

MOLECULAR WEIGHT:

The sum of the atomic masses present in a substance is called as molecular weight.

EMPIRICAL FORMULA:

The simplest formula of a chemical compound that expresses the number of each kind of atom present in the molecule of a compound is called as empirical formula.

Example:

The empirical formula of water is "H2O". It indicates that the water molecule is composed of two elements hydrogen and one element of carbon and the ratio between these two elements is 2:1.

DETERMINATION OF EMPIRICAL FORMULA:

1. First detect the elements that are present in the compound.
2. Determine the masses of each element present in compound.
3. Then calculate the percentage of each element that is present in compound.
4. After that determine mole composition of each element present in compound.
5. in last Determine simplest ratio between the element present in compound.

MOLECULAR FORMULA:

The formula that represents number of atoms in each elemet present in the compound is called as molecular formula.

MOLECULAR MASS:

The sum of the masses present in a molecule is called as molecular mass.

GRAM MOLECULAR MASS:

The molecular mass if expressed in grams then it is called as gram molecular mass.

MOLE:

The atomic mass or molecular mass of a substance if expressed in grams is called as mole.

FORMULA:

Number of moles of = mass of substance (in grams) / molecular mass or atomic mass or formula mass

AVOGADRO'S NUMBER:

One mole of any substance contains equal number of particles (atoms or molecules or ions).Value of this number is 6.02×10^{23}.

ATOMIC MASS:

The weight of an atom is called as atomic mass. 1 unified atomic *mass* unit is defined as 1/12 of the *mass* of a single carbon-12 atom.

SIGNIFICANT FIGURE:

Significant figures are reliable digits known with certainty in a given number. The number of significant figure refers to the precision and accuracy of measured quantity, in this numbers the last digit may not be precisely mentioned, the value of last digit is uncertain.

RULES OF SIGNIFICANT FIGURE:

1. All non zeros are significant figures. E.g. 789 has 3 significant figures
2. Zero between non significant digits are significant. e.g. 4002 has 4 significant figures
3. Zero locating the decimal point in number, less than 1 is not significant. E.g. 0.065 has 2 significant figures
4. Final zeros to the right of the decimal point are significant. E.g. 4.000 have 4 significant figures.

5. Zeros that locate the decimal point in numbers larger than one are not necessarily significant. e.g. 40 have one significant figure.

RULES OF ROUNDING OFF DATA:

RULE No 1:

If the last digit is greater than 5, then add "1" to the last digit to be hold and drop all digits farther to the right.
For example: 4.788 are rounded off to the 4.78 or 4.8.

RULE NO 2:

If the last digit is less than 5, then simply write it as it is without adding any number to the last digit.
For example: 5.531 are rounded as 5.53 if we want three significant digits.
5.531 is rounded off as 5.5 if we want two significant figures.

RULE NO 3:

If the last digit is exactly equal to 5 then:
(A) If the digit to be retained is even, then just drop the "5".
For example:
3.35 is rounded off to 3.3 for two significant figures.
3.3565 is rounded off to 3.356 if we need four significant figures.
(B) If the digit to be retained is odd, then add "1" to it.
For example:
4.15 is rounded off to 4.2 if we need two significant figures.
4.1375 is rounded off to 4.138 if we need four significant figures.
We know that zero is an even number
4.05 is rounded off to 4.0 if we need two significant figures.

ADDITION AND SUBTRACTION OF SIGNIFICANT FIGURE:

3.325 + 12.**5** =15.825 (actual answer by using calculator)
Answer after rounding off: 15.8

MULTIPLICATION AND DIVISION OF SIGNIFICANT FIGURES:

2.5337 x 3.8 =9.62806(actual answer by using calculator)
Answer after rounding off: 10

STOICHIOMETRY:

The quantitative relationship between the reactants and products in a balanced chemical equation is called as stoichiometry.

TYPES OF STOICHIOMETRIC CALCULATIONS:

It is divided into following three categories
1. Mass-Mass relationship
2. Mass-Volume relationship
3. Volume-Volume relationship

LIMITING REACTENT:

The reactant that is totally consumed during the chemical reaction due to which the reaction is stopped is called limiting reactant.

Chapter 2

THREE STATES OF MATER

MATTER:

Anything that has mass and occupies some space is called as matter.

ATOM:

Matter is composed of small tiny particles that are called as atoms.
Matter has three states
Solid
Liquid
Gas

SOLID:

- Solid has a definite shape.
- It has fixed volume.
- We cannot compress solid easily.
- The rate of diffusion is solids are very low.

LIQUID:

- Liquid has no definite shape that means that it can easily change its shape.
- It has a fixed volume.
- It can be compressed to the negligible
- The diffusion of a liquid is possible if and only if the both liquid are polar or non polar.

GASES:

- The gas neither has a fixed volume nor have a fixed shape.
- The molecules of gas are in continuous motion.
- The molecules of gas can easily be diffused.

PRESSURE:

The force per unit area is called as pressure

P= F/A

UNITS:

Pascal
Atmosphere
Cm of hg
mm of hg

BOYLE'S LAW:

Boyle's law states that,
The volume of a gas is directly proportional to the absolute temperature. And the temperature remains constant through out the time.

$V \alpha \frac{1}{P}$

V= (constant)1/P

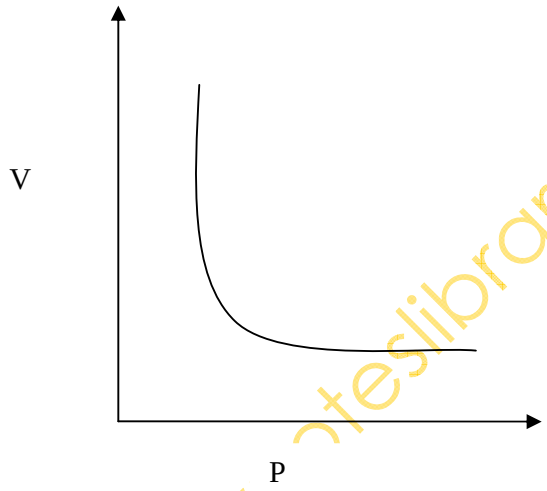
PV=constant

SECOND STATEMENT:

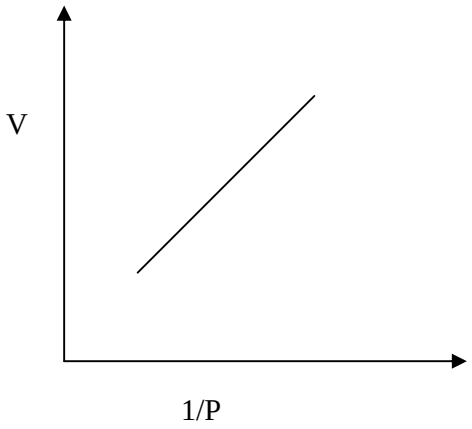
The product of pressure and volume remains constant at constant temperature.

GRAPHICAL REPRESENTATION OF BOYLE'S LAW:

The Graph between P and V is a smooth curve that shows that they are inversely proportional to each other. This curve is called as "Parabola".



The graph between V and 1/P is a straight line.



