Physics

1.	Current Electricity ✓	60-72
2.	Light Optics ✓	73-90
3.	Magnetism ✓	91-96
4.	Kinematics ✓	100-106
5.	Force & Laws of Motion ✓	107-116
6.	Human Eye ~~Sm~~	131-133 ~~117~~
7.	Source of Energy	129-130
8.	Gravitation	135-138
9.	Work, Power & Energy ✓	117-121
10.	Dimension Analysis ✓	97-99
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CHEMICAL REACTIONS AND EQUATIONS ①

★ **Chemical Reaction** :- Chemical reactions are the process in which new substances with new properties are formed.

★ **Chemical Equations** :- The method of representing a chemical reaction with the help of symbols and formula of the substances involved in it is known as a chemical equation.

★ **Types of Chemical Reactions** :-

① **Combination Reactions** → $(A + B \rightarrow AB)$

Those reactions in which two or more substances combine to form a single substance are called combination Reactions.

Eg:- (i) $2Mg + O_2 \xrightarrow{\text{Combination}} 2MgO$ (Magnisium oxide)

(ii) $2H_2 + O_2 \xrightarrow{\text{Combination}} 2H_2O$ (water)

2017

② **Decomposition Reactions** :- $(AB \rightarrow A + B)$

Those reactions in which a compound splits up into two or more simpler substances are known as Decomposition Reactions.

Eg:- (i) By Heat →

$CaCO_3 \xrightarrow{\text{Heat}} CaO + CO_2$

(Limestone) (Calcium oxide + Carbon dioxide)

Calcium carbonate

② By Current →

$$2NaCl \xrightarrow[\text{current}]{\text{Electricity}} 2Na + Cl_2$$

(Sodium chloride) (Sodium + chlorine)
(salt)

This process is known as Electrolysis.

③ By light (Sun light) →

$$2AgCl \xrightarrow{\text{Sun Light}} 2Ag + Cl_2$$

(Silver chloride) (Silver + chlorine gas)

③ **Displacement Reactions** :- $(A + BC \rightarrow AC + B)$

Those reactions in which one element takes the place of another element in a compound are known as Displacement Reactions.

Eg:- (i) $CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$
(Copper sulphate) (zinc) (Zinc sulphate) (Copper)

Note:- Only High reactive metal can ~~split~~ replace (ऐसा बदलना है) the low reactive metal. Here, Zn is High reactive and Cu is low reactive. [Learn Table] reactivity series.
eg:- $ZnSO_4 + Cu \rightarrow$ No reaction.

④ **Double Displacement Reaction** :- $(AB + CD \rightarrow AD + CB)$

Those reactions in which two compounds react by an

Combustion Rxn → All Hydrocarbons burns in presence of oxygen to give CO_2 and water. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Dissociation Rxn → On Heating compound breaks into its constituents.
$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ / $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

exchange of ions to form two new compounds are called Double Displacement Reactions.

Eg:-
$$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$$
(Silver Nitrate) (Sodium chloride) (Silver chloride) (Sodium Nitrate)

⑤ **Oxidation and Reduction Reactions** :-

Oxidation :→ ★ The addition of oxygen to a substance is called oxidation.
★ The removal of hydrogen from a substance is also called oxidation.

Reduction :→ ★ The addition of hydrogen to a substance is called reduction.
★ The removal of oxygen from a substance is called reduction.

⑥ Redox :→ (Reduction + oxidation)

The oxidation and Reduction reactions are also called Redox Reactions.

Eg:- Removal of oxygen : Reduction

$$CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O$$

Addition of oxygen : oxidation

★ **Effects of oxidation Reactions** :-

(2018) **Corrosion** :- Corrosion is the process in which metals are eaten up gradually by the action of air, moisture or a chemical on their surfaces. Corrosion is caused mainly by the oxidation of metals by the oxygen of air. Rusting of iron metal is the most common form of corrosion.

Eg:- $4Fe + 3O_2 + 2xH_2O \longrightarrow 2Fe_2O_3 \cdot xH_2O$
(Iron) (oxygen) (water) (Hydrated iron (III) oxide) (Rust)

★ Al to be layered on Iron to prevent it from Rusting by Galvanization.

★ Gold and silver metal never be corrode.

★ **RANCIDITY** :-

The conditions produced by aerial oxidation of fats and oil in foods marked by unpleasant smell and taste is called Rancidity.

It can be prevented by the following ways:-

(i) Rancidity of food can be prevented by adding anti-oxidants to foods containing fats and oils.

(ii) Rancidity can be prevented by packaging fat and oil containing foods in nitrogen gas.

(iii) Rancidity can be retarded by keeping food in a refrigerator.

(iv) Rancidity can be retarded by storing food in air-tight containers.

(v) Rancidity can be retarded by storing foods away from light.

(7) 2018 **Exothermic Reaction**: The reaction in which heat is evolved (produce) is known as exothermic reaction.

eg:- $C + O_2 \longrightarrow CO_2 + Heat$

(8) **Endothermic Reaction** The reaction in which heat is absorbed is known as endothermic reaction.

eg:- $CaCO_3 \xrightarrow{heat} CaO + CO_2$

Important Valency (Charge) Ions

Monovalent Radicals

Cation	Anions
$Cl \rightarrow -1$	$Na \rightarrow +1$
$Br \rightarrow -1$	$Ag \rightarrow +1$
$NO_3 \rightarrow -1$	$K \rightarrow +1$

Divalent

Cation	Anion
Carbonate $(CO_3) \rightarrow -2$	$Ba \rightarrow +2$
Sulphate $(SO_4) \rightarrow -2$	$Ca \rightarrow +2$
Sulphite $(SO_3) \rightarrow -2$	$Cu \rightarrow +2$
Oxide $(O) \rightarrow -2$	$Pb \rightarrow +2$
Sulphide $(S) \rightarrow -2$	$Mg \rightarrow +2$
Zinc $(Zn) \rightarrow -2$	$Zn \rightarrow +2$
$Fe^{+2} \rightarrow$ Ferrous oxide	NH_4^{+1}
$Fe^{+3} \rightarrow$ Ferric oxide	
$Cu^{+} \rightarrow$ Cuprous oxide	
$Cu^{2+} \rightarrow$ Cupric oxide	

Trivalent

Phosphate	Aluminium
$PO_4 \rightarrow -3$	$Al \rightarrow +3$
$B \rightarrow -3$	$B \rightarrow +3$

REACTIVITY SERIES

Most (Highly) Reactive → K
Na
Ca
Mg
Al
C
Zn
Fe
Sn
Pb
H
Cu
Ag
Au
Least Reactive → Pt

HALIDES

I^{-1} = Iodide
F^{-1} = Fluoride
Cl^{-1} = chloride
Br^{-1} = Bromide
} monovalent

O^{-2} oxide
S^{-2} sulphide
} divalent

N^{-2} Nitride
P^{-2} phosphide
} trivalent

C^{-4} – Carbide –

ANIONS

$OH^{-1} \rightarrow$ hydroxide
$CH_3COO^{-} \rightarrow$ Acetate
$NO_3^{-1} \rightarrow$ Nitrate
$HCO_3^{-1} \rightarrow$ Bicarbonate
$CO_3^{2-} \rightarrow$ Carbonate
$SO_4^{-2} \rightarrow$ Sulphate
$PO_4^{3-} \rightarrow$ phosphate

ACID, BASE AND SALT

Indicator → It is a dye that changes colour when it is put in acid or base. It can be classified as

1. Litmus Paper = Acid turn Blue litmus to Red
   Base turn Red litmus to Blue

2. Methyl Orange = It become Red in Acid
   It become Yellow in Base.

3. Phenolphthalien = (Neitral colour) It become colourless in Acid
   It become Pink in Base.

ACID

Those chemical substance which have sour (खट्टा) taste.

Types of Acid

Organic Acid	Mineral Acid
Those acid which are present in plant and animals (weak acid)	Those acid which are obtain from minerals. (Strong Acid)
Eg:- Hydrosulfuric acid H_2S	Eg:- Hydrochloric acid - HCl
Acetic Acid - CH_3COOH	Sulphuric acid - H_2SO_4
Formic Acid - $HCOOH$	Nitric acid - HNO_3
Carbonic acid - H_2CO_3	phosphoric acid - H_3PO_4
Formonitride - HCN	

Some Imp Organic acid And their Source :-

ACID	Formula	Source of Acid
1. Acetic Acid	CH_3COOH	Vinegar
2. Oxalic Acid	$C_2H_2O_4$	Tomato
3. Lactic Acid	$C_3H_6O_3$	Curd
4. Formic Acid	$HCOOH$	Ant Sting
5. Malic Acid	$C_4H_6O_5$	Tea leaves
6. Carbonic Acid	H_2CO_3	Rain Water

CH_3NH_2 → methyl amine

weak Base → NH_3, $Al(OH)_3$, $Fe(OH)_3$, NH_4OH

BASE

Those chemical substance which have bitter (कड़वा) taste. Water Soluble base are known as alkalis.

Eg:- $NaOH$ - Sodium Hydroxide (Caustic Soda)
KOH - Potasium Hydroxide (Caustic Potash) 2012, 2016, 2017, 2019
$Ca(OH)_2$ - Calcium Hydroxide (slaked lime)
$Mg(OH)_2$ - Magnisium Hydroxide

★ ACID - BASE Theory of different Scientist :-

Imp **ARHENIUS THEORY** :- Acid are those substance which gives H^+ ion on dissolving in water and Base are those substance which gives OH^- ion on dissolving in water.

Eg:- Acid $HCl \longrightarrow H^+ + Cl^-$ (more H^+ → Strong Acid)
$NaOH \longrightarrow Na^+ + OH^-$ (more OH^- → Strong Base)

BRONSTED - LOWRY THEORY :- An Acid is a substance which loose proton and Base is a substance which accept proton.

LEWIS CONCEPT :- An Acid is a substance which accept pair of electron and Base is a substance which donate pair of electron.

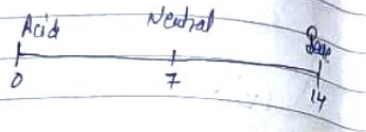
2016, 2019 ★ **PH Scale** :- It is a scale which is used to find the strength of Acid or Base. It depends on the concentration of hydrogen ion.

This scale has number from 0 to 14

$0 < pH < 7$ Acid

$pH = 7$ Neutral (water)

$7 < pH < 14$ Base



SALTS - (Ist) Sodium chloride (~~Sodium~~ Nacl - Common Salt

Method to prepare →

2013 Neutralisation Reaction → when an acid react with base it will form salt and water, this reaction is known as neutralisation Rxn

eg/. ACID + BASE ⟶ SALT + WATER

$HCl + NaOH \longrightarrow NaCl + H_2O$

Uses :-

(i) use as raw material

(ii) Use in manufacture of soap

(IInd) Sodium Hydroxide - NaOH - Caustic Soda

Method to prepare →

Chlor - alkali process → It is formed by Electrolysis of aqueous solution of Nacl (Brine). In this process chlorine gas is produce at anode and Hydrogen at cathode.

$$2NaCl + 2H_2O \longrightarrow \underset{\text{Sodium Hydroxide}}{2NaOH} + Cl_2 + H_2\uparrow$$

Uses :-

(i) In manufacture of paper

(ii) In manufacture of Soap.

IIIrd Sodium Hydrogen Carbonate → Baking Soda - $NaHCO_3$

Method to prepare →

Prepared by Reacting Solution of NH_3 and CO_2.

$$NaCl + H_2O + NH_3 + CO_2 \longrightarrow \underset{\text{Baking Soda}}{NaHCO_3} + NH_4Cl$$

Uses - (i) It is used to remove acidity of stomach.

(ii) It is used to making baking powder.

2011, 2017 IVth Calcium oxy chloride - $CaOCl_2$ - Bleaching powder

Method to prepare → Prepared by passing chlorine gas over slaked lime.

$$\underset{\text{slaked lime}}{Ca(OH_2)} + Cl_2 \longrightarrow \underset{\text{Bleaching powder}}{CaOCl_2} + H_2O$$

Uses - (i) To disinfectant water

(ii) To Bleaching of clothes.

IVth Washing Soda - $Na_2CO_3 \cdot 10H_2O$ - Sodium Carbonate deca Hydrate

Method to prepare → It is formed by two steps by Baking Soda.

$$\underset{\text{(Baking Soda)}}{2NaHCO_3} \xrightarrow{Heat} Na_2CO_3 + H_2O + CO_2$$

$$Na_2CO_3 + 10H_2O \longrightarrow \underset{\text{Washing Soda}}{Na_2CO_3 \cdot 10H_2O}$$

Uses - (i) Used in manufacture of soap, paper

(ii) Used in removing permanent hardness of water.

2017 Calcium Sulphate Hemi Hydrate - $CaSO_4 \cdot \frac{1}{2} H_2O$ - Plaster of Paris (POP)

Method to prepare -> Prepare by heating Gypsum at 373 K

$$\underset{\text{Gypsum}}{CaSO_4 \cdot 2H_2O} \xrightarrow[373K]{Heat} \underset{(P.O.P)}{CaSO_4 \cdot \tfrac{1}{2} H_2O} + \underset{(Ice}{1\tfrac{1}{2} H_2O}$$

Uses - (i) Making Wall Surface smooth.
(ii) Making plaster to set up fractured bones.