CHARLE'S LAW:

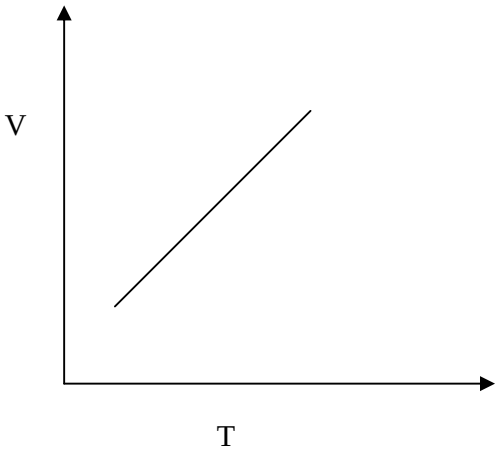
The volume of a gas is inversely proportional to the absolute temperature where the pressure remains constant at that time.

$V \alpha T$
V= (constant) T
V/T=constant

SECOND STATEMENT:

The ratio of volume and temperature remains constant at constant pressure.

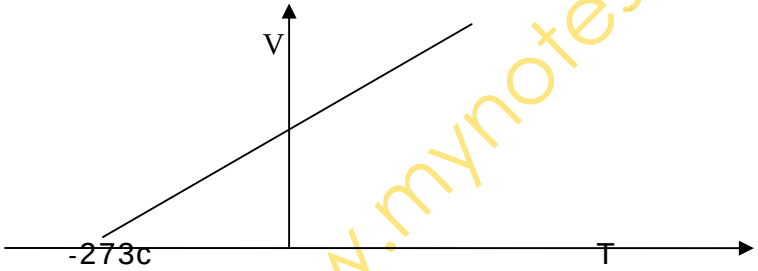
GRAPHICAL REPRESENTATION OF CHARLE'S LAW:



ABSOLUTE SCALE OF TEMPERATURE OR ABSOLUTE ZERO:

This law states that,
The volume of the gas increases or decreases to 1/273 times of its original volume for each 0 ºC change of temperature.

GRAPHICAL REPRESENETATION:



According to this statement the volume of a gas would theoretically be zero at -273ºC. But this temperature has never been achieved for any gas because all the gases condense to liquid at a temperature above this point. So the minimum possible temperature for a gaseous system is to be -273ºC. This temperature is called as absolute scale of temperature or absolute zero or or Kelvin scale.

AVOGADRO'S NUMER:

Equal volume of all gasses contains equal number of molecules under the given condition of temperature and pressure.

SECOND STATEMENT:

The volume of a gas is directly proportional to the number of moles.

GENERAL GAS EQUATION:

According to the Boyle's law,

Volume of a given mass is inversely proportional to the applied pressure and temperature remains constant.

$$V\alpha\frac{1}{P}\text{----------i}$$

According to the charle's law

The volume of a gas is inversely proportional to the absolute temperature where the pressure remains constant at that time.

$$V\alpha T\text{ ----------ii}$$

According to the Avogadro's law:

The volume of a gas is directly proportional to the number of moles.

$$V\alpha n\text{ ----------iii}$$

By combining equation no I, ii, iii we get

$V\alpha T.n.\frac{1}{P}$

$V\alpha Tn/P$

$V=(const)Tn/P$ const = R

V=RTn/P

$PV=nRT$

This is called as ideal gas equation.
R= universal gas constant
R= 0.0821dm3.atmosphere/ mole.K

VALUE OF R:

Consider one mole of an ideal gas at S.T.P
We know that one mole of gas occupies 22.4dm3 volume.
Data:
T=0 C
P=1atm
n=1mole
V= 22.4dm3
R=?

Solution:
Using ideal gas equation
PV=nRt
R= PV/nT
R= 1*22.4/1*273
R= 0.08210821dm3.atmosphere/ mole.K

KINETIC THEORY OF MATTER:

Important postulates of kinetic molecular theory are as under.

- The gas consists of small tiny particles called as molecules.

- These molecules are widely separated from each other and are so small that they are invisible.
- The size of the molecules is very small as compared to the distance between them.
- There is no attractive or repulsive force between molecules so they can move freely.
- The molecules are very hard and perfectly elastic so when they collide no loss of energy takes place.
- The gas molecules are in continuous motion they move in a straight path until they collide.
- During their motion these molecules are collided with one another and with the walls of the container.
- The collision of the molecules is perfectly elastic. When molecules collide they rebound with perfect elasticity and without loss or gain of energy.
- The pressure of the gas is the result of collision of molecules on the walls of the container.
- The average kinetic energy of gas molecules depends upon the absolute temperature. At any given temperature the molecules of all gases have the same average kinetic energy (1/2 mv2).

TYPES OF SOLIDS:

There are following types of solids.
Crystalline solids
Amorphous Solids

DIFFERENCE BETWEEN CRYSTALLINE SOLIDS AND Amorphous solids:

Crystalline solids	Amorphous solids
They have definite geometrical shape.	They do not have definite geometrical shape.
They have sharp melting points.	They do not have sharp melting points
They are symmetrical in nature	They are unsymmetrical in nature
Crystalline solids cleavage along particular direction at fixed cleavage	These type of solids don't break at fixed cleavage planes
There physical properties are different in different direction	There physical properties are same in all directions

IMPORTANT DEFINITIONS:

VAPOUR PRESSURE:

AT equilibrium condition, pressure exerted by the vapours of that liquid is called as vapour pressure of that liquid.

BOILING POINT:

The temperature at which the vapour pressure of liquid becomes equal to the atmospheric pressure or external pressure is called as boiling point.

VISCOSITY:

The apposing force produce during the flow of liquid is called as viscosity.

UNIT: Poise, $N.S/m^2$

FACTORS AFFECTING VISCOSITY:

These are the factors that depend on the viscosity.

- **SIZE OF MOLECULES:**

The viscosity of liquid depends upon size of the molecule
The viscosity is directly proportional to the size of the molecules that large the size of molecules the greater the viscosity.

- **SHAPE OF MOLECULES:**

Shape of molecules also affects the viscosity. The spherical shape molecule has low resistance and can easily flow.

- **INTERMOLECULAR FORCES:**

The viscosity is directly proportional to the intermolecular forces. The liquids having large intermolecular forces having greater viscosity.

- **TEMPERATURE:**

The viscosity is inversely proportional to the temperature so we can say that the viscosity of a liquid decreases as the temperature increases.

- **SURFACE TENSION:**

The perpendicular force acting on the unit length of the surface of a liquid is called as surface tension.

FORMULA:

Surface tension = F/L

UNITS:

Dyne/cm, N/m, Erg/cm2

FACTORS AFFECTING SURFACE TENSION:

These are the factors that depend on the surface tension.

- **HYDROGEN BONDING:**

Liquids that have H bonds have high surface tension.

- **TEMPERATURE:**

The surface tension is inversely proportional to the temperature. That means that surface tension of a liquid decreases as the temperature increase in temperature.

- **INTERMOLECULAR FORCES:**

The intermolecular forces are directly proportional to the surface tension. That means that as the intermolecular forces increases surface tension of liquid is called as intermolecular forces.

LATENT HEAT OF FUSION:

The amount of heat that is required to melt unit mass of a solid is called as latent heat of fusion.

UNIT:

J/kG

FORMULA:

$Q = m \times H_f$

Where m = mass of solid
Q= amount of heat

CRYSTAL SYSTEM:

There are seven types of crystal system.