Some Imp Rxn

Metal + Acid ⟶ Salt + Hydrogen gas

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Buffer Solution

It is a chemical Solution which resist (farther) change to its pH or acidity. It is a solution in water of a mixture of a weak acid or base and its salt.

Eg:- $\underset{\text{weak Acid}}{CH_3COOH} + \underset{\text{its salt}}{CH_3COONa}$
Acetic Acid

METAL AND NON METAL

2017 Properties of metals :-

1. Hard and have high tenside strength. (Except Na, k - They are soft) They can easily cut with Knife.
2. Solid at room temprature. (Except Mercury (Hg) is liquid)
3. Good Conductor of heat and Electricity. (Ag is best)
4. Malleable i.e Can be beaten into flay sheets. (Gold is highly Malleable).
5. Ductile i.e Can be drawn into thin wires. (Gold is most ductile)
6. High Melting and boiling point. (Except Cesium (Cs) and Gallium (Ga))
7. They are lusturous. (चमकीले)
8. Sonorus (Ringing found when strike with each other.
9. From Basic oxide

2017 Properties of Non metals :-

1. Non metals are solid, liquid and gas. (Br is only non metal found in liquid state).
2. Non metals are brittle (भुरभुरा) i.e can be broken into thin pieces.
3. Non metals are non-malleable and non-ductile.
4. Non lusturous. (Except ~~Diamond -> Hardest Natural~~) (Except Iodine)
5. Bad Conductor of heat and electricity (Except Graphite)
6. Soft (Except - Diamond -> Hardest Natural)
7. Non Sonorus.
8. From Acidic oxide

Metaloids
1. From Amphoteric ~~nature~~ oxide.
2. They are semi Conductor
3. They have characteristic of both metal & non-metal.
4. Group :- 13 -> B
14 -> Si, Ge
15 -> As, Sb
16 -> Te, Po

★ Some Imp chemical properties of Metals :-

1. Metal react with water and produce H_2 gas.

Metal + water ⟶ Metal Hydroxide + H_2

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Note - Cu, Ag, Au never react with water or steam.
Ag - Silver, Au - Gold

2. Metal react with oxygen and form metal oxide.
Metal oxide are basic.

metal + O_2 ⟶ metaloxide

Eg:- $2Mg + O_2 \longrightarrow 2MgO$ (Basic)
Magnesium oxide

Amphoteric oxide :- Those oxide which show both acidic as well basic behaviour known as amphoteric oxide.
Eg:- Al_2O_3, ZnO

Note - Non metal oxides are acidic.

★ Reactivity Series - A high reactive metal displace least reactive metal from its salt

K (High reactive)
Na
Ca
Mg
Al
Zn
Fe
Ni
Pb
H
Cu
Ag
Au
Pt

↓ reactivity Decreasing

Eg:- $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$
$Cu + FeSO_4 \longrightarrow$ No Reaction
(Displacement Rxn)

Thermite Reaction - In this reaction Aluminium is reacted with iron oxide and Molten Iron is obtained.
This reaction is used in welding of railway track, cracked machine parts.

Rxn $2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$ (Molten)
Iron oxide — Iron

★ Occurrence of metals - Most of the elements (metals) occur in nature in the compound state. Some found in free state.

Minerals → All the compound in earth crust in which metal present are known as minerals. like sand, soil or rocks.

Ores → The minerals from which metal can be extracted profitably and easily are known as ores.

Some Imp metals and their Ores -

Metal	Ores	Chemical formula
Na (Sodium)	Common Salt	NaCl
Al (Aluminium)	Bauxite	$Al_2O_3 \cdot 2H_2O$
Fe (Iron)	Imp: Haemetite	Fe_2O_3
	Iron Pyrite	FeS_2
	Magnetite	Fe_3O_4
Cu (Copper)	Cubrite	Cu_2O
	Copper glance	Cu_2S
Ca (Calcium)	Lime stone	$CaCO_3$
Zn (Zinc)	Zinc blende	ZnS
	Calamine	$ZnCO_3$
Hg (Mercury)	Cinabar	HgS
Pb (Lead)	Galena	PbS

Note - Gold (Au), Platinum (Pt) are the metals which found in free state.

Some Imp process →

2016 **Roasting** → The process in which sulphide ore is heating strongly in the presence of air.

Eg!- $2ZnS + 3O_2 \xrightarrow{Heat} 2ZnO + 2SO_2$
Zinc Sulphide

2014 **Calcination** → The process in which Carbonate Ore is heating in the absence of air.

Eg!- $ZnCO_3 \xrightarrow{Heat} ZnO + CO_2$
(Zinc carbonate)

2020 Q. Why is Na (Sodium) kept immersed in kerosene oil?

Ans Sodium is highly reactive metal and react with oxygen at room temperature, so it kept immersed in kerosene oil. and burns.

Matter in our Surroundings

★ **Characteristics of Particles of matter**

(i) The particle of matter are very small.
(ii) The particle of matter have space between them.
(iii) The particle of matter are constantly moving.
(iv) The particle of matter attract each other.

2015 ★ **Classification of matter as Solid, liquid & Gas**

Properties	Solid	Liquid	Gas
Shape	Fixed	Non fixed	Non Fixed
Volume	Fixed	Fixed	Non Fixed
Rigidity (दृढ़ता)	Highest	less than solid	Less than liquid
Fluidity (तरलता)	less than liquid	less than Gas	Highest
Kinetic Energy	less than liquid	less than Gas	Highest
$D = \frac{mass}{volume}$ Density (घनत्व)	Highest	less than Solid	less than liquid

2017 **Diffusion** → (विसरण)

The spreading out and mixing of a substance with another substance due to the motion of its particle is called Diffusion. (नोट :- अवस्थान्तरण) Diffusion is a property of matter which is based on the motion of its particles. Diffusion is fastest in gas and slowest in solid.

Change of state:-

Melting (or fusion) M.P of Ice = 0°C

The process in which a solid substance changes into a liquid on heating is called melting (or fusion).

Boiling (or Vaporisation) (B.P of water = 100°C)

The process in which a liquid substance changes into gas rapidly on heating is called boiling.

melting (fusion)] on heating / condensation] cooling
Boiling (vaporisation) / Freezing

CONDENSATION

The process of changing a gas to a liquid by cooling is called condensation.

FREEZING (freezing point of water is 0°C)

The process of changing a liquid to solid by cooling is called freezing.

Latent Heat (Hidden Heat)

The heat energy which has to be supplied to change the state of a substance is called latent heat.

Latent Heat is of two types:-
Latent Heat of fusion (Melting)
Latent Heat of vapourisation (Boiling)

★ **Latent Heat of Fusion (melting)** :- The heat which is going into ice but not increasing its temprature or the energy required to change the state of ice from solid to liquid.

(at 0°C at Room temp & Pressure)
(Latent Heat)

★ **Latent Heat of Vapourisation (Boiling)** :- The latent heat of vapourisation of liquid is the quantity of heat in joules required to convert 1 kg of the liquid to gas, without any change in temprature.

SUBLIMATION

The changing of solid directly into gas on heating and of vapours into solid on cooling is known as sublimation.

$$\text{Solid} \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} \text{Gas}$$

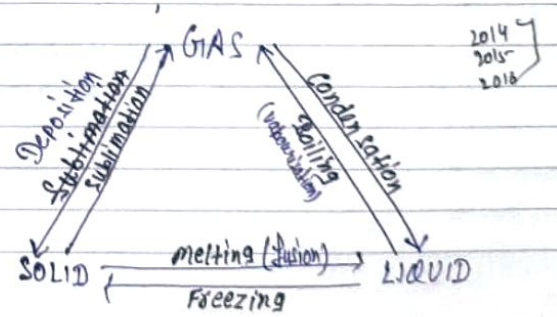
Imp! The common substance which undergo sublimation are Ammonium chloride, Iodine, Camphour, Naphthalene balls and Anthracene.

Evaporation

The process of liquid changing into vapours (or gas) even below its boiling point is called evaporation.

Factors affecting evaporation

The evaporation of a liquid depends mainly on the following factors: (i) Temprature, (ii) Surface Area, (iii) Humidity, (iv) Wind speed.



(5) molecular mass = 2 × Vapour Density

MOLE CONCEPT

Mole = Collection of atoms or molecules.

1 Mole = 6.022×10^{23} atoms/molecules

6.02×10^{23} is also known as Avogadro Number.

Formulas

No. of Mole = $\frac{\text{wt of substance in gm}}{\text{atomic wt}}$

No. of mole = $\frac{\text{Total no. of atoms}}{6.02 \times 10^{23}}$

mass of 01 mole = ~~mass of 01 atom~~ × Avogadro No.

Numericals

2019 (1) Find the number of moles in 11gm CO_2?

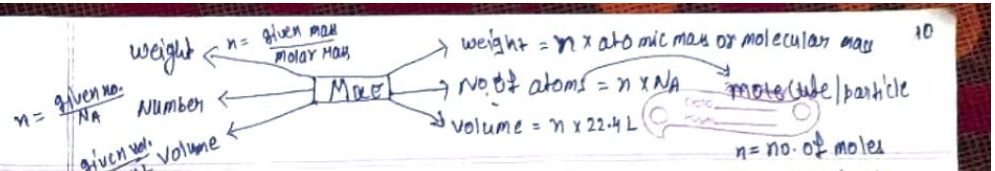
Ans Atomic weight (wt) of CO_2 = 12 + 16 × 2 = 44 gm

No. of moles = $\frac{\text{wt in gm}}{\text{atomic wt}} = \frac{\cancel{11}^{1}}{\cancel{44}_{4}} = 0.25$ Ans

2017 (2) Find the number of moles of a substance having 12.04×10^{24} atoms?

Ans Total No. of Atoms = 12.04×10^{24}

No. of Moles = $\frac{\text{Total No. of atoms}}{6.02 \times 10^{23}} = \frac{\cancel{12.04}^{2} \times 10^{24}}{\cancel{6.02} \times \cancel{10^{23}}} = 20$ Ans



(3) Find no. of atoms in 5 moles of CO_2.

Soln 1 mole CO_2 = 6.02×10^{23} atoms

So, 5 mole CO_2 = $5 \times 6.02 \times 10^{23}$

= 30.1×10^{23} Ans

(4) Find wt of 0.5 mole of CH_4?

Soln Atomic wt of CH_4 = 12 + 1 × 4 = 16

We know that,

No. of moles in a substance = $\frac{\text{wt of substance in gm}}{\text{atomic wt}}$

$0.5 = \frac{wt}{16}$

wt = 0.5 × 16 = 8 gm

0.5 mole of CH_4 have 8 gm weight. Ans

2019 (5) Find the wt of H_2O having 1.204×10^{24} atoms.

Atomic wt of H_2O = 2 × 1 + 16 = 18 gm

No. of moles = $\frac{\text{Total no. of atoms}}{6.02 \times 10^{23}} = \frac{\cancel{1.204}^{0.2} \times \cancel{10^{24}}}{\cancel{6.02} \times \cancel{10^{23}}} = 2$ moles

We also know that,

No. of moles = $\frac{\text{wt of substance}}{\text{atomic wt}}$

$2 = \frac{\text{wt of } H_2O}{18}$

wt of H_2O = 36 gm Ans

2017

⑥ Find Number of atoms in 3.2 gm CH_4.

Soln. Atomic wt of CH_4 = 12+4×1 = 16 gm

we know that,

$$\frac{\text{wt of Substance}}{\text{Atomic wt}} = \frac{\text{Total No. of atoms}}{6.02\times10^{23}}$$

$$\frac{3.2}{16} = \frac{n}{6.02\times10^{23}}$$

$$0.2 = \frac{n}{6.02\times10^{23}}$$

$$n = 0.2\times6.02\times10^{23}$$

$$n = 1.204\times10^{23} \text{ Ans}$$

⑦ What is the mass of 0.2 mole of oxygen atom.

Soln Atomic mass of O_2 = 16×2 = ~~32 gm~~

we know that,

$$\text{No. of Moles} = \frac{\text{wt of Substance}}{\text{Atomic wt}}$$

$$0.2 = \frac{n}{16}$$

$$n = 0.2\times16 = \boxed{3.2 \text{ gm}}$$

⑧ Calculate the mass of 0.5 mole of water molecules?

Atomic wt of water (H_2O) = 1×2+16 = 18 gm

$$\text{No. of Moles} = \frac{\text{wt of substance}}{\text{Atomic wt}}$$

$$0.5 = \frac{n}{18}$$

$$n = \frac{18\times1}{2} = 9 \text{ gm Ans}$$

⑨ Calculate the no. of molecules of sulphur (S) present in 16 gm of solid sulphur.