1. **CUBIC CRYSTAL SYSTEM:**

In cubic crystal system all the edges of cube are equal.
a=b=c

For example:

Zinc Sulphide
Diamond
Sodium chloride

2. **TETRAGONAL CRYSTAL SYSTEM:**

When two sides are equal and one side is different then this type of structure is called as tetragonal crystal system.

For example:

SnO_2
$BaSO_4.4H_2O$

3. **ORTHORHOMBIC CRYSTAL SYSTEM:**

When all the edges are different from each other then it is called as orthorhombic crystal.

For example:

KNO3
FeSO4.7H2O

4. RHOMBOHEDRAL CRYSTAL SYSTEM:

When all the edges are same or equal then it is called as rhombohedral crystal system.
In this case all the angles are equal but not equal to 90^{o}.

For example:

KNO3
AgNO3

5. HEXAGONAL CRYSTAL SYSTEM:

In this system two sides are same but third side is different and the angle between equal edges is 90 and the angle between third angle is equal 120.

For example:

Graphite

6. MONOCLINIC CRYSTAL SYSTEM:

All the edges are different in this system. Two angles are equal to 90 but third angle is not equal to 90.

For example:

CuSO4.5H2O

7. TICLINIC CRYSTAL SYSTEM:

All the edges are different in this system and the angles between the edges are not equal to 90

For example:

CuSO4.5H2O
K2Cr2O7

POLYMORPHISM:

Existence of substance into more than one crystalline form is called as polymorphism.

ALLOTROPY:

Existence of an element into more than one physical forms is called as allotropy.

ISOMORPHISM:

Existence of different substances in one crystalline form is called as isomorphism.

TYPES OF CRYSTALS:

Solid crystals can be divided into four types.

METALLIC CRYSTALS:

When atoms are joined together by metallic bond then it is called as metallic bond.

CHARACTERISTICS OF METALLIC CRYSTAL:

- Metallic crystals are very hard.
- They have high melting point and boiling point.
- They have shiny surface.
- They conduct electricity and heat.
- They are ductile and malleable.

IONIC CRYSTAL:

Solids that have ionic bond in their structure is called as ionic crystals.

CHARACTERISTICS OF IONIC BOND:

- They are hard in nature.
- They he high melting and boiling point.
- They are not ductile.
- They have electricity in molten state.

COVALENT CRYSTAL:

Solid substances in which atoms are held together by covalent bond are called as covalent crystals. They are in stable state.

MOLECULAR CRYSTAL:

Molecules are joined together by weak Vander Wall forces are called as molecular crystal. They have low boiling point as well as melting point. They are volatile in nature.

PARTIAL PRESSURE:

Individual pressure that a gas exerts in a mixture of gases is called as partial pressure.

DALTON'S LAW OF PARTIAL PRESSURE:

If two or more gases are enclosed in a vessel, the total pressure exerted by them is equal to the sum of their partial pressure.

MATHEMATICAL REPRESENTATION:

Consider a mixture of three gasses a b and c and there partial pressure are P_a, P_b and P_c.
$Pa+Pb+P_c$

DALTON'S LAW IN THE LIGHT OF KINETIC MOLECULAR THEORY:

The total pressure exerted by all the gasses is equal to the sum of collisions of the molecules exerted by individual gas.

DERIVATION:

Consider a mixture of three different gases a , b and c in a container of volume V at T. Consider that the partial pressures of these gases are P_a ,P_b and P_c respectively and total pressure of mixture is P_t. Let there are n_a ,n_b and n_c moles of each gas respectively and the total number of moles are n_t.
Using general gas of equation
PV=nRT

For gas a
$P_a = n_aRT/V$-------i

For gas b
$P_b = n_bRT/V$----------ii

For gas c
$P_c = n_cRT/V$----------iii

For n gas
$P_n = n_nRT/V$

Pn/nn=RT/V-------a
Adding above three equations
Pt=naRT/V+ nbRT/V+ ncRT/V
Pt= (na+nb+nc) RT/V
nt= na+nb+nc
Pt= nt RT/V
Pt/nt=RT/V----------b
Comparing equation and b
Pt/nt=pn/nn
Pn/ptotal=nn/ntotal

RESULT:

This expression indicates that the pressure of a gas is directly proportional to number of moles.

DIFFUSION OF GASSES:

The mixing of two or more gases to form a homogeneous mixture is called as diffusion of gases.

GRAHAM'S LAW OF DIFUSION:

The rate of diffusion of a gas is inversely proportional to the square root of its density.

$$r\alpha\frac{1}{\sqrt{d}}$$

The rate of diffusion of two gases is inversely proportional to the square root of their densities.

$$\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}}$$

MATHEMETICAL REPRESENTATION:

For gas a

$$r\alpha \frac{1}{\sqrt{d_1}}$$

$$rK \frac{1}{\sqrt{d_1}} \text{----------i}$$

For gas b

$$r\alpha \frac{1}{\sqrt{d_2}}$$

$$rK \frac{1}{\sqrt{d_2}} \text{---------ii}$$

$$\frac{r_1}{r_2} = \frac{K\frac{1}{\sqrt{d_1}}}{K\frac{1}{\sqrt{d_2}}}$$

$$\frac{r_1}{r_2} = \frac{\frac{1}{\sqrt{d_1}}}{\frac{1}{\sqrt{d_2}}}$$

$$\frac{r_1}{r_2} = \frac{\sqrt{d_2}}{\sqrt{d_1}}$$

We can replace molecular mass by density

$$\frac{r_1}{r_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

Chapter 3

ATOMIC STRUCTURE

ATOM:

The smallest particle of an element that represents all properties of element is called as atom.

FUNDAMENTAL PARTICLE OF ATOM:

Atom has following important particle
Electron
Proton
Neutron

ELECTRON:

- Electron is a negatively charges particle.
- It revolve around the nucleus of the atom
- It is the lightest part of an atom.
- Charge of electron is 1.6022×10^{-19} Coulomb
- Its mass is 9.1×10^{-31} kg.

PROTON:

- It is positively charged particle.
- It is present in the nucleus of atom.
- It is 1837 times heavier than an electron.
- Charge of proton is 1.6022×10^{-19} coulomb.
- Its mass is 1.6726×10^{-27} kg

NEUTRON:

- The neutrally charged is called as neutron.
- It is the heaviest particle of atom
- It is present in the nucleus of atom.
- Mass of neutron is 1.6749×10^{-27} kg

ATOMIC NUMBER OR CHARGE NUMBER:

The sum of the number of protons and number of neutrons is called as atomic number.

MASS NUMBER:

The total number of protons and neutrons present in the nucleus of an atom is called as mass number.
A=p+n

DISCOVERY OF ELECTRON OR CATHODE RAYS:
OR
DISCHARGE TUBE EXPERIMENT:

Electron was the first subatomic particle found through the discharge tube experiment done by discharge tube experiment.

WORKING OF DISCHARGE TUBE:

Discharge tube contains a glass fitted inside it fitted with two electrodes placed opposite to each other. They are connected to the high voltage battery
This tube is sealed and to reduce the pressure of the tube a vacuum pump im used.

WORKING:

A low pressure and at very high potential difference electric current is passed through the gas.
Different result was obtained during different rate of pressure.
First when pressure is reduced to 1cm to hg and very low potential difference a spark of light is produced. At 1 mm Hg, the tube is mostly filled with a glow extending from the positive electrode. At 0.001 m Hg, the glow disappears and the walls of the glass tube begin to glow with a brilliant green light.

RESULT:

This is come to the conclusion that cathode rays are emitted.

PROPERTIES OF CATHODE RAYS:

1. These rays originate from cathode.
2. They carry negative charge.
3. Cathode rays travel in straight line.
4. The produce fluorescence when they strike the glass wall of the discharge tube.
5. Their e/m ratio was equal to that of an electron.
6. Cathode rays penetrate small thickness of matter such as aluminum foil, gold foil, etc.
7. Cathode rays exert mechanical pressure.

DISCOVERY OF PROTON:

During the discharge tube experiments, a famous scientist Gold Stein observed that if a perforated cathode is used, some radiations appear behind the cathode. These radiations are carrying positive charge because they are originating from anode.

PPROPERTIES OF ANODE RAYS:

1. They travel in straight line in a direction opposite to the cathode.
2. They are positively charged particle.
3. They consist of material particle.
4. The charge to mass ratio (e/m) of positive particles varies with the nature of the gas placed in the discharge tube.
5. Positive rays are produced from the ionization of gas and not from anode electrode.

RADIOACTIVITY:

All the elements having atomic masses greater than 82 are the radioactive elements. And this phenomenon of emitting the rays is called as radioactivity.

TYPE OF RADIO ACTIVE RAYS:

α-Rays
β-RAYS
γ-RAYS

Properties of α-Rays

This particle carries positive charge.
Its mass is 4 times of hydrogen atom.
It has high ionization power.
It has small penetration power.
These rays produce fluorescence in different substances.
It is approximately equal to the $1/10^{th}$ of the velocity of light.

β-RAYS

They are negative charged particle.
They are just like moving electrons.
They have ionization power weaker than alpha rays.
β – rays produce fluorescence in different substance
Velocity of β – rays is 27×10^7 m/sec.
Their kinetic energy is less than alpha rays.

It is neutral in nature.
They travel with the speed of light
It's penetration power is very large
These rays produce fluorescence when incident on screen coated with barium platino cyanide.

SPECTROSCOPY:

The branch of chemistry that deals with the study of absorption and the emission of radiation is called as spectroscopy.

SPECTRUM:

The light ray consists of different wave length. When this light is passed through any prism then it is scattered into wave length or band of seven colours that is called as spectrum.

TYPE OF SPECTRUM:

Emission spectrum
Absorption spectrum

EMISSION SPECTRUM:

When an element absorbs sufficient amount of energy from an electric arc it emits some radiations. Then these radiation are passed through spectrometer, The resultant spectrum is called as emission Spectrum.
It has two types
Continuous spectrum
Line spectrum

CONTINUOUS SPECTRUM:

When white light is passed through prism then it is dispersed into its colors. And the resultant spectrum is called as continuous spectrum.

CHARACTERISITICS:

This spectrum consists of seven colors.
They have no boundary in these colors.
For example spectrum of sunlight.

LINE SPECTRUM:

When electric current is passed through a prism at low pressure, the atoms of gas are excited and radiate light. A resultant spectrum is called as line Spectrum.

CHARACTERISITICS:

Every two colors are separated from each other in this spectrum.
Each line has a definite wave length
There colors depends upon the nature of light

QUANTUM NUMBER:

The number that is used to complete the behavior of electron in an atom is called as quantum number.
There are four quantum numbers.
Principle quantum number
Azimuthal quatum number
Magnetic quantum number
Spin quantum number

PRINCIPLE QUANTUM NUMBER:

They represent the energy level of electron. It is denoted by n. It is also used to describe the size of orbit.

AZIMUTHAL QUANTUM NUMBER:

They are used to describe the shape of orbit.

For s-orbital $l = 0$
For p-orbital $l = 1$
For d-orbital $l = 2$
For f-orbital $l = 3$

MAGNITIC QUANTUM NUMBER:

They are used to describe the orientation of orbital in space.

Orbital	L	M
S	0	0
P	1	-1,0,+1
D	2	-2, -1,0,+1,+2
f	3	-3,-2, -1,0,+1,+2,+3

SPIN QUANTUM NUMBER:

They are used to represent spin of an electron in orbital.

DALTON'S ATOMIC THEORY:

The main postulates of Dalton atomic theory are:

- Matter is composed of very small or tiny particles called as "Atom".
- Atom is an indivisible particle.
- Atom can neither be created nor be destroyed.
- The atoms are identical in size, shape, mass and in other properties.
- Atoms of different elements are different in their properties.
- Atoms combine with each other in small whole numbers.
- All chemical reactions are due to combination or separation of atoms.

BOHR'S ATOMIC MODEL:

Energy of an electron is constant in orbit. As long as an electron remains in its orbit, it does not absorbs energy.
Electrons revolve around the nucleus in a circular orbit. These orbits are known as energy levels.
When an electron jumps from higher energy level to lower energy level. It radiates the amount of energy.
When an electron jumps from lower energy level to the higher energy level then it absorb some amount of energy.
Energy released or absorbed by an electron is equal to the difference of energy of two energy levels.

$\Delta E = E_2 - E_1$

$E_2 - E_1 = h\nu$

Where

h = Planck's constant (6.6256×10^{-34} j.s)

ν = Frequency of radiant light

ANGULAR MOMENTUM:

Angular momentum of an electron in an energy level is given by:

$m\ v\ r = nh / 2\pi$

Where n =1, 2, 3, ……..

m = mass of electron

V = velocity of electron

r = radius of orbit

UNCERTANITY PRINCIPLE:

According to Heisenberg's uncertainty principle:
It IS impossible to determine the momentum and position of an electron

simultaneously.

RULES OF ELECTRONIC CONFUGUARATION:

AUFBAU PRINCIPLE:
According to this principle:
The electrons are filled to the orbitals of lowest energy in sequence, two electrons to each orbital.

EXAMPLE:

Li (z = 3) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^1$
B (z = 5) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^1$
Mg (z = 12) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$
Cl (z = 17) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^5$
Ca (z = 20) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$
Sc (z = 21) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^1$
Ti (z = 22) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^2$
Fe (z = 26) : ELECTRONIC CONFIGURATION = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^6$

(n+1) RULE:

According TO (n+1) rule:

RULE NO 1:
Orbital having least value will be filled first to the electron.

For example:

4s orbital will be filled prior to 3rd orbital.
4d orbital will be filled prior to 4f orbital.

RULE NO 2:
If there are two orbital having same value of (n+1) then the orbital having least value of n will be filled first

For example:

2p-orbital will be filled prior to 3s-orbital.
4d-orbital will be filled prior to 5p-orbital.

HUND'S RULE:

A greater total spin state usually makes the resulting atom more stable. Accordingly, it can be taken that if two or more orbitals of equal energy are available, electrons will occupy them singly before filling them in pairs.

PAULI'S EXCLUSION PRINCIPLE:

Two electrons can have the same set of four quantum numbers in an atom.

CHAPTER NO 4

CHEMICAL BONDING

CHEMICAL BOND:

The force of attraction between two atoms or ions that help them to hold together is called as chemical bond.

TYPES OF CHEMICAL BOND:

Ionic bond or electrovalent bond
Covalent bond
Coordinate covalent bond

IONIC BOND OR ELECTROVALENT BOND:

When an atom completely transfers an electron to the other atom then this type of bond is called as ionic bond or electrovalent bond.

EXPLANATION:

In this bond one atom transfer the electron to the other atom and the atom that looses its electron is considered to be positive and the electron gainer become negative.