Atomic wt of solid sulphur (S) = ~~32 gm~~ 8×32 = 256 gm

$$\frac{\text{wt of substance}}{\text{Atomic wt}} = \frac{\text{Total No. of atoms}}{6.02\times10^{23}}$$

$$\cancel{\frac{16}{32} = \frac{n}{6.02\times10^{23}}}$$

$$\cancel{2n = 6.02\times10^{23}}$$

$$\cancel{n = 3.01\times10^{23}}$$

$$\frac{16}{256} = \frac{n}{6.02\times10^{23}}$$

$$n = \frac{6.02\times10^{23}}{16} = 0.376\times10^{23}$$

$$\boxed{n = 3.76\times10^{22}}$$

⑩ Calculate the No. of aluminium ion present in 0.051 gm of Aluminium oxide (Al_2O_3).

Atomic wt of Aluminium oxide (Al_2O_3) = 27×2+16×3

= 54+48 = 102

$$\frac{\text{wt of Substance}}{\text{Atomic wt}} = \frac{\text{Total No. of Atoms}}{6.02\times10^{23}}$$

$$\frac{0.051}{102} = \frac{n}{6.02\times10^{23}}$$

$$6.02\times10^{23}\times\frac{51}{1000} = n\times102$$

$$n = \frac{301\times10^{23}}{1000\times100\times2} = \cancel{3.07\times10^{20}}$$

$$= \frac{301\times10^{23}}{1000\times100} = 3.01\times10^{20}$$

The no. of Aluminium ions present in one molecules of aluminium oxide is = 2.

" " " " " " " 3.01×10^{20} molecules " " " $= 2\times3.01\times10^{20}$

$= 6.02\times10^{20}$

(11) Calculate the no. of ions obtained from $CaCl_2$ when 222 gm of its dissolved in water?

Sol^n Atomic ~~wt~~ weight of $CaCl_2$ = $40 + \cancel{35.5 \times 2}^{35.5 \times 2} = 40 + 71 = 111$ gm/mol

$$\frac{\text{weight of Substance}}{\text{Atomic weight}} = \frac{\cancel{\text{Total No. of atoms}}}{\cancel{6.02 \times 10^{23}}} \text{ Moles}$$

$$\frac{\cancel{222}^{2}}{\cancel{111}} = \frac{\cancel{n}}{\cancel{6.02 \times 10^{23}}} \text{ moles}$$

~~moles~~ =

$$\cancel{111n = 222 \times 6.02 \times 10^{23}}$$

$$\cancel{n = \frac{222 \times 6.02 \times 10^{23}}{111}}$$

$$\cancel{n = \frac{1336.44 \times 10^{23}}{111}}$$

$n = 12.04 \times 10^{23}$

1 mole have $CaCl_2$ ion – 3

12.04×10^{23} ——— $3 \times 12.04 \times 10^{23}$

$= 36.12 \times 10^{23}$

$= 3.612 \times 10^{24}$

Q→ 48 gm oxygen gas present in a cylinder. Calculate its volume. Also Calculate the no. of oxygen molecule present.

Ans mass of oxygen = 48 g

Atomic mass of oxygen = $16 \times 2 = 32$ g

No. of moles = $\frac{\text{wt of subs}}{\text{Atomic weight}} = \frac{48}{32} = 1.5$

Vol. of oxygen = No. of moles × 22.4 L

$= 1.5 \times 22.4 = 33.6$ L Ans

1 mole O_2 gas = N_A O_2 molecule

1.5 " " " = $6.022 \times 10^{23} \times 1.5$ = 9.033×10^{23} molecules.

(12) Calculate the number of moles in 2.58×10^{24} atoms of oxygen?

6.02×10^{23} atoms have = 1 mole of O_2

1 " = $\frac{1}{6.02 \times 10^{23}}$

2.58×10^{24} " = $\frac{1}{6.02 \times 10^{23}} \times 2.58 \times 10^{24}$

$= \frac{25.8}{6.02} = \frac{\cancel{258}^{129}}{\cancel{602}_{301}} \times \frac{\cancel{100}}{10} = \frac{1290}{301}$

= 4.28 Moles

(13) Which has more no. of atoms 100 gm N_2 and 100 gm NH_3?

Atomic wt of N_2 = $14 \times 2 = 28$ gm

" " NH_3 = $14 + 1 \times 3 = 17$ gm

N_2

$\frac{100}{28} = \frac{n}{6.02 \times 10^{23}}$

$n = \frac{6.02 \times 10^{25}}{28}$

$n = 0.215 \times 10^{25}$

NH_3

$\frac{100}{17} = \frac{n}{6.02 \times 10^{23}}$

$n = \frac{6.02 \times 10^{25}}{17}$

$n = 0.354 \times 10^{25}$

NH_3 have more no. of atoms.

Q 4 mole of $CaCl_2$ was dissolved in water. Calculate :- a) Total No. of ions b) No. of chloride ions.

Ans (a) $CaCl_2 \longrightarrow Ca^{+2} + 2Cl^-$

1 mole, 1 mole, 2 mole

Total No. of ions = $4 \times (1+2) = 12 N_A$

$= 12 \times 6.022 \times 10^{23}$

(b) No. of chloride ions = $4 \times 2 = 8 N_A$

$= 8 \times 6.022 \times 10^{23}$

(14) Compute the no. of ions present in 5.85 gm Sodium chloride?

Sol^n ~~No. of mole = 5.85~~ Atomic weight of Nacl = 23+35.5 = 58.5

No. of mole = $\frac{5.85}{58.5} = \frac{1}{10} = 0.1$

Nacl = $Na^+ + Cl^-$ = 2 ions

Total moles of ions = No. of moles (substance) × 2 ions
= 0.1 × 2 = 0.2

No. of ion = $0.2 \times 6.02 \times 10^{23} = 1.2042 \times 10^{23}$ Ans

(15) Find the wt of 2 mole of CO_2?

Atomic wt of CO_2 = 12 + 16×2 = 44 gm

$$\text{mole} = \frac{\text{wt of Substance}}{\text{Atomic wt}}$$

$$2 = \frac{\text{wt of Substance}}{44}$$

wt of Substance = 88 gm

MOLARITY, NORMALITY

2018

Molarity :- The number of moles of solute present in 1 ltr of solution is known as Molarity. (Represented by M)

$$M = \frac{\text{No. of Moles of Solute}}{\text{Volume of Solution in ltr}} = \frac{\text{wt of Solute in gm}}{\text{atomic wt} \times \text{Volume (l)}}$$

In short,

$$M = \frac{W \text{ (In gm)}}{w \times V(l)}$$

w → atomic wt

Equivalence wt – Eq wt for any element or Compound = $\frac{\text{Atomic wt}}{\text{Valency}}$

Eq wt for Acid = $\frac{\text{Atomic wt}}{\text{No. of } H^+ \text{ ion}}$

Eq wt for Base = $\frac{\text{Atomic wt}}{\text{No. of } OH^- \text{ ion}}$

Eq wt for Compound = $\frac{\text{Atomic wt}}{\text{Total charge on cation}}$

$AlCl_3 \Rightarrow Al^{+3}$ 3 valency

$Al_2(SO_4)_3 \Rightarrow 2Al^{+3}$ 6 valency

2017

Normality – The number of gram Equivalence of solute present in 1 ltr of solution is known as Normality. (Represented by N).

$$N = \frac{\text{No. of gram Equivalence of solute}}{\text{Volume of solution in ltr}}$$

OR

$$N = \frac{\text{wt of Solute in gm}}{\text{Eq wt} \times \text{Volume of solution (l)}}$$

Note (Imp) ① Relation b/w M an N $\boxed{\frac{N}{M} = \text{Valency}}$

② If Sol^n of Volume V_1, Normality N_1 is neutralize by V_2, N_2 then $\boxed{N_1 V_1 = N_2 V_2}$

2017 Examble

1. If 5.85 gm NaCl dissolved in water and make Solⁿ 500 ml. Find its Molarity, Normality?

Solⁿ Atomic weight of NaCl = 23 + 35.5 = 58.5

NaCl
Na^+ Cl^-

$$\text{Eq wt} = \frac{\text{Atomic wt}}{\text{Valency}} = \frac{58.5}{1}$$

$$\text{Volume (V)} = 500\ ml = \frac{500}{1000}\ ltr = \frac{1}{2}\ l$$

$$\text{Molarity (M)} = \frac{\text{wt of Solute in gm}}{\text{Atomic wt} \times \text{Volume of Solⁿ (l)}}$$

$$= \frac{5.85}{58.5 \times \frac{1}{2}} = \frac{2}{10} = 0.2\ Ans$$

$$\text{Normality (N)} = \frac{\text{wt}}{\text{Eq wt} \times \text{Volume}} = \frac{5.85}{58.5 \times \frac{1}{2}} = \frac{2}{10} = 0.2\ Ans$$

2. Find the Equivalence wt for following :-
(i) NaOH (ii) $CaCl_2$ (iii) Na_2CO_3 (iv) H_2SO_4

Solⁿ (i) Atomic wt of NaOH = 23 + 16 + 1 = 40

NaOH = Na^+ OH^-

$$\text{Eq wt} = \frac{\text{Atomic wt}}{\text{Valency}} = \frac{40}{1} = 40$$

(ii) $CaCl_2$ Ca^{++} $2Cl^-$

At wt = 40 + 35.5 × 2 = 111

Eq wt = $\frac{111}{2}$ = 55.5

(iii) Na_2CO_3 $2Na^+$ CO_3^{--}

At wt = 23 × 2 + 12 + 16 × 3 = 106

Eq wt = $\frac{106}{2}$ = 53

(iv) $H_2SO_4 \longrightarrow 2H^+ + SO_4^{-2}$

Atomic weight = 2 × 1 + 32 + 16 × 4 = 98

Eq wt = $\frac{98}{2}$ = 49

2019 (3) If the Eq wt of a Substance is 40 and valency is 2. Find its atomic wt.

Solⁿ

$$\text{Eq wt} = \frac{\text{Atomic wt}}{\text{valency}}$$

$$40 = \frac{\text{At wt}}{2}$$

Atomic weight = 80

2017, 2019 (4) Calculate the amount of 400 ml of $\frac{N}{10}$ Na_2CO_3 Solⁿ?

Solⁿ Atomic weight of Na_2CO_3 = 23 × 2 + 12 + 16 × 3 = 106

Eq wt = $\frac{106}{2}$ = 53

$N = \frac{1}{10} = 0.1$, V = 400 ml = 0.4 ltr

$$N = \frac{\text{wt}}{\text{Eq wt} \times \text{volume (l)}}$$

$$0.1 = \frac{\text{wt}}{53 \times 0.4}$$

$$\text{wt} = \frac{1 \times 53 \times 4}{10} = \frac{212}{10} = 21.2\ gm\ Ans$$

2010

(5) 15 ml 0.1 N NaOH solⁿ is neutralized by 10 ml of HCl solⁿ. Find out Normality of solⁿ (HCl).

Solⁿ $N_1 = 0.1$ $V_1 = 15$ ml $N_2 = ?$ $V_2 = 10$

$N_1V_1 = N_2V_2$

$0.1 \times 15 = N_2 \times 10$

$N_2 = \frac{15}{100} = 0.15\ N$ Ans

(6) 4 gm of NaOH is dissolved in water and Solⁿ become 250 ml. Find Molarity and Normality?

Given,

wt of NaOH = 4 gm

Volume of Solⁿ = 250 ml = $\frac{250}{1000}$ = $\frac{1}{4}$ l

Atomic wt NaOH = 23+16+1 = 40

Equivalent wt = $\frac{\text{Atomic wt}}{\text{valency}} = \frac{40}{1} = 40$

molarity = ~~Moles of Solute in ltr~~ $\frac{\text{wt of Solute}}{\text{at wt} \times \text{vol of soln in ltr}}$

$= \frac{4}{40 \times \frac{1}{4}} = 0.4\ M$

Normality = $\frac{\text{wt of Solute in gm}}{\text{Eq wt} \times \text{Vol (l)}} = \frac{4}{40 \times \frac{1}{4}} = 0.4\ N$

(7) If 20.6 g of NaBr is dissolved in 500 ml water. Calculate Molarity.

Given,

wt of Solute (NaBr) = 20.6 gm

Vol. of Solⁿ in ltr = 500 ml = $\frac{1}{2}$ l

Atomic wt (NaBr) = 23 + 80 = 103

molarity = $\frac{\text{wt of solute}}{\text{atomic wt} \times \text{vol (l)}} = \frac{20.6}{103 \times \frac{1}{2}} = \frac{206 \times 2}{103 \times 10} = \frac{4}{10} = 0.4\ M$

8. How much amount of Sodium carbonate (Na_2CO_3) is required to prepare 500 ml solution of 0.01 M Na_2CO_3 Solⁿ.

Given,

Vol. of solution = 500 ml = $\frac{1}{2}$ l

Molarity = 0.01 M

atomic wt (Na_2CO_3) = 23×2 + 12 + 16×3 = 46 + 12 + 48 = 106

wt of Solute (Na_2CO_3) = ?

We know that,

Molarity (m) = $\frac{\text{wt of solute in gm}}{\text{Atomic wt} \times \text{Vol of soln in ltr}}$

$0.01 = \frac{\text{wt of solute}}{\frac{106}{53} \times \frac{1}{2}}$

wt of Solute = $\frac{53 \times 1}{100} = 0.53$ gm.

9. $\frac{1}{10}$ of Equivalent wt of HCl is present in 500 ml solution. Calculate Normality.