EXAMPLE:

Consider the atom of Na and Cl. Na has 11 electrons and Cl has 17 electrons. Cl wants to complete its outer most orbit so it will ask an electron to the Na and When Na will transfer the electron it become positive and Cl become negative.

CONDITIONS OF IONIC BOND:

Two atoms must be different. Similar atoms cannot form ionic bond.
Ionization of one atom must be small.
Electro negativity and electron affinity must be high of second atom.

PROPERTOES OF IONIC BOND:

They exist in solid form.
They have high melting and boiling point.
They are very hard because they have strong attraction of forces.
They are soluble in water except few substances.
They are insoluble in non polar compounds.

COVALENT BOND:

The type of chemical bond that formed due to the mutual sharing of electron among the atoms is called as covalent bond.

EXAMPLE:

Consider the example of HCl in which H has only 1 electron in its outer most

shell. And Cl has 7 electrton in its outer most shell it require only one electron to complete its outer most orbit.
So H share electron with Cl and they both complete their outer most orbit.

TYPES OF COVALENT BOND:

SINGLE COVALENT BOND:

The covalent bond formed by the mutual sharing of one electron is called as single covalent bond. It is denoted by 1 line ___

DOUBLE COVALENT BOND:

The covalent bond formed by the mutual sharing of two electrons is called as single covalent bond. It is denoted by two lines

TRIPLE COVALENT BOND:

The covalent bond formed by the mutual sharing of three electrons is called as single covalent bond. It is denoted by three lines

POLAR COVALENT BOND:

A covalent bond formed between two different atoms is known as Polar covalent bond.

NON- POLAR COVALENT BOND:

A covalent bond formed between two like atoms is known as Non-polar bond.

PROPERTIES OF CO VALENT BOND:

They are volatile in nature.
They are liquid or gasses.
They have low boiling point and melting point.
They are insoluble in water.
They do not conduct electricity.

COORDINATE COVALENT BOND:

The type of chemical bond in which one atom provides shared pair of electron for bond formation is called Coordinate Covalent Bond or dative bond.
The atom that provide electron is called as Donor or the atom that accept the electron is called as acceptor.

VALENCE BOND THOERY:

According to Valence bond theory:
A covalent bond is formed by the overlapping of partially filled orbitals of two atoms.
Electrons must have opposite spins.
In bond formation the participated atoms must be un paired.
The number of covalent bonds formed by an atom would be equal to the numbe of half filled orbital.

SIGMA BOND:

1. Sigma bond is formed by the head to head overlapping of orbitals.
2. They are strong bonds in nature because of maximum overlapping of orbitals.
3. Electron density is maximum around the bond axis.
4. Compounds that have sigma bonds are stable in nature and they are less reactive.

5. First bond formed between two atoms is always a sigma bond.
6. s-s overlap, s-p overlap and p-p overlap give rise to sigma bond

PI BOND:

This is formed due to the side wise overlap of p orbital, and produced the region of high electron density so they are called as pi bond.

HYBERDIZATION:

The process of mixing up of different orbitals of same energy level of an atom to produce equal number of hybrid-orbitals of same energy and identical properties is known as hybridization.

TYPE OF HYBERDIZATION:

There are three types of hybridization :

Sp^3-hybridization.

Sp^2- hybridization.

Sp- hybridization.

Sp^3-HYBERDIZATION:

The process in which one s-orbital and three p-orbitals overlap to produce four hybrid-orbital is known as Sp^3-hybridization.

EXAMPLE OF Sp^3-HYBERDIZATION:

Take The example of methane molecule that is composed of one carbon atom and four hydrogen atom i.e. CH_4. In methane molecule central atom is carbon. Here carbon atom is Sp^3-hybridized. One s-orbital (2s) and three p-orbital (2px, 2py, 2pz) overlap to produce four Sp^3-hybrid orbitals. Sp^3- hybrid orbital have an angle of 109.5^o from each other.

ELECTRON PAIR REPULSION THEORY:

The shape of element can be finding by the force of repulsion between the electron pairs that are present in valence shell of electron.

There are two types of electron pairs.

BOND PAIR:

This type of pair is formed when the central atom shared unpaired electrons with surrounding atoms is called as bond pair.

LONE PAIR:

They are called as paired electron and they do not take part in sharing of electrons.

HYBRID ORBITAL MODEL:

We can determine shape of a molecules in hybrid orbital modelAccording to hybrid orbital model:
Sp-hybridization have linear molecule with an angle of 180^o.
For example: C_2H_2, CO_2, CS_2, $BeCl_2$.
Sp^2-hybridization have trigonal structure with bond angles of 120^o.
Sp3-hybridization gives tetrahedral geometry with bond angles of 109.5^o.
Sp^3-hybridization with one non-bonding orbital (lone pair) gives pyramidal structure with an angle of 107^o.

DIOPLE MOMENT:

The degree of polarity of a molecule is expressed in terms of dipole moment.

SHAPE OF MOLECULES:

H_2O

Oxygen is a central atom in this element. It has total four active sets of electron pairs that are two lone pair and 2 bond pair. The reduced angle is formed 109^o to 104.5^o.

NH_3

N is the central atom in this compound. It has three bonds of hydrogen. It angle is reduced from 109 to 107 degrees.

BF_3

Boron is the central atom and it has three electron pairs. It angle is 120 degree.

BOND ENERGY:

The amount of energy that is required to break a bond between two atoms in a di-atomic molecule is called bond energy.

FACTORS ON WHICH BOND ENERGY DEPENDS:

BOND LENGTH:
They are inversely proportional to each other. The shorter the bond length, greater is the bond energy.

IONIC CHARACTER:
They are directly proportional to each other. Greater the ionic character, greater is the bond energy.

MULTIPLE BOND:
They are inversely proportional to each other. Multiple bonds have short length; therefore, they have high bond energy.

CHAPTER NO 5

THERMODYNAMICS

THERMODYNAMICS:

The branch of science that deals with the conversion of heat energy into another form of energies is called as thermodynamics.

THERMOCHEMICAL REACTIONS:

The Type of chemical reactions in which there is some change in mass as well as energy is called as thermo chemical reactions.

TYPE OF THERMO CHEMICAL REACTIONS:

There are two types of chemical reactions

1. Exothermic reaction
2. Endothermic reaction

ENDOTHERMIC REACTION:

The type of chemical reaction in which heat is absorbed by the system is called as endothermic reaction.

EXOTHERMIC REACTION:

They type of chemical reaction in which the heat is exit or released from the system during the chemical reaction is called as exothermic reaction.

INTERNAL ENERGY:

The total energy possessed by the system is called as internal energy of the system.

THERMODYNAMIC SYSTEM:

The system that is the part of universe as well as under the study of thermodynamics is called as thermodynamics.

TYPE OF SYSTEMS:

1. Open system
2. Closed system
3. Isolated system

OPEN SYSTEM:

The system in which the energy can transfer easily out of the boundaries is called as open system.

Example: An open tank of water

CLOSED SYSTEM:

The system in which the energy can not transfer easily out of the boundaries is called as open system.

Example: an air in the balloon

ISOLATED SYSTEM:

The type of system in which the heat is not transfer into the system or out of the system is called as isolated system.

MACROSCOPIC PROPERTIES:

The properties that can be easily measured are called as macroscopic properties.

INTENSIVE PROPERTIES:

The type of properties that are independent of mass are called as intensive properties.

For example: boiling point, melting point, viscosity, pressure

EXTENSIVE PROPERTIES:

The properties that are dependent on the mass of a body is called as extensive properties.

For example: kinetic energy, volume, enthalpy

ENTHALPY:

The total heat content of a system is called as enthalpy of the system.

Enthalpy = E+PV

It is denoted by H

HEAT OF FORMATION:

The amount of enthalpy changed during the formation of one gram of a compound is called as heat formation.

STATE OF THERMODYNAMIC SYSTEM:

When all the properties of system are fixed or at certain stage then it is said to be in state of thermodynamics.

These stages are:

1. **INITAIL STAGE:**

The state of a system before any kind of chemical or physical changes is called as initial change.

2. FINAL STAGE:

The state of a system after the chemical or physical changes is called as final stage.

CHANGE IN STATE:

The difference between initial and final state is called as change in state.

FIRST LAW OF THERMODYNAMICS:

STATEMENT:

Energy can neither be created nor be destroyed but it can converted from one form into an other form.

OR

The total energy of a system remains constant through out the process.

OR

The total energy of a system as well as surroundings remains constant through out the process.

MATHEMATICAL REPRESENTATION:

Consider a system that have internal energy E1 and when the amount of heat energy Q is supplied it perform the work W and internal energy will become E2.

So we can write as

Heat supplied = Internal energy+ work done

PRESSURE-VOLUME WORK:

Consider a cylinder fitted with a frictionless piston having area "**A**". An ideal gas is filled in the cylinder. The volume of gas at initial state is "$\mathbf{V_1}$". An external pressure "**P**"is exerted on the piston.
When we supply "**q**" amount of heat to the system then it will increase its internal energy by ΔE. "The gas will exert pressure on the piston. And the gas will covered the distance **d**" and the volume of system increases from $\mathbf{V_1}$ to $\mathbf{V_2}$.

We know that pressure is the force per unit area i.e.

$$\mathbf{P = F/A}$$

OR

$$\mathbf{F = PA \ldots\ldots\ (i)}$$

We also know that the work done by the gas on the piston is given by:

$$\mathbf{\Delta W = F\ d}$$

Where d = displacement of piston
Putting the value of F and d ,we get

$$\Delta W = (PA)\, d$$

OR $\Delta W = P\,(Ad)$

But Ad = change or increase in volume = ΔV

Hence

$$\Delta W = P\,\Delta V$$

Here is the required relation

APPLICATIONS OF FIRST LAW OF THERMODYNAMICS:

At constant volume (Isobaric)
At constant pressure (Isochoric)

AT CONSTANT VOLUME:

The system in which volume of a system remains constant during the continuous supply of heat energy is called as isochoric system.

EXPLANATION:

Consider a cylinder with fitted piston on it. The delta Q amount of heat is given to the cylinder internal energy increases to U1 to U2. Volume of a system remains constant to V and temperature will increase to T1 to T2. Pressure will also increase from P1 to P2. No work is performed during the all process.
According to the first law of thermodynamics

$\Delta Q = \Delta U + \Delta W$

$\Delta Q = \Delta U + \Delta W$

$\Delta W = P\Delta V$

$\Delta V = 0$

$\Delta Q = \Delta U + P(0)$

$\Delta Q = \Delta U$

AT CONSTANT PRESSURE:

The system in which pressure remains constant during the continuous supply of heat energy is called as isobaric system.

EXPLANATION:

Consider a cylinder with piston on it. This piston can be easily move up and down.
When we enter the ideal gas in cylinder.
The initial volume of a system is V1 and initial energy is U1. And the amount of heat energy Qp is entered. In final U1 will increase to U2. Volume of a system increase to V1 to V2 and temperature will increase to T1 to T2.

$\Delta Q = \Delta U + \Delta V$

$\Delta w = P\Delta V$

$\Delta Qp = \Delta U + P(V2 - V1)$

HESS'S LAW OF CONSTANT HEAT SUMMATION:

STATEMENT:

The Amount of heat evolved or absorbed during the chemical reactions is constant and independent of the method followed or number of steps followed.

CHAPTER NO 6

CHEMICAL EQUILIBRIUM

IRREVERSIBLE REACTION:

The type of chemical reaction that processed only in one direction is called as irreversible reaction.

REVERSIBLE CHEMICAL REACTION:

The type of chemical reaction in which the reactants are converted into the products and the products can be converted back into the reactants, is known as reversible chemical reaction.

For example when we react nitrogen with hydrogen then the product NH3 is formed but after that NH3 immediately converts back into N2 and 3H2, so it is a reversible reaction

$N_2 + 3H_2 \rightleftharpoons NH_3$

This type of chemical reaction is called as forward reaction.

RATE OF REACTION

The rate of change of concentration of reactants or products is called as rate of reaction. In the chemical reaction, the concentration of reactants decreases and the of the products increases with the passage of time so we can say that the reactants reduced and become final product.

RATE OF FORWARD REACTION:

The Change in the concentration of reactants during the reversible reaction is called as rate of forward action.

RATE OF BACKWARD REACTION:

The change in the concentration of products during the reversible reaction is called as rate of backward reaction.

EQUILIBRIUM STATE:

The state at which the rate of forward chemical reaction becomes equal to the rate of backward chemical reaction is called as equilibrium state.

$H_{2(G)} + I_{2(g)} \text{----------} > 2HI$

Consider that, here the concentration of reactants (H2+I2) is maximum, hence the rate of forward reaction will be high and only for ward reaction will occur. After sometime, enough amount of products (HI) is formed and reverse reaction starts, the rate of forward reaction will be high than rate of reverse reaction. After sometime, the concentration of reactants decreases enough and thus, rate of reverse reaction increases.
After sometime, the rate of forward reaction is just equal to the rate of reverse reaction and the concentration of reactants and products becomes constant and no more change occur in them, although the reaction does not stop. This is called as the equilibrium state.

LAW OF MASS ACTION:

This law states that,
The rate of a chemical reaction is directly proportional to the product of the concentration or active masses of substances.

A + B ⇌ C + D

According to the law of mass action:

Rate of reaction∝ [A][B]

Here we have general reaction

aA + bB ⇌ cC + dD

According to the law of mass action

Rate of forward reaction ∝ [A]a[B]b

Rate of forward reaction = Kf [A]a[B]b

Similarly,

Rate of backward reaction ∝ [C]c[D]d

Rate of backward reaction = Kb [C]c[D]d

Where

Kf = rate constant for forward reaction

Kb = rate constant for backward reaction

Here, a, b, c, d = number of moles

At equilibrium rate of forward reaction becomes equal to the rate of backward reaction, thus,

Rate of forward reaction = Rate of backward reaction

Kf [A]a[B]b = Kb [C]c[D]d

Kf / Kb = [C]c[D]d/[A]a[B]b

Let Kf/Kb = Kc

Kc = [C]c[D]d/[A]a[B]b

This is the expression of equilibrium constant where c represents concentration.

APPLICATION OF EQUILIBRIUM CONSTANT Kc

Kc is used for following reasons.

It is used to predict the direction of the reaction.

TO PREDICT THE DIRECTION OF THE REACTION:

The equilibrium constant Kc is used to determine the direction in which a reaction will shift in order to achieve the equilibrium state.

Ratio= [product]/[reactant]

There are three possible cases for the value of Kc.