Given,

Eq wt = $\frac{1}{10}$

Vol of Solⁿ = 500 ml = $\frac{1}{2}$ l

~~Atomic wt of HCl = 1 + 35.5 = 36.5 gm~~

Normality = ~~$\frac{\text{wt of HCl}}{\text{Eq wt} \times \text{Vol (l)}}$~~

~~$= \frac{36.5}{\frac{1}{10} \times \frac{1}{2}} = \frac{365}{10} \times 20 =$~~

$= \frac{\text{No. of gm equivalence of Solute}}{\text{Vol of soln in ltr.}}$

$= \frac{\frac{1}{10}}{\frac{1}{2}} = \frac{2}{10} = 0.2\ N$

10. Calculate the molarity of water. Density of water is 1 gm/ml.

Given,

At wt (H_2O) = 1x2+16 = 18

Vol of ~~the~~ Soln = 1 ltr. or 1000 ml

wt of Solute (H_2O) should be = 1000 gm

$$M = \frac{\text{wt of Solute in gm}}{\text{At wt} \times \text{Vol (l)}}$$

$$= \frac{1000}{18 \times 1} = 55.56M$$

11. Determine the amount of NaOH needed to prepare 250 ml of 0.1 N Soln.

Given,

Vol of Soln = 250ml = $\frac{1}{4}$ l

Normality = 0.1 N

At wt (NaOH) = 23+16+1 = 40 gm

Valency = 1

Eq wt = $\frac{40}{1}$ = 40 gm

We know that,

$$\text{Normality (N)} = \frac{\text{wt of solute in gm}}{\text{Eq wt} \times \text{Vol (l)}}$$

$$0.1 = \frac{\text{wt of Solute in gm}}{40 \times \frac{1}{4}}$$

wt of Solute = 1 gm

12. If 11.70 gm NaCl is dissolved in 100 ml. find Molarity,

Given, wt of Solute (NaCl) = 11.70 gm

Vol of Solution (l) = 100 ml = $\frac{1}{10}$ l

Atomic wt (NaCl) = 23+35.5 = 58.5 gm

$$\text{molarity} = \frac{11.70}{58.5 \times \frac{1}{10}} = \frac{1170 \times 100}{585 \times 100} = 2M$$

13. 20 ml of 0.2 NaOH Soln is neutralized by 10 ml of HCl Soln. Find out Normality of HCl Soln.

Given,

Vol of Sol. NaOH (V_1) = 20 ml = $\frac{20}{1000}$ = $\frac{1}{50}$ l

Vol of Sol. HCl (V_2) = 10 ml = $\frac{1}{100}$ l

~~wt of Solute (NaOH) = 0.2 gm~~

Valency = 1

At wt (NaOH) = 23+16+1 = 40

Eq wt (NaOH) = $\frac{40}{1}$ = 40

$$\text{Normality of NaOH } (N_1) = \frac{\text{wt of Solute}}{\text{Eq wt} \times \text{Vol (l)}}$$

$$= \frac{0.2}{40 \times \frac{1}{50}} = \frac{2 \times 5}{4 \times 10} = \frac{1}{4}$$

$$= 0.25 N$$

We know that if Vol (V_1) and Normality (N_1) is neutralized by Vol (V_2) and Normality (N_2) then,

$N_1 V_1 = N_2 V_2$

$0.25 \times \frac{1}{50} = N_2 \times \frac{1}{100}$

$N_2 = \frac{\cancel{100}^{2}}{} \times \frac{1}{\cancel{4}_{2}} \times \frac{1}{\cancel{50}} = \frac{1}{2}$

$N_2 =$

$0.2 \times 20 = N_2 \times 10$

$N_2 = \frac{2 \times 20}{100} = \frac{4}{10} = 0.4$

Given,

Vol of Sol. NaOH (V_1) = 20 ml

" " HCl (V_2) = 10 ml

Normality of NaOH (N_1) = 0.2

" " HCl (N_2) = ?

$N_1 V_1 = N_2 V_2$

$0.2 \times 20 = N_2 \times 10$

$N_2 = \frac{2 \times 20}{10 \times 10} = 0.4 N$

14. Calculate the normality of a solⁿ containing 6.3 gm of oxalic acid crystal (mol mass 126) dissolved in 500 ml solⁿ

Given,

wt of Solute $(C_2H_2O_4)$ = 6.3 gm

Atomic weight $(C_2H_2O_4)$ = 126

Vol. of Solⁿ = 500 ml = $\frac{1}{2}$ l

valency = 2

$$\text{Equivalent wt} = \frac{\text{Atomic weight}}{\text{Valency}} = \frac{126}{2} = 63$$

$$\text{Normality} = \frac{\text{wt of Solute in gm}}{\text{Eq wt} \times \text{Vol}_n(l)_{soln}}$$

$$= \frac{6.3}{63 \times \frac{1}{2}} = \frac{6.3 \times 2}{6.3 \times 10} = 0.2N$$

15. Find out Equivalence wt of
(a) HCl (b) $MgSO_4$

(a) Atomic wt = 1 + 35.5 = 36.5

Valency = 1

Eq wt = $\frac{36.5}{1}$ = 36.5

(b) Atomic wt = 24 + 32 + 16 × 4

= 56 + 64 = 120

valency = 2

Eq wt = $\frac{120}{2}$ = 60

Valancy of Acid Compound

$H_2SO_4 \rightarrow 2H^+ + SO_4^{-2}$

$CH_3COOH \rightarrow CH_3COO^- + H^+$

$H_3PO_4 \rightarrow 3H^+ + PO_4^{-3}$

$HNO_3 \rightarrow H^+ + NO_3^-$

Valancy of Basic Compound

$NaOH \rightarrow Na^+ + OH^-$

$KOH \rightarrow K^+ + OH^-$

$Ca(OH)_2 \rightarrow Ca^{+2} + 2OH^-$

$Mg(OH)_2 \rightarrow Mg^{+2} + 2OH^-$

PERIODIC CLASSIFICATION OF ELEMENTS

2017

★ DOBEREINER'S TRIADS :- 53 elements

When elements are arranged in the order of increasing atomic masses, groups of three elements (known as triads), having similar chemical properties are obtained. The atomic masses of the middle element of the triad being equal to the arithmetic mean of the atomic masses of the other two elements.

Examples

① The Alkali Metal Group

$\frac{7+39}{2} = 23$

Elements of the triad	Symbols	Atomic Masses
Lithium	Li	7
Sodium	Na	23
Potassium	K	39

② The Alkaline Earth Metal Group

Elements of the triad	Symbols	Atomic Masses
Calcium	Ca	40
Strontium	Sr	88
Barium	Ba	137

③ The Halogen Group.

Elements of the triad	Symbols	Atomic Masses
Chlorine	Cl	35.5
Bromine	Br	80
Iodine	I	127

2017

★ Limitation of Dobereiner's classification :- It was that it failed to arrange all the known elements in the form of triads of elements having similar chemical properties. Dobereiner could identify only three triads from the elements known at that time. So, his classification of

elements was not much successful.

★ Newland's Law of Octaves :- 56 elements

When elements are arranged in the order of increasing atomic masses, the properties of the eight element are a repetition of the properties of the first element.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co & Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce & La	Zr	-	-

★ Limitations :-

① Newland's law of Octaves was applicable to the classification of elements up to calcium only. After Calcium, every eight element did not possess the properties similar to that of the first element. Thus, Newlands law of octaves worked well with lighter elements only.

② Newlands assumed that only 56 elements existed in nature and no more elements would be discovered in the future. But later on, several new elements were discovered whose properties did not fit into Newlands law of octaves.

③ In order to fit elements into his table, Newlands put even two elements together in one slot and that too in the column of unlike elements having very different properties.

eka Boron - Scandium
eka Aluminium - Gallium
eka silicon - Germanium

(4) Iron element (Fe) which resembles Cobalt and Nickel elements in properties was placed far away from these elements.

★ Mendeleev's Periodic Table :- 63 elements

According to Mendeleev's periodic law, the properties of elements are a periodic function of their atomic masses.

There were seven periods (horizontal rows) and eight groups (vertical columns) in the original periodic table of Mendeleev.

★ Merits of Mendeleev's classification of Elements :-

(1) Mendeleev's periodic law predicted the existence of some elements that had not been discovered at that time.

(2) Mendeleev's periodic table could predict the properties of several elements on the basis of their positions in the periodic table.

(3) Mendeleev's periodic table could accomodate noble gases when they were discovered.

★ Limitations of Mendeleev's classification of Elements :-

(1) The position of isotopes could not be explained.
(2) Wrong order of atomic masses of some elements could not be explained.
(3) A correct position could not be assigned to hydrogen in the periodic table.

(4) Apart from atomic mass, the reaction of elements with Hydrogen and oxygen (nature of hydrides and oxides) was also considered the basis of arrangement.

★ Modern periodic law :-

"The properties of elements are a periodic function of their atomic number" - According to modern periodic law.
The modern periodic law is based on the atomic numbers of elements.

★ Modern periodic Table :- 118 elements

The horizontal rows of elements in a periodic table are called periods. (or Periods)

The vertical columns in a periodic table are called groups. (18 groups)

★ Merits of Hydrogen :-

Hydrogen element has been placed at the top of group 1, above the alkali metals because the electronic configuration of Hydrogen is similar to those of alkali metals. Both, Hydrogen as well as alkali metals have 1 valance electron each. Since hydrogen atom is very small in size, many properties of hydrogen are different from those of alkali metals. Therefore, while discussing the alkali metals of group 1, hydrogen is never included.

2020 feb
★ Properties of Periods :-

1. On going left to right in a period atomic size decreases.

2. On going left to right in a period metalic character decreases.

3. The number of valence electron increases from 1 to 8 along the period.

4. From left to right valency first increases from 1 to 4 and decreases upto zero.

5. Ionisation energy and electronegativity increases.

Properties of Group :-

1. From top to bottom in a group the size (radius) of atom increases.

2. From top to bottom in a group metallic character increases.

3. The number of valence electrons are same in a particular group.

4. All the elements lie in a group has same valency.

5. Ionisation energy and electronegativity ~~increases~~ decreases

6. No. of shells increases.

★ Ionization energy → The minimum amount of energy reqd to remove the most loosely bound electron of an isolated neutral gaseous atom or molecule.

★ Electron affinity → The energy change that results from adding an electron to a gaseous atom, or
The amt of energy released when an electron is attached to a neutral atom or molecule in the gaseous state.

To Find Period and group and Valency of Elements. (up to 20 elements)

Period - Horizontal Rows in modern periodic table (Total 7 Periods)

Period no = last shell no in electronic configuration.

Group - Vertical Column in modern periodic table (Total 18 group)

Group no = n (no. of electrons in last shell) $n < 3$ (Ex - 1,2)

OR

$= 10 + n$ when $n \geq 3$ (Ex $n = 3,4,5,6,7,8$)

Valency = n when $n < 4$ metal
$= n - 8$ when $n > 4$ Non metal

Ex -

① Na_{11} → Atomic No.
$Na_{11} = 2, 8, 1$ Period = 3rd
Group = Ist
Valency = 1 (metal)

② $Mg_{12} = 2, 8, 2$ Period = 3rd
Group = 2nd
Valency = 2 (metal)

③ $Cl_{17} = 2, 8, 7$ Period = 3rd
Group = 10 + 7 = 17
Valency = 7 - 8 = -1 (Non Metal)

CARBON AND ITS COMPOUND

Important Question

2018 Feb

Q-1 Define Allotropy?

Ans Allotropy - It is a property of some chemical Element to be able to take two or more different chemical forms where the atoms are arrange by differently bond. These forms are known as allotropes and this phenomena is known as allotropy.

2017

Q-2 Describe all the allotropes of Carbon?

Ans Carbon has 3 allotropes :-

1. Diamond
2. Graphite
3. Buckminster fullerene (C_{60})

on burning them in the presence of oxygen(O_2).
$C + O_2 \xrightarrow{burn} CO_2 \uparrow$
(Complete finish)

Diamond	Graphite
1. It is a colourless transparent substance having extraordinary brilliance	It is greyish black opaque substance.
2. made up of Carbon only.	It is also made up of Carbon only
3. It does not conduct electricity	It conduct electricity.

2019

Q-3 Define hydrocarbon? Describe its types.

Ans Hydrocarbon -> A Compound made up of hydrogen and Carbon only is known as hydrocarbon.

Types of Hydrocarbon -> There are two types of hydrocarbon :-

(i) Saturated hydrocarbon , (ii) Unsaturated hydrocarbon

Saturated hydrocarbon -> Hydrocarbon in which carbon atoms are connected by single bond is known as saturated hydrocarbon. It is generally known as alkane. Its General formula is C_nH_{2n+2}

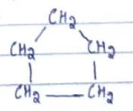
Ex :- methane - CH_4, Ethane - C_2H_6 ($C_2H_{2n+2} = C_2H_{4+2} = C_2H_6$)

Unsaturated hydrocarbon -> Hydrocarbon in which Carbon atoms are connected by double or triple bond is known as Unsaturated hydrocarbon It can be classified in two ways

Alkene	Alkyne
In which carbon atoms are connected by double bond. It's general formula is C_nH_{2n}. Ex- Ethene - C_2H_4	In which Carbon atoms are connected by triple bond. It's general formula is C_nH_{2n-2}. Ex - Ethyne - C_2H_2

Cyclic Hydrocarbon -> There are some other hydrocarbon in which carbon atoms are connected in the form of ring known as cyclic Hydrocarbon.