When Kc= 0

At this state there will be no change in concentration of reactant as well as product and the system is has achieve equilibrium state.

When Kc>0

At this state the reaction will be goes backward direction to achieve state. Here the product will decrease and the quantity of reactant will increase.

Kc<0

In this case the reaction will shift in forward direction to achieve equilibrium state. At this state the quantity of product will increase and and the quantity of reactant will decrease.

EXTENT OF A REACTION

When the value of equilibrium constant is very high:

A very high value of equilibrium constant indicates that the forward reaction is almost completed and in other words we can say that the reactants are converted to the products.

When the value of equilibrium constant is very small:

A very small value of equilibrium constant indicates that there is very little tendency for the reaction to occur in the forward direction and in other words we can say that the reactants are very stable.

When the value of equilibrium constant moderate:

At this case, we come to the conclusion that the reaction occurs both in forward and backward direction and state of equilibrium will be attained after certain period of time.

RELATION BETWEEN KP AND KC

Kp:

The equilibrium constant can be determined by using partial pressure of gases in a gaseous chemical equilibrium is expressed as Kp.
Here we have general reversible reaction :

$$a A_{(g)} + b B_{(g)} \rightleftharpoons c C_{(g)} + d D_{(g)}$$

For the reaction K_p is

$$K_p = [P_C]^c[P_D]^d / [P_A]^a[P_B]^b$$

Where [P] = partial pressure of gas

If Kp=Kc

In this case there is no change in the volume of a system. Here the volume a product is always equal to the volume of a reactants.

For example:

$H_2 + I_2 \rightleftharpoons 2HI$

If Kp>Kc

In this case the resultant volume increase or we can say that the final product is increased then the reactants.

For example:

$2NH_3 \rightleftharpoons N_2 + 3H_2$

If Kp<Kc

Here the reactant is in greater amount and the resultant products are in lesser amounts.

For example

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

LE CHATELIER PRINCIPLE:

If a system is at equilibrium state and any disturbance happen by changing in conditions concentration so that the system shifts in such a direction to re-establish a new equilibrium.

APPLICATIONS OF LE CHATELIER PRINCIPLE

1. **EFFECTS OF CHANGE IN TEMPERATURE:**

According to Le-chatelier's principle a change in temperature will result in disturbance of equilibrium state. To restore this state, the reaction will in either forward or backward direction.
By applying Le-chatelier's principle, we can predict the direction of reaction when temperature of an equilibrium system is changed. For endothermic reaction, $\mathbf{K_c}$ increases with the increase in temperature.
For exothermic reaction, $\mathbf{K_c}$ decreases with the increase in temperature.

2. **EFFECT OF CHANGE IN PRESSURE:**
The change in pressure affects the volume of a system**.**

<u>When the products and reactants are equal:</u>

When the volume of reactants and products are equal then it will not affect the pressure of system

<u>When the volume of reactants are greater than the volume of products:</u>

In this case the pressure will increase and the reaction goes forward. Or might be the pressure will decrease and the reaction goes backward.

<u>When the volume of products are greater than the volume of reactants:</u>

In this case the pressure may be increase or decrease. If pressure wil increase the reaction will go to the backward direction and if the pressure increase the reaction will go to the forward direction

3. **EFFECT OF CHANGE IN CONCENTRATIOON:**

When the concentration of one or more substances present in equilibrium mixture is changed, then the system is not in equilibrium state. The system will tries to maintain its previous balanced position.

Consider a reversible reaction:

$$\mathbf{aA + bB \rightleftharpoons cC + dD}$$

$\mathbf{K_c}$ for the reaction is

$$\mathbf{K_c = [C]^c[D]^d / [A]^a[B]^b}$$

At this state if we add some amount of **A** or **B**, the equilibrium system will be disturbed.
According to the Le-chatelier's principle, to restore equilibrium, the reaction

will shift in the forward direction to cancel the effect of change in concentration.
Actually an increase in concentration of reactants decreases the ratio $[C]^c[D]^d / [A]^a[B]^b$ than K_c.
according to Le-chatelier's principle, To attain equilibrium, the concentration of **A** and **B** will decrease and the concentrations of **C** and **D** will increase i.e the reaction will shift in the forward direction.
However if at equilibrium the concentration of **C** or **D** is increased, the reaction will shift in the backward direction.

SOLUBILITY:

The number of grams of solute necessary to saturate100 grams solvent is called as solubility.

SOLUBILITY PRODUCT:

Solubility product is defined as the product of ionic concentration when dissolved ions and un dissolved ions are in equilibrium.

COMMON IONS EFFECT:

The process of addition of a strong electrolyte containing common ion affect the process of ionization and this phenomenon is called as common ion effect.

BUFFER ACTION:

A solution that resists the change in it Ph even after adding small amount of strong acid is called as buffer solution.

BUFFER ACTION:

The ability of a buffer solution to resists for a change in Ph is called as buffer action.

CHAPTER NO 7

SOLUTION AND ELECTROLYSIS

SOLUTION:

A homogeneous mixture of two or more than two sybstances is called as solution.

The substance that will be dissolved is called as solute.
The medium in which the solute will be mixed is a solvent.
The most common solvent in the universe is water.
When the solvent is water then it is called as aqueous solution.

SATURATED SOLUTION:

The type of solution in which the solute is added in miximum amount that is can hold is called as saturated solution.

UNSATURATED SOLUTION:

The Type of solution in which the solute is present in small quantity then it is called as unsaturated solution.

SUPER SATURATED SOLUTION:

The type of solution in which the solute is present in large amount more than the solvent can dissolve is called as super saturated solution.

SOLUBILITY:

The quantity required to achieve the saturated solution is called as solubility.

OR

The amount of solute dissolved in 100g of a solvent to form a saturated solution is called as solubility.

MOLARITY:

The number of moles of solute that are dissolve in $1dm^3$ of solution is called as molarity.

FORMULA:

Molarity = no. of moles of solute/volume of solution in dm^3

OR

Molarity = mass of solute in gms/molecular mass of solute x volume of solution in dm^3

MOLALITY:

The number of moles of solute that are dissolved in 1kg of solvent is called as molality.

FORMULA:

Molality= no of moles of solute/mass of solvent in kg

OR

Molality = mass of solute in gm/molecular mass of solute x mass of solvent in kg

HYDROLYSIS:

The reaction of cations or anion or both with water in which pH of water is changed, is known as hydrolysis.

EXAMPLE:

When ammonium chloride is reacted with water following reaction takes place

$$NH_4^+Cl^- + H^+OH^- \rightarrow HCl + NH_4OH$$

In this example products are HCl which is strong acid and NH_4OH which is a weak base. Due to this reason, pH of solution will change towards acidic nature.

HYDRATION:

When an ionic compound is dissolved in water it splits into positive and negative ions. These ions are surrounded by water molecules. The phenomenon in which water molecules surround a positive or negative ion is called 'HYDRATION'. Hydration occurs either by the interaction of lone pairs of electrons in water with a cation or by hydrogen bonding with anions.

TYPE OF IONIZATION:

- The electrolytic solution conduct electricity
- When acid basis dissolve in water it breakdown into positive and negative charged particles. And these particles are called as ions.
- When electrolyte dissolve in water then the electrostatic forces becomes weak and electrolytes breakdown
- The ionization is a reversible process because there is a state of equilibrium between dissociated and un-dissociated
- When we pass electric current to the electrolyte solution then the ions moves in the opposite direction in the solution.