Ex-



Cyclo pentane

(6) Each member of a series can be prepared using same reactions.
(7) As we move down the series physical properties like melting point, boiling point etc. increase due to increase in molecular mass.

2011/16
Q-4 Define homologus series? Describe its properties also?

Ans Homologus Series → It is a series of compounds with same functional group and similar chemical properties.

Properties → (1) Its members have same chemical properties.
(2) Its members are differ by CH_2 group.
(3) Its members are differ by atomic mass 14 unit.
(4) Different physical properties.
(5) They have same General formula (Eg:- Alkane - C_nH_{2n+2}, Alkene - C_nH_{2n}, Alkyne - C_nH_{2n-2})

IUPAC →
Used to naming compound
Prefix + Suffix

Prefix (No. of C atom)		Suffix		
C_1	meth	Alkane	(-)	ane
C_2	eth	Alkene	(=)	ene
C_3	Prop	Alkyne	(≡)	yne
C_4	Bute			
C_5	Pent			
C_6	Hex			
C_7	Hept			
C_8	Oct			
C_9	Non			
C_{10}	Dec			

Functional Group →

			Suffix
(1)	Alcohol Group	- OH	ol
(2)	Aldehyde Group	- CHO	al

			Suffix
(3)	Carboxylic Acid	- COOH	Oic acid
(4)	Ketone	$-\overset{O}{\overset{\|\|}{C}}-$	One

			As prefix
(5)	Halogen Group -	Cl	chloro
		Br	Bromo
		I	Ido
		F	Floro

Alkyl Group → It is formed by removal one hydrogen from alkane.
Ex - CH_3 → methyl.

Q.5. Name (IUPAC) for following :-

Ans (1) $CH_3 - CH_2 - CH_2 - CH_3$ — Butane

(2) $\underset{3}{CH_3} - \underset{2}{CH} = \underset{1}{CH_2}$ — Propene-1

(3) $\underset{3}{CH_3} - \underset{2}{CH_2} - \underset{1}{CH_2} - OH$ — Propanol

(4) $\underset{5}{CH_3} - \underset{4}{CH_2} - \underset{3}{CH_2} - \underset{2}{CH_2} - CHO$ — Pentanal

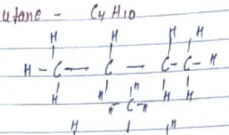
(5) $\underset{3}{CH_3} - \underset{2}{CH_2} - \underset{1}{CH_2} - Cl$ — Chloro propane

(6) $\underset{5}{CH_3} - \underset{4}{CH_2} - \underset{3}{\overset{CH_3}{\overset{|}{CH}}} - \underset{2}{\overset{CH_3}{\overset{|}{CH}}} - \underset{1}{CH_3}$ — 2,3 dimethyl Pentane

Isomers Example

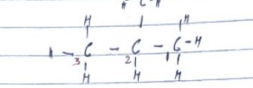
2017

① Butane - C_4H_{10}



Butane

2 Isomers



2- Methyl, propane

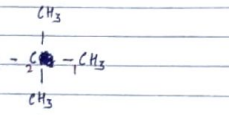
2018

② Pentane - C_5H_{12}

$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ Pantane

$CH_3 - CH_2 - CH(CH_3) - CH_3$ 2- Methyl Butane

3 Isomers



2,2- dimethyl Propane

Isomerism - The organic compound have same melecular formula but different structure are known as Isomers and this phenomena is known as Isomerism.

Some Imp Carbon Compound and their rxn

Ethanol (Ethyl alcohol) - C_2H_5OH

① Ethanol is heated in ~~presence~~ presence of acidified $KMnO_4$ or acidified $K_2Cr_2O_7$ - (Oxidation)

★ Ester is a sweet Smelling organic compound.
★ Used in perfumes & flavouring agents.

$$C_2H_5OH \xrightarrow[\text{acidified } K_2Cr_2O_7]{\text{alk } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

2020

② Ethanol is heated at 170°C in presence of Conc H_2SO_4.

$$C_2H_5OH \xrightarrow[170°C]{\text{Conc } H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$$

Ethanoic Acid (Acetic Acid) - CH_3COOH

2017

Esterification Rxn - When an acid React with alcohol in the presence of some drops of Conc H_2SO_4 it will form ester. Rxn is known as Esterification.

$$\boxed{CH_3COO}H + \boxed{C_2H_5}OH \xrightarrow{\text{Conc } H_2SO_4} \underset{\text{Ester}}{CH_3COOC_2H_5} + H_2O$$

2017

Saponification Reaction - It is simply the process of making Soaps. In this reaction Ester react with an inorganic base to produce alcohol and soap.

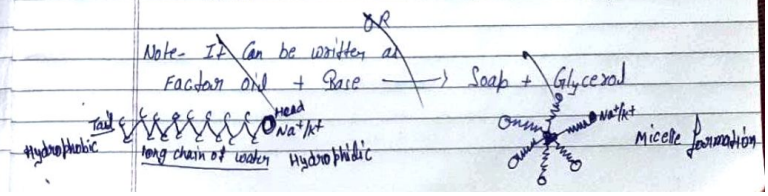
Ester + Inorganic Base ⟶ Soap + Alcohol.

It is also known as hydrolysis of ester.

$$\underset{\text{Ester}}{CH_3COO\boxed{C_2H_5}} + Na\boxed{OH} \longrightarrow \underset{\text{Alcohol}}{C_2H_5OH} + \underset{\text{Soap}}{CH_3COONa}$$

Note- It can be written as OR

Factor oil + Base ⟶ Soap + Glycerol



Some Basic Point related to Carbon :-

1. Carbon is non metal (allotropes :- Diamond, graphite)
2. In our earth crust % age of carbon is 0.18 %.
3. All living organism made up of carbon compound.
4. Carbon's Atomic No is 6 and its electronic Configuration. ($C_6 = 2,4$)
5. Due to presence of 4 electron in outer most shell it is known as Tetravellent.
6. Carbon always form covalent bond.

★ **Catenation** :- The property of Carbon to form long chain Compounds through covalent bonding.

eg :- -C-C-C-C-C-

ATOMIC STRUCTURE - Part I st

Atom → Atoms are made up of three ~~sub~~ sub-atomic particle electron, proton and neutron.

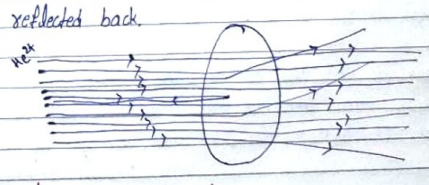
Particle	Discovered by	Charge	Mass
Electron	J.J Thomson	-1.6×10^{-19} C	9.1×10^{-31} kg
Proton	Rutherford (Gold Stein)	1.6×10^{-19} C	1.67×10^{-27} kg
Neutron	James Chadwick	No charge (Neutral)	1.66×10^{-27} kg

★ **Thomson Atomic Model** → According to this model ~~the most of~~ an atom consists of a positively charged sphere ~~Part of atom is hollow~~ and electrons are distributed in it in such a way like seeds in watermelon.

Drawback → when he give his model there were no discovery of Proton and neutron.

★ **Rutherford α- Particle Scattering Experiment** →

In this Experiment he passes high speed α-particle over very thin gold foil he observed most of α particle pass through it without any deflection. Some deflected at small angle and very few reflected back.



Rutherford Atomic Model

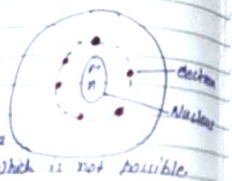
1. Most of the part of atom is hollow.
2. There is a positive nucleus at the centre of atom.

Energy of K = -12.8 eV
L = -3.4 eV
M = -1.51 eV
N = -0.85 eV

(3) The sub-atomic particle proton and neutron present in the nucleus.
(4) Electron revolve around the nucleus in all circular path (orbit).

Drawback of Rutherford atomic model :-

He can't explain the stability of atom according to electro magnetic theory when charge-particle undergoes accelerated motion it radiate energy continuously and it decrease its path and finally drop into nucleus which is not possible.



2017
★ Neils Bohr Atomic Model

(1) Most of the part of atom is hollow.
(2) Protons and Neutrons are present in nucleus.
(3) Electrons revolve around the nucleus in those orbit whose angular momentum is multiple of $h/2\pi$.
Angular momentum $M_{ur} = \frac{nh}{2\pi}$ (where, h = Planck's Constant = 6.6×10^{-34} Joule sec)

(4) When electrons are revolved in ~~their~~ their orbits it does not radiate Energy. This fix energy level are known as shell.

2017
★ Isotopes → The atom of the same element whose atomic number is same but mass number is different is known as isotopes. Ex- Hydrogen has three isotopes - $_1H^1$, $_1H^2$, $_1H^3$
Protium Deutrium Tritium

★ Isobar → The atom of different element has same mass no. but different atomic number are known as isobar.
Ex- $_{18}Ar^{40}$, $_{20}Ca^{40}$.

Properties of Isotopes → (1) They have same atomic no. but different atomic mass.
(2) They have same chemical property but different physical property.
(3) They have different number of neutrons.

★ Isotones → The atom of different element has same number of neutrons are known as isotones.
Ex- $_6C^{14}$ and $_8O^{16}$ has same neutrons.

★ Electronic Configuration → This is first type of configuration to distribute electrons in the atom. It is based on shell and suggested by Bohr Burry. According to him :-

1. Each shell has maximum no. of electron = $2n^2$, n = no. of shell
n = 1 (K shell) Max e = $2 \times 1^2 = 2$
n = 2 (L shell) Max e = $2 \times 2^2 = 8$
n = 3 (M shell) Max e = $2 \times 3^2 = 18$
n = 4 (N shell) Max e = $2 \times 4^2 = 32$

2. When a shell fill then electron enter into next shell.
3. Generally any shell of atom does not have more than 8 electron.
Ex- Na_{11} = 2, 8, 1 Ca_{20} = 2, 8, 8, 2 (K L M N)

Valency → It is decided by valence electron (outermost shell e).
This rule of Bohr Burry can be applied to find valency of lighter element up to Ca (Atomic No - 20) only.

Rule
Valency = n if n < 4 metal (n = no. of valence electron)
Valency = n - 8 if n > 4 Non-metal

Ex. (i) Na_{11} = 2, 8, 1 valency = 1 (n<4)
(ii) Mg_{12} = 2, 8, 2 valency = 2 (n<4)
(iii) Cl_{17} = 2, 8, 7 valency = 7 - 8 = -1 (n>4)
(iv) O_8 = 2, 6 Valency = 6 - 8 = -2 (n>4)

Note :- Any element can be represented as $_{Z}X^{A}$ (A = mass no. / atomic weight; Z = Atomic No.)

$\boxed{Z = P = e}$ and $\boxed{A = P + n}$

Atomic No. (Z) = Proton (P) $\boxed{= \text{electron (e)}}$
Atomic mass (A) = Proton (P) + neutron (n)

Eg:- Find P, e, n in $_{11}Na^{23}$

Solⁿ $_{11}Na^{23}$

$Z = 11$, $A = 23$

$\because P = e = Z$

$P = 11$, $e = 11$

$\because A = P + n$

$n = A - P$

$n = 23 - 11 = 12$

$\boxed{n = 12}$

★ It is a type of bond formed between a metal & Non-metal held together by strong electrostatic force of attraction.

⇒ Properties of Ionic bond →

1. They are hard crystalline solids.
2. They have very high melting and boiling points.
3. They conduct electricity in liquid and molten state.
4. They are soluble in water and break into their ionic components.

(10)

CHEMICAL BONDING

The various atoms present in any molecule are linked with each other by different forces these forces are called chemical bonds. They are of three types:-

1. Ionic or Electro valent bond
2. Covalent bond
3. × Cordinate Bond (not in our syllabus)

Electro Valent or Ionic Bond → The bond which is formed by transfer of electron from one atom to other is known as Electrovalent bond.

2017 Ex-1 NaCl $Na_{11} = 2,8,1$
$Cl_{17} = 2,8,7$

$Na \cdot \; \cdot \ddot{\underset{..}{Cl}}:$

$Na - e^- \rightarrow Na^+$ (cation)
$Cl + e^- \rightarrow Cl^-$ (Anion)
$Na^+ + Cl^- \rightarrow NaCl$

Ex-2 $MgCl_2$ $Mg_{12} = 2,8,2$
$Cl_{17} = 2,8,7$

$Mg: \; \cdot \ddot{\underset{..}{Cl}}: \; \cdot \ddot{\underset{..}{Cl}}:$

So, $Mg - 2e^- \rightarrow Mg^{++}$
$2Cl + 2e^- \rightarrow 2Cl^-$
$Mg^{++} + 2Cl^- \longrightarrow MgCl_2$

Q→ Draw structure for following:-
(a) CaO (b) $CaCl_2$

★ $Ca = 2,8,8,2$ $Ca: \; \cdot \ddot{\underset{..}{O}}:$ So, $Ca - 2e^- \rightarrow Ca^{++}$ $Ca^{++} + O^{--} \rightarrow CaO$
$O = 2,6$ $O + 2e^- \rightarrow O^{--}$

★ $Ca = 2,8,8,2$ $Ca: \; \cdot \ddot{\underset{..}{Cl}}: \; \cdot \ddot{\underset{..}{Cl}}:$ So, $Ca - 2e^- \rightarrow Ca^{++}$
$Cl_{17} = 2,8,7$ $Cl + 2e^- \rightarrow 2Cl^-$
$\therefore Ca^{++} + 2Cl^- \rightarrow CaCl_2$

between two or more Non metals

Covalent Bond → The bond formed by sharing of electrons is known as covalent bond.