CONDUCTORS:

The substances that allow the electricity to pass through it are called as conductors.
For example: metals, aqueous solution

NON CONDUCTORS:

The substances that do not allow the electricity to pass through it are called as conductors.

ACIDS:

The compounds that provide H+ ions are called as acids.

BASES:

The substance that provide the OH ions in the aqueous solution is called as base.

ARRHENIUS THEORY OF IONIZATION:

- The electrolytes have charged particles called ions.
- The H+ positive charge is derived from metals and negative charged received from non metals.
- Molecules of electrolytes like acids, bases and salts separate into oppositely charged ions in water, e.g.
- $NaCl \rightleftharpoons Na^{+} + Cl^{-}$
- The number of positive and negative charges on the ions must be equal so that the solution remains neutral.
- The ions are in random motion. They may collide to give unionized molecules. Thus ionization is a reversible process in which the solution contains ions of electrolyte together with unionized molecules.
- Strong electrolytes such as HCl completely dissolve in water.
- When electric current is passed thorugh the solution then the charges tries to move to their opposite electrodes.
- The dissolution of electrolyte depends upon nature of electrolyte, temperature and the degree of dilation.
- The electrical conductivity depends upon the number of ions that are present in solution as well as speed of those ions.

CHAPTER NO 8

INTRODUCTION TO THE CHEMICAL KINETICS

KINETICS:

Rate constant determined when the concentration of each reactant is unity i.e. one mole/dm^3 then **K** is called specific rate constant.
It is the branch of chemistry, that deals with the rate and the speed during the chemical reactions is called as chemical kinetics. In this branch we also study the factors that influence or alter or control the rate of chemical reactions. In chemical kinetics we study how molecules react, bond breaking and new bond formation.

RATE OF REACTION:

The amount of product formed in a unit time or the amount of reactant consumed in a unit time is called as rate of reaction.

VELOCITY OF REACTION:

The rate of reaction at a particular or given time is called as velocity of reaction.

FORMULA:

$V = dx/dt$

TYPES OF REACTION:

FAST REACTION:

The ionic compounds are fast in nature. We can not calculate their velocity.

SLOW REACTION:

The solution that takes more time to complete in a product is called as slow reaction.

MODERATE REACTION:

The reactions that are measurable are called as moderate reaction because these are normal in their speed nor very fast neither very slow.

CHARATCERISTICS OF RATE CONSTANT (K):

(i) It has a fixed value at a particular temperature.
(ii) K varies with temperature.
(iii) K remains unaltered with the change in concentration of reactants.

ORDER OF REACTION:

FIRST ORDER REACTION:

The reaction in which only one molecule undergoes a chemical change is called first order reactions.

SECOND ORDER REACTION:

The reaction in which two molecules undergo a chemical change is called second order reactions

THIRD ORDER REACTION:

The reaction in which only three molecules undergo a chemical change is called third order reactions.

SPECIFIC RATE CONSTANT:

when the concentration of each reactant is one or unity then the rate of constant determined and it is called specific rate constant.

ENERGY OF ACTIVATION:

The minimum amount of energy that a molecule requires to form activated coplex is called as energy of activation.

FACTOR AFFECTING RATE OF REACTION:

NATURE OF REACTANT:

The rate of reaction depends upon the nature of reactant.

TEMEPRATURE OF SYSTEM:

The rate of reaction increases the rate of temperature during the reaction.

THE PRESENCE OF CATALYST:

The catalyst uses to increase the rate of reaction.

TYPES OF CATALYST:

POSITIVE CATALYST:

The type of catalyst that is used to increase the rate of reaction is called as positive catalyst.

NEGATIVE CATALYST:

The type of catalyst that do not increase the rate of reaction but they involve with the reaction and slow down the rate of reaction is called as negative catalyst.

SCIENTIFIC REASONS

Reason No 1: Steam produces severe burns then boiling water, although they have same temperature

Answer: Both steam and boiling water have the same temperature i.e. 100 ^{o}C. But heat content of steam is greater than the boiling water because latent heat of steam is 2.26 x 10^5 J/kg .That's why steam produces severe burn as compared to boiling water.

Reason No 2: Falling drop of liquid is spherical.

Answer: Falling drop of a liquid is always spherical in shape because of the surface tension. The inward forces on the molecules of the liquid drop allow the liquid to form as small as possible shape. Since surface to volume ratio is minimum for the spherical shape that's why falling drop of a liquid is spherical.

Reason No 3: Evaporation causes cooling

Answer: we know that temperature is the measurement of average kinetic energy of molecules. When liquid evaporates, kinetic energy molecules escape from the surface of liquid and lower the average kinetic energy molecules remain in the liquid. Due to this reason temperature of liquid falls down.

Reason No 4: In mountain areas the water takes time to cook longer.

Answer: The normal boiling point of water is 100 0C at normal atmospheric pressure. On mountain areas such as Swat, atmospheric pressure decreases below 760 torr. Due to this reason boiling point of water decreases and food takes longer time to cook.

Reason No 5: Why honey is more viscous than water

Answer: Honey is more viscous or thick than water due to strong interlocking molecular forces between the atoms. While water has less strong molecular forces. So we can say that honey is more viscous than the water.

Reason No 6: A drop of ink spreads on a blotting paper why?

Answer: Blotting paper has a large number of tiny holes on its surface. Each hole acts like a capillary tube. When a drop of ink is placed on a blotting paper, it spreads on the paper due to capillary action.

Reason No 7: Why does the pressure of gas increase when volume decreased and the temperature remain constant.

Answer: At constant temperature if volume of a gas is reduced, gas molecules will come close to each other. In small area the collision among the molecules will increase so that pressure of gas also increases.

i.e. $\mathbf{V \propto 1/P}$

which is according to Boyle's law.

Reason No 8: At constant pressure increase in temperature decreases the volume of a gas.

Answer: At constant pressure, temperature of a gas is reduced, velocity and K.E of gas molecules will also decreases. Due to decrease in K.E, force of attraction between gas molecules will become large, consequently volume of gas decreases

i.e. $V \propto T$

which is according to Charle's law.

Reason No 9: Glycerin distilled at 290 C but it decompose at this temperature how would you distilled it

Answer: At 760 torr, B.P of glycerin is 290 0C but at 290 0C temperature glycerine evaporates and it become difficult to distill it. In order to overcome this difficulty it is distilled at 50 torr . At 50 torr it's B.P decreases to 210 0C. At 210 0C it does not decompose and distiledl easily.

Reason No 10: atomic radius increases from top to bottom of group. Reason?

Answer: Due to the addition of energy level the atomic radius increases from top to bottom of group.

Reason no 11: From top to bottom in any group of the periodic table, the atomic radius of atoms increases.

Answer As we go down the group, an extra shell is added in the atoms. Thus the valence shell moves away from the nucleus and we say that atomic radius increases.

Reason no 12: In Periodic table from left to right in any period of the periodic table, atomic radius of the atoms decreases.

Answer: From left to right in any period of the periodic table, the atomic radius decreases because an electron is successively added in the same shell. It means that in a particular period of the periodic table, same valence shell is possessed by all the elements of that period. From left to right the no. of electrons increases that valence shell, hence number of protons in the nucleus also increases. Thus the valence shell is attracted by the nucleus due to increased nuclear charge and thus the atomic radius decrease.