Types of covalent Bond :-

① **Non polar covalent Bond** - It is a type of chemical bond where two atoms share Equally of electrons.

Eg :- O_2, Cl_2

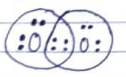
② **Polar covalent Bond** - It is a type of chemical bond where a pair of electron shared unequally between two atoms.

Eg :- H_2O, NH_3

★ **Electron dot structure or Lewis dot structure for covalent bond** →

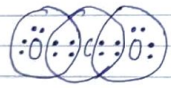
⇒ **Double covalent bond**

① O_2 $\quad {}_8O = 2,6$



O=O

② CO_2 $\quad C_6 = 2,4$, $O_8 = 2,6$

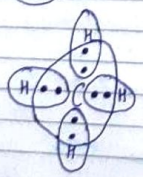


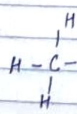
O=C=O

③ H_2O $\quad H_1 = 1$, $O_8 = 2,6$

H-O-H

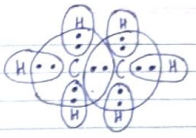
④ CH_4 $\quad C_6 = 2,4$, $H_1 = 1$

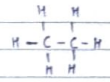




2018

⑤ C_2H_6 $\quad C_6 = 2,4$, $H_1 = 1$





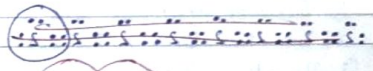
Q → (1) Draw Electron structure for following

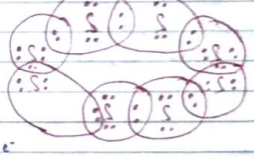
(i) C_2H_2 (ii) S_8 (iii) Cl_2 (iv) N_2 (v) H_2

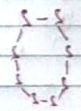
(i) C_2H_2 $\quad C_6 = 2,4$, $H_1 = 1$

H-C≡C-H

(ii) S_8 $\quad S_{16} = 2,8,6$

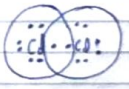






⇒ **Single Covalent bond** sharing of 1 e⁻

(iii) Cl_2 $\quad Cl_{17} = 2,8,7$



Cl-Cl

⇒ Triple ~~Double~~ Covalent bond sharing of 3e⁻

(iv) N_2 $\quad N_7 = 2,5$

N≡N

(v) H_2 $\quad H_1 = 1$

H-H

2019

★ Difference b/w Electrovalent and covalent bond or Compound :-

	Electrovalent/Ionic Bond	Covalent Bond
1.	Formed by transfering of electron	Formed by sharing of electron.
2.	Formed by ion. So, ffs have high melting and boiling point	low melting and boiling point.
3.	Dissolve in water	Does not dissolve in water
4.	Conduct Electricity	Does not conduct Electricity
5.	example - NaCl	Example - Ethanol (Petrol, Diesel)
6.		

★ Properties of Covalent compound :-

1. Generally liquids or gases or soft solids.
2. They have lower melting and boiling point.
3. They don't conduct electricity.
4. Polar covalent compounds → Dissolve in water
5. Non polar covalent compound → Soluble in organic solvent

Coordinate Bond → (2e⁻)

It is a type of bond in which e⁻ pair is shared by single atom.

DONOR ATOM [The atom which gives/donates its e⁻ pair (2e⁻)
must have lone pair (2e⁻)

ACCEPTOR ATOM [The atom which accept e⁻ pair (2e⁻)
must have vacant orbital

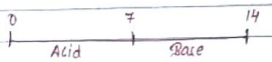
(11)

PH Value (POTENTIAL of HYDROGEN ION) PH

ACID → which gives H^+
Ex:- HCl, HNO_3, H_2SO_4

Base → which gives OH^-
Ex:- NaOH, KOH

PH value → It is a value by which we can find the strength of acid or base. It depends on the concentration of hydrogen ion.



This scale has number from 0 to 14.

$0 < PH < 7$ Acid
$7 > PH < 14$ Base
if $PH = 7$ Neutral (water)

PH Scale is derived by Sorensen.

Formulas →

1. $PH = -\log [H^+]$
2. $[H^+] = 10^{-PH}$
3. $[H^+][OH^-] = 10^{-14}$
4. $PH + POH = 14$
5. $[OH^-] = 10^{-POH}$

$[H^+]$ Means Hydrogen ion Concentration
$[OH^-]$ Means Hydroxide ion Concentration

$\log 1 = 0$
$\log 2 = 0.3010$
$\log 3 = 0.4771$
$\log 5 = 0.6990$
$\log 4 = 0.6$

$\log 8 = 0.9$
$\log 9 = 0.95$
$\log 10 = 1$
$\log 3.3 = 0.5185$
$\log 6 = 0.77$
$\log 7 = 0.8$

Numericals

2015-16

① Find PH of an acid whose $[H^+]$ is 0.0001?

Sol^n

$[H^+] = 0.0001$
$= 10^{-4}$

$\because [H^+] = 10^{-PH}$

so, $\boxed{PH = 4}$

② Find pH of $\frac{1}{100}$ HCl Solution?

Sol^n

$[H^+] = \frac{1}{100} = 10^{-2}$

$\because [H^+] = 10^{-PH}$

so. $\boxed{PH = 2}$

③ Find PH of a solution whose $[H^+]$ is 2×10^{-3}?

Sol^n

$[H^+] = 2 \times 10^{-3}$

$PH = -\log [H^+]$
$= -\log (2 \times 10^{-3})$
$= -(\log 2 - 3\log 10) = -(0.3010 - 3) = 2.6990.$

2018

④ Find the POH of a sol^n whose PH is 10?

Sol^n

$PH + POH = 14$
$10 + POH = 14$
$POH = 14 - 10 = 4$ Ans.

2019

⑤ Find the PH of $\frac{N}{10}$ NaOH sol^n.

Sol^n

$[OH^-] = \frac{1}{10}$

so, $[OH^-] = 10^{-1}$

Since, $[OH^-] = 10^{-POH}$

so, $POH = 1$

$\because PH + POH = 14$

$PH + 1 = 14$

$\boxed{PH = 13}$

2015, 2019

⑥ Calculate the OH^- Conc of Solution whose PH is 10.

Sol^n

$PH = 10$

$PH + POH = 14$

$10 + POH = 14$

$POH = 4$

$[OH^-] = 10^{-POH}$
$= 10^{-4}$ Ans

2018

⑦ The $[H^+]$ of a fruit juice is 3.3×10^{-2}. Find PH of Solution.
$\log 3.3 = 0.5185$

Sol^n

$[H^+] = 3.3 \times 10^{-2}$

$PH = -\log [H^+]$
$= -\log (3.3 \times 10^{-2})$
$= -(\log 3.3 \times \log 10^{-2}) = -(0.5185 - 2\log 10)$
$= -(0.5185 - 2 \times 1) = -(1.4815)$
$= 1.4815.$

(8) Calculate the pH of 0.01M HCl.

Solⁿ

$[H^+] = 0.01 = 10^{-2}$

$[H^+] = 10^{-pH}$

$pH = 2$ Ans

(9) Find the pH of 0.01M H_2SO_4.

Solⁿ

$[H^+] = 0.01 = 10^{-2}$

In H_2SO_4 have $2[H^+] = 2\times10^{-2}$

$pH = -\log[H^+]$

$= -\log[2\times10^{-2}]$

$= -(\log 2 - 2\log 10) = -(0.3010 - 2\times1) = -(-1.6990)$

$= 1.6990$

(10) Find the pH of $\frac{N}{100}$ NaOH Solution.

$[OH^-] = \frac{1}{100} = 10^{-2}$

$[OH^-] = 10^{-pOH}$

$= 10^{-2}$

$pOH = 2$

$pH + pOH = 14$

$pH = 14 - 2 = 12$ Ans

(11) Calculate the pH of 0.0001M H_2SO_4.

$[H^+] = 0.0001 = 10^{-4}$

$2[H^+] = 2\times10^{-4}$

$pH = -\log[H^+]$

$= -\log(2\times10^{-4})$

$= -(\log 2 - 4\log 10) = -(0.3010 - 4) = -(-3.6990)$

$= 3.6990$ Ans

(12) If pH of a solⁿ is 7 find its pOH

$pH = 7$

We know that,

$pH + pOH = 14$

$pOH = 14 - 7 = 7$

(13) If hydrogen ion conc of a solⁿ is 5×10^{-4}. Find its pH and pOH.

$[H^+] = 5\times10^{-4}$

$pH = -\log[H^+]$

$= -\log(5\times10^{-4})$

$= -(\log 5 - 4\log 10) = -(0.6990 - 4)$

$= -(-3.3010) = 3.3010$ Ans

We know that,

$pH + pOH = 14$

$pOH = 14 - 3.3010$

$= 10.6990$ Ans

(14) The pH of NaOH solⁿ is 9. Find its pOH and hydroxide ion concentration.

Given,

$pH = 9$

$pH + pOH = 14$

$pOH = 14 - 9 = 5$

$[OH^-] = 10^{-pOH}$

$= 10^{-5}$

(15) Calculate the PH of $\frac{M}{500}$ HCl Solution.

$$[H^+] = \frac{1}{500} = \frac{1}{5 \times 100}$$
$$= \frac{1}{5} \times 10^{-2}$$

$$PH = -\log [H^+]$$
$$= -\log \left(\frac{1}{5} \times 10^{-2}\right)$$
$$= -\left(\log \frac{1}{5} - 2\log 10\right)$$
$$= -\left(\log \frac{1}{5} - 2\right)$$
$$= -\left(-\log 5 - 2\right)$$
$$= -\left(-0.6990 - 2\right)$$
$$= -\left(-2.6990\right)$$
$$= 2.6990 \text{ Ans}$$

(16)

ELECTROCHEMISTRY

The study of chemical reaction which are caused by passing electric current is known as electrochemistry.

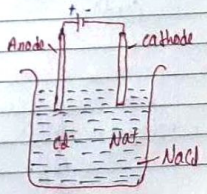
Electrolyte -> A solution in which current can pass.
Ex - Nacl

Electrodes
- Anode (Positive electrode)
- Cathode (Negative Electrode)

Ions
- Cations (positive ion)
- Anions (Negative ion)

Electrolysis ~~of Nacl~~ -> The decomposition of electrolyte on passing electric current is known as Electrolysis.

Electrolysis of Nacl -> When current is passed through molten Sodium chloride by the help of electrodes, Nacl breaks up into Na^+ and Cl^- following reaction take place at electrodes.



At Cathode $Na^+ + e^- \rightarrow Na$
At Anode $2Cl^- + 2e^- \rightarrow Cl_2$

Rx^n $2\,Nacl \xrightarrow{Current} 2Na + Cl_2$

★ **Faraday's law of Electrolysis** → Faraday gives two laws of Electrolysis.

I^st law → According to this law in the process of Electrolysis mass deposit on electrodes is directly proportional to quantity of current pass.

$m \propto q$

$m \propto it$ $\quad (\because q = it)$

so $\boxed{m = Zit}$

Where Z is Constant known as Electrochemical Equivalence. Unit of Z is gm/coulomb.

IInd law → According to this law if same amount of current passed through two different solⁿ then mass deposit on electrodes is directly proportional to Equivalent wt.

$m \propto E$

or $\frac{m}{E}$ = Constant

so $\frac{m_1}{E_1} = \frac{m_2}{E_2}$

or $\boxed{\frac{m_1}{m_2} = \frac{E_1}{E_2}}$

Condⁿ

1 F = 96500 coulomb
↓
(Faraday)

Charges - Na^{+1} $\quad I^{+1}$
Ag^{+1} $\quad Zn^{+2}$
Cu^{+2}

Types of Numerical

20/6/17
Q-1 A current 3A passing through $AgNO_3$ solution for 20 min deposit 4 gm Silver. Calculate E.C.E of Ag.

Solⁿ
$m = Zit$
$4 = Z \times 3 \times 1200$
$Z = \frac{4}{3 \times 1200} = \frac{1}{900}$ gm/coulomb

$t = 20$ min
$= 20 \times 60 = 1200$ sec
$m = 4$ gm
$i = 3A$

Q-2 Same amount of current for same time through $AgNO_3$ and $CuSO_4$ solution, 0.390 gm Cu and 1.322 gm Ag Collected on Electrodes. If Equivalent wt of Cu is 31.8. Find Equivalent wt of Ag.

Solⁿ
$m_{Cu} = 0.390$ gm $\quad m_{Ag} = 1.322$ gm
$E_{Cu} = 31.8 \quad E_{Ag} = ?$

So, $\frac{m_{Cu}}{m_{Ag}} = \frac{E_{Cu}}{E_{Ag}}$

$\frac{0.390}{1.322} = \frac{31.8}{E_{Ag}}$

So $E_{Ag} = \frac{31.8 \times 1.322}{0.390} = \frac{31.8 \times 1322}{390} = 107.9$

Short cut $\boxed{\frac{\text{Mass}}{\text{atomic wt}} \times \text{Charge} = \frac{it}{96500}}$

2014
Q-3 How much quantity of Cu will be deposit on electrode by passing 0.5 ampere current for 30 min in $CuSO_4$ solⁿ.
(Atomic wt of Cu = 63.5)

$m = ZQ$

$m = E \cdot \frac{I}{F} \cdot t$

$m = \frac{Eq\ wt}{F} \times Q$

$m = \frac{Atomic\ wt}{Valency} \times \frac{Charge}{96500}$

Sol^n $m = ?$

$i = 0.5\ A$

$t = 30\ min$

$= 30 \times 60 = 1800\ sec$

$\frac{mass}{at\ wt} \times charge = \frac{it}{96500}$

so, $\frac{m}{63.5} \times 2 = \frac{0.5 \times 1800}{96500}$

so, $\boxed{m = 0.296\ gm}$

If ~~charge~~ Z (E.C.E) not given in numerical then, Z should be used

as, $Z = \frac{atomic\ wt}{Charge \times 96500}$

$m = Zit$

$\boxed{m = \frac{at\ wt}{Charge \times 96500} \times i \times t}$

$\frac{mass \times charge}{at\ wt} = \frac{it}{96500}$

$m = \frac{Eq\ wt \times i \times t}{96500}$

Q-14 20.14 gm Ag is deposited on electrodes by passing 5 Ampere Current for 70 min in $AgNO_3$ Sol^n. Find out E.C.E ?

Sol^n Given, mass of Ag(m) = 20.14 gm

Current(i) = 5 A

Time (t) = 70 min = 70×60 = 4200 sec

E.C.E (Z) = ?

According to Faraday's first law,

$m = Zit$

$Z = \frac{m}{it} = \frac{20.14}{5 \times 4200} = \frac{\cancel{2014}\ 1007}{\cancel{5 \times 4200}\ 2100 \times 100} = \frac{1007}{1050000}$

$Z = 0.00096\ gm/coulomb$

2018

Q-15 Same amount of Current passes for same time through $AgNO_3$ and $CuSO_4$ Sol^n. Eq wt of Ag is 108 and for Cu is 31.5. Calculate quantity of Cu deposited on electrode if quantity for Ag is 45 gm.

Given, $E_{Ag} = 108$

$E_{Cu} = 31.5$

$m_{Ag} = 45\ gm$

$m_{Cu} = ?$

According to Faraday's IInd law,

$\frac{E_1}{E_2} = \frac{m_1}{m_2}$

$\frac{108}{31.5} = \frac{45}{m_2}$

$m_2 = \frac{45 \times 31.5}{108 \times 10} = \frac{1417.5}{108 \times 10} = 13.125\ gm$

Q-16 How much electric current will be passed in KI Sol^n to liberate 10 gm I_2 in 1 hour.

Given, mass of I_2 (m) = 10 gm

Time (t) = 1 hour = 3600 sec

i = ?

we know that,

$\frac{mass}{at\ wt} \times Charge = \frac{it}{96500}$

$\frac{10}{126.90} \times 1 = \frac{i \times 3600}{96500}$

$i = \frac{1000}{12690} \times \frac{965}{36} = \frac{96500}{45684} = 2.1\ A$

Q-17 A cell consist of zinc sulphate Sol^n. How much zinc will be deposit if 12A current passed for 2 hours.

Given,

$i = 12\ A$

$t = 2\ hours = 7200\ sec$

$m = ?$

Atomic weight = 65.38

Charge = 2

we know that

$\frac{mass}{at\ wt} \times Charge = \frac{it}{96500}$

$\frac{m}{65.38} \times \frac{2}{6} = \frac{12 \times 7200}{96500}$

$m = \frac{12 \times 72 \times 6538}{965 \times 2 \times 100}$

$m = \frac{6 \times 72 \times 6538}{96500}$

$= \frac{\cancel{282}\ 2824416}{96500} = 29.1649$

$= 29.2\ gm$

Q→8 0.25A Current is passed for 1 hour in $CuSO_4$ solⁿ. Calculate the amount of Cu liberated on electrode?

Given, $i = 0.25A$, at wt = 63.5

t = 1 hour = 3600 sec , charge = 2

$m = ?$

we know that, $\frac{\text{mass}}{\text{at wt}} \times \text{charge} = \frac{it}{96500}$

$$\frac{m}{63.5} \times 2 = \frac{0.25 \times 3600}{96500}$$

$$m = \frac{\cancel{25}^{5} \times \cancel{36}^{18} \times 63.5}{\cancel{2} \times \cancel{965}_{193} \times 1000} = \frac{285750}{965 \times 1000} = \frac{29.61}{100} = 0.296 \text{ gm}$$

Q→9 If 0.5A Current passed for 30 min in a solⁿ of $AgNO_3$ and 1.006 gm Ag Silver is deposit on electrode. Calculate E.C.E

Given, $i = 0.5A$

$t = 30 \text{ min} = 30 \times 60 = 1800 \text{ sec}$

$m = 1.006 \text{ gm}$

$z = ?$

According to Faraday's 1st law,

$$m = zit$$

$$1.006 = z \times 0.5 \times 1800$$

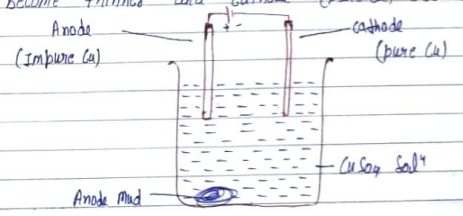
$$z = \frac{\cancel{503}^{503}}{\cancel{1000}_{1000}} \times \frac{\cancel{10}}{5} \times \frac{1}{\cancel{1800}_{90}} = \frac{503}{45 \times 10000} = \frac{11.177}{10000} = 0.00111778$$

$z = 0.00111778$ gm/coulomb

2019

Electrolytic Refining → It is the process in which impure metal get pure by the process of Electrolysis.

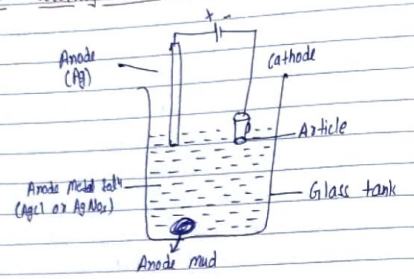
Electrolytic Refining of Cu → In this process impure Cu is made as anode and pure Cu is made as Cathode. Any solution of Cu like $CuSO_4$ is used as electrolyte in the tank. By passing Current the anode (Impure Cu) start to dissolve in solution and equal amount of pure Cu start to go at Cathode. The impurities are settle down below anode as anode mud. Anode (Impure Cu) become thinner and Cathode (pure Cu) become thicker.



Electroplating → The process of coating of a metal over the other with the help of Electrolysis is known as Electroplating.

Method → In this process we make the electroplated metal as cathode and the metal who has to electroplate is make as anode and in tank take electrolyte of same metal which has to make anode. On passing the current Anode metal dissolve in solution and then deposit on Cathode metal.

Ex- Coating of Ag (silver) on a Article →



(17)

EMPIRICAL FORMULA

★ Empirical formula :- It shows simple ratio of atom present in compound.

★ Molecular formula :- It shows actual no of atom present in compound.

Molecular formula = (Empirical formula)n

where,

$$n = \frac{\text{molecular formula wt}}{\text{Empirical formula wt}}$$

Note - molecular wt = 2 x vapour density

2016 Q→1 An organic compound consist of C = 26.67 %, H = 2.22 % and remaining oxygen. It molecular weight is 90. Find its Empirical and formula (molecular).

Soln C = 26.67 %, H = 2.22 % and O = 100 - (26.67 + 2.22) = 71.11

Element	%age	at wt	$\frac{\%\text{age}}{\text{at wt}}$	Simple Ratio
C	26.67	12	$\frac{26.67}{12} = 2.22$	$\frac{2.22}{2.22} = 1$
H	2.22	1	$\frac{2.22}{1} = 2.22$	$\frac{2.22}{2.22} = 1$
O	71.11	16	$\frac{71.11}{16} = 4.44$	$\frac{4.44}{2.22} = 2$

divide by least

So, Empirical Formula = $C_1H_1O_2$

now Empirical wt = 12+1+16x2 = 45

$$n = \frac{\text{Molecular wt}}{\text{Emp wt}} = \frac{90}{45} = 2$$

molecular formula = (Emp ~~Fatty~~ formula)n
= $(C_1H_1O_2)2$
= $C_2H_2O_4$

Note - In Simple Ratio no should by perfect integer like
1:9 → 2
1:1 → 1 etc

Q-2 An Organic Compound Consist of C = 57.8%, H = 3.6%, O = 38.6%. If the molecular wt is 166. Find its Empirical and Molecular formula.

Sol^n

Element	% age	at wt	% age / at wt	Simple Ratio	Simple Integer
C	57.8	12	57.8/12 = 4.82	4.82/2.41 = 2	2x2 = 4
H	3.6	1	3.6/1 = 3.6	3.6/2.41 = 1.5	1.5x2 = 3
O	38.6	16	38.6/16 = 2.41	2.41/2.41 = 1	1x2 = 2

Empirical formula = $C_4H_3O_2$
Empirical formula wt = 12x4 + 3x1 + 16x2 = 83

$n = \frac{\text{molecular wt}}{\text{Emp wt}} = \frac{166}{83} = 2$

molecular formula = (Emp formula)n
= $(C_4H_3O_2)_2$
= $C_8H_6O_4$ Ans

Q-3 In Organic Compound C = 65.73%, H = 15.06%, N = 19.21%. Its molecular wt is 74. Find its Emprical, molecular formula.

Sol^n

Element	% age	at wt	% age / at wt	Simple Ratio
C	65.73%	12	65.73/12 = 5.48	5.48/1.37 = 4
H	15.06%	01	15.06/1 = 15.06	15.06/1.37 = 11
N	19.21%	14	19.21/14 = 1.37	1.37/1.37 = 1

Emprical formula = $C_4H_{11}N_1$
Emp wt = 12x4 + 1x11 + 14x1
= 48 + 11 + 14 = 73

$n = \frac{\text{molecular wt}}{\text{Emp wt}} = \frac{74}{73} = 1.01 = 1$

molecular formula = $C_4H_{11}N_1$

Q-4 An Organic compound Contain C = 66.7%, H = 7.4% and N = 25.9%. Its vapour density is 54. Then find its Emperical and molecular f.

Ans

Element	% age	at wt	% age / at wt	Simple Ratio
C	66.7%	12	66.7/12 = 5.56	5.56/1.85 = 3
H	7.4%	01	7.4/01 = 7.4	7.4/1.85 = 4
N	25.9%	14	25.9/14 = 1.85	1.85/1.85 = 1

Emprical formula = C_3H_4N
Emp wt = 12x3 + 1x4 + 14x1
= 36 + 4 + 14 = 54

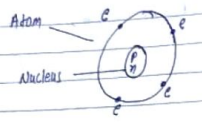
vapour density = 54
Molecular wt = 2x vapour density
= 2x54 = 108

$n = \frac{108}{54} = 2$

molecular formula = (Emp formula)n
= $(C_3H_4N)_2$
= $C_6H_8N_2$ Ans

(111)

MASS DEFECT



P = Proton
e = electron
n = neutron

$_zX^A$

A = Atomic mass or Atomic wt or Mass number or no. of nucleons
z = Atomic no.
X = Element

$\boxed{A = P+n}$

$\boxed{Z = P = e}$

2017
Q-) Find the no. of Proton, electron and neutron in $_{11}Na^{23}$.

Solⁿ $_{11}Na^{23}$ Given, $Z = 11$, $A = 23$

$\because Z = P = e$

So, $P = 11$, $e = 11$

$\because A = P+n$

$n = A - P$

$n = 23 - 11$

$\boxed{n = 12}$

★ Mass Defect (Δm) :- The difference between calculated mass of atoms and actual (Isotopic) mass of atom is known as mass defect.

30

★ Binding Energy of a Nucleus :- It is defined as the energy release when nucleus is formed from protons and neutrons.

If Δm is in kg then $BE = (\Delta m)c^2$

where $c = 3 \times 10^8$

Q-) Helium ($_2He^4$) has isotopic mass 4.0026 amu. The mass of hydrogen atom is 1.00815 amu mass of neutron is 1.00867 amu. Calculate mass defect and Binding energy per nucleon of $_2He^4$?

Solⁿ Mass defect (Δm) = Calculated mass - Actual (Isotopic) mass.

$_2He^4$ No. of protons = 2
" " neutrons = 2

Calculated mass = (mass of 1 Proton × No. of Proton) + (mass of 1 Neutron × No. of neutron)

$= (2 \times 1.00815) + (2 \times 1.00867)$

($\because$ mass of Proton = mass of hydrogen) $= 2.0163 + 2.01734 = 4.03368$ amu

Δm = Calculated mass - Actual mass

$= 4.03368 - 4.0026 = 0.03104$ amu

$\therefore BE = \Delta m \times 931$ MeV (mega-volt)

$= 0.03104 \times 931 = 28.89824$ MeV

B.E per Nuclion $= \frac{\Delta m \times 931}{\text{Atomic mass no.}}$

$= \frac{28.89824}{4} = 7.22456$ MeV

Q2 Calculate mass Defect and B.E per nuclion of $_{27}Co^{60}$ which has isotopic mass 59.92250 amu, mass of Proton = 1.00782 amu, mass of neutron = 1.00866 amu.

Solu $_{27}Co^{60}$ No. of Proton = 27

" " neutron = 60 - 27 = 33

Calculated mass = (mass of proton x No. of proton) + (mass of Neutrons x No. of neutron)

= (1.00782 x 27) + (1.00866 x 33)

= (27.21114) + ~~(33.27117)~~ = ~~59.48826~~ 33.28578 = 60.49692

Δm = Calculated mass - Actual mass

= ~~59.48826~~ 60.49692 - 59.92250 = 0.57442 amu

BE = Δm x 931 mev

= 0.57442 x 931 = 534.78502 mev

B.E per nucleon = $\frac{534.78502}{60}$ = 8.913083

= 8.91308 mev

Q3 Calculate Δm BE/for Nucleon of $_{15}P^{31}$ which has (Atomic mass) 30.984 amu. mass of Proton = 1.0078, mass of neutron = 1.0086 amu

Given,

$_{15}P^{31}$ No. of proton = 15

" " Neutron = 31 - 15 = 16

Calculated mass = (No. of proton x mass of proton) + (No. of Neutron x mass of Neutron)

= (15 x 1.0078) + (16 x 1.0086)

= (15.1170 + 16.1376) = 31.2546 amu

Atomic Mass = 30.984 amu.

Δm = Calculated mass - Atomic mass

= 31.2546 - 30.984 = 0.2706 amu

BE = Δm x 931 mev

= 0.2706 x 931 = ~~0.2519286 mev~~ 251.9286 mev

B.E per Neucleon = $\frac{2519286}{31}$

= 0.81267

= 0.81267 mev

(19)

GASEOUS LAW

Boyle's Law → According to this law at constant temp, Pressure is inversely proportional to volume.

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

$$\boxed{PV = \text{Constant}}$$

For two Gaseous,

$$\boxed{P_1V_1 = P_2V_2}$$

Charle's law → At constant pressure volume of a gas is directly proportional to its temp

$$V \propto T$$

$$\boxed{\frac{V}{T} = \text{Constant}}$$

for two Gaseous,

$$\boxed{\frac{V_1}{T_1} = \frac{V_2}{T_2}}$$

Gay Lussac Pressure law → At Constant volume, Pressure is directly proportional to its temp.

$$P \propto T$$

$$\frac{P}{T} = \text{Constant}$$

for two Gaseous,

$$\boxed{\frac{P_1}{T_1} = \frac{P_2}{T_2}}$$

$1m^3 = 1000L$

$1cm^3 = \frac{1}{1000}L$

40

Avogadros law → According to this law equal volume of all the ideal gases at same temp & ~~temp~~ pressure contains the same no. of molecules.

$$\frac{V}{n} = \text{Constant}$$

Ideal Gas → The Gas which follows both Boyles law and Charle's law is known as Ideal gas.

NTP → Normal Temperature Pressure.

$T = 20°C = 293K$

$P = 1\ atm = 10^5\ N/m^2$

$V = 22.4\ l$

STP → Standard temp Pressure

$T = 0°C$

$P = 1\ atm$

(P) atm → atmospheric pressure.

$1\ atm = 10^5\ N/m^2$

$1\ atm = 760\ mm\ Hg$

(V) $1\ atm = 760$ torr

$1l = 1000ml$ or $1000\ cm^3$

(T) $K = C + 273$ [Kelvin]

$C = K - 273$ [Celcius]

Discharge law* → Under the same condition of temp & pressure. According to this law the rate of discharge of any gas is inversely proportional to the square root of the density of gas.

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

for two gases

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

or

$$\boxed{\frac{r_1}{r_2} = \sqrt{\frac{m_2}{m_1}}}$$

m → Molecular mass

$d \times D$ = Molecular mass

Dalton Partial Pressure law* -> According to this law of same gases one filled in container which will never ~~with~~ react in each other then the total pressure of the container is equal to the partial pressure of all the gases.

Total Pressure -> $\boxed{P = P_A + P_B + P_C + P_D}$
Partial Pressure.

Where,

$$\boxed{P_A = \left(\frac{n_A}{n_T}\right) \times P}$$

Ideal Gas -> Suppose the initial pressure, volume & temp is P_1, V_1 & T_1 under the constant temp & constant pressure its final value be P_2, V_2, T_2.

$P_1V_1T_1 \xrightarrow[\text{Temp}]{\text{At Constant}} P_2V_2P_1 \xrightarrow[\text{Pressure}]{\text{At Constant}} P_2V_2T_2$

In situation by Boyle's law,

~~$P_1V_1 = P_2V_2$~~ so,

~~$V_1 = P$~~

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

or

$V \propto \frac{1}{P}$ — ①

By charles law,

$V \propto T$ — ②

from eqn - ① & ②

$V \propto \frac{T}{P}$

$PV \propto T$

$\frac{PV}{T} = \text{Constant}$

$\frac{PV}{T} = R$ (where R is gas constant)

$\boxed{PV = RT}$ $\boxed{R = 8.31 \text{ Jole/mole}}$

for n mole of gas,

$\boxed{PV = nRT}$

For 2nd condition, (two gases)

$\frac{PV}{T} = \text{Constant}$

$$\boxed{\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}}$$ → If in numerical, don't given any constant thing (P,V,T).

From the above formula you may find every formula.

If Temp constant in numerical — $P_1V_1 = P_2V_2$ — Boyle's law

If pressure constant in numerical — $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ — Charle's law

If volume constant in numerical — $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ — Gray lussac Pressure law.

For numerical

Pressure (P)	Volume (V)	Temperature
SI Unit -> N/m^2 or Pascal		It should be in Kelvin.
1 atm = 10^5 N/m^2	1 ltr = 1000 ml	$K = C + 273$.
1 atm = 760 mm Hg	1 ltr = 1000 cm^3	
1 atm = 760 torr		
N.T.P = (Normal temp pressure)	STP (standard temp pressure)	
T = 20°C	T = 0°C	
P = 1 atm	P = 1 atm	

Gas law Numericals

1. The volume of a gas sample is 100 ml at 100°C. If pressure is constant at what temperature volume become 200ml.

Ans Given,

$V_1 = 100$ ml

$T_1 = 100°C = 100+273 = 373$ K

$V_2 = 200$ ml

$T_2 = ?$

We know that, if pressure is constant,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{100}{373} = \frac{200}{T_2}$$

$$T_2 = \frac{200 \times 373}{100} = 746 \text{ K}$$

$$T_2 = 746 - 273 = 473 °C$$

2. The volume of gas sample is 500 ml at 1 atm. If temperature is constant then calculate pressure at which volume become 1000 ml.

Ans Given,

$V_1 = 500$ ml

$P_1 = 1$ atm

$V_2 = 1000$ ml

$P_2 = ?$

Temp is constant,

$$P_1V_1 = P_2V_2$$

$$1 \times 500 = P_2 \times 1000$$

$$P_2 = \frac{500}{1000} = \frac{1}{2} \text{ atm.}$$

3. Calculate the temperature at which volume of a gas is double to volume at temperature 0°C. If pressure is constant.

Ans Given,

$T_1 = 0°C = 0+273 = 273$ K

~~$V_2 = V$~~ $V_1 = V$

~~$V_2 = 2V$~~ $V_2 = 2V$

$T_2 = ?$

Pressure is constant. (Charles law)

We know that,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{2V}{273} = \frac{V}{T_2}$$

$$\cancel{T_2 = \frac{V \times 273}{2V}}$$

$$\frac{V}{273} = \frac{2V}{T_2}$$

$$T_2 = \frac{2V \times 273}{V} = 546 \text{ K}$$

$$T_2 = 546 - 273 = 273 °C$$

4. The volume of a gas is 100 ml at 2 atm at 0°C. Find new volume if pressure become 1 atm at temp 273°C.

Ans Given,

$V_1 = 100$ ml

$P_1 = 2$ atm

$T_1 = 0°C = 0+273 = 273$ K

$V_2 = ?$

$P_2 = 1$ atm

$T_2 = 273°C = 273+273 = 546$ K

We know that,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{2 \times 100}{273} = \frac{1 \times V_2}{546}$$

$$V_2 = \frac{2 \times 100 \times \cancel{546}^{2}}{\cancel{273}} = 400 \text{ ml}$$

New Volume = 400 ml Ans

5. 100 ml of a gas is kept at a pressure of 760 mm of Hg. How much the pressure be increased to reduce the volume of the gas to 25 ml. Temperature remaining Constant?

Given,
$V_1 = 100$ ml
$P_1 = 760$ mm of Hg.
$P_2 = ?$
$V_2 = 25$ ml.

According to Boyle's law,
$P_1 V_1 = P_2 V_2$
$760 \times 100 = P_2 \times 25$
$P_2 = \frac{760 \times 100}{25} = 3040$ mm of Hg.

6. A Gas occupies a volume of 4.5 litre (l) at a pressure of 1 atm. Determine its volume if the pressure is increased to 1.25 atm at the same temperature.

Given,
$V_1 = 4.5$ l $= 4500$ ml
$P_1 = 1$ atm
$V_2 = ?$
$P_2 = 1.25$ atm $= \frac{125}{100}$ atm

According to Boyle's law,
$P_1 V_1 = P_2 V_2$
$1 \times 4500 = \frac{125}{100} \times V_2$
$V_2 = \frac{4500 \times 100}{125} = 3600$ ml.
$V_2 = 3.6$ lt.

7. A Gas was allowed to expand at Constant temperature from an initial volume of 500 ml to 1000 ml. At the end of the expansion, the pressure of the gas was found to be 1 atm. What was the initial pressure of the gas.

Given,
$V_1 = 500$ ml $\quad P_1 = ?$
$V_2 = 1000$ ml $\quad P_2 = 1$ atm

According to Boyle's law,
$P_1 V_1 = P_2 V_2$
$P_1 500 = 1 \times 1000$
$P_1 = \frac{1000}{500} = 2$ atm

8. A gas occupies a volume of 2.5 L at $9 \times 10^5 Nm^{-2}$ pressure. Calculate the pressure required to decreased the volume of the gas to 1.0 L. Keeping the temperature constant.

Given,
$V_1 = 2.5$ L $\quad V_2 = 1.0$ L
$P_1 = 9 \times 10^5 Nm^{-2} \quad P_2 = ?$

Boyle's law,
$P_1 V_1 = P_2 V_2$
$9 \times 10^5 \times 2.5 = P_2 \times 1$
$P_2 = \frac{9 \times 10^5 \times 25}{10} = 225 \times 10^4 Nm^{-2}$ ans
$P_2 = 22.5 \times 10^5 Nm^{-2}$

9. At what temperature (Celsius), will the volume of a gas at 0°C double itself, the pressure remaining Constant?

Given,
$V_1 = V$ L
$T_1 = 0°C = 273$ K
$V_2 = 2V$ L
$T_2 = ?$

Charle's law, $\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V}{273} = \frac{2V}{T_2}$

$= T_2 = \frac{2V \times 273}{V}$
$T_2 = 546$ K
$T_2 = 273°C$

10. A Gas occupies a volume of 100 mL at 50°C and 1 atm pressure. The gas is cooled at the same pressure so that the volume reduces to 50 mL. what is the final temperature of the gas?

Given,

$V_1 = 100$ mL

$T_1 = 50°C = 50 + 273 = 323$ K

$P_1 = 1$ atm. (constant)

$V_2 = 50$ mL

$T_2 = ?$

Charle's law,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{100}{323} = \frac{50}{T_2}$$

$$T_2 = \frac{50 \times 323}{100} = \frac{16150}{100} = 161.5 K$$

$$T_2 = 273 - 161.5 = 111.5 °C$$

11. A Sample of a gas at 101.5 kPa pressure had a volume of 1.2 L at 100°C. what would be its volume at 0°C at the same pressure?

Given,

$V_1 = 1.2$ L

$T_1 = 100°C = 100 + 273 = 373$ K

$V_2 = ?$

$T_2 = 0°C = 0 + 273 = 273$ K

Charle's law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{1.2}{373} = \frac{V_2}{273}$$

$$V_2 = \frac{12 \times 273}{373 \times 10} = \frac{3276}{373} = 0.878 = 0.88 L$$

12. On a ship sailing in the pacific Ocean where the temp is 23.4°C, a balloon is filled with 2 L air. what will be the volume of the ballon when the ship reaches Indian Ocean where the temperature is 26.1°C?

Given,

$T_1 = 23.4°C = 23.4 + 273 = 296.4$ K

$V_1 = 2$ L

$T_2 = 26.1°C = 26.1 + 273 = 299.1$ K

$V_2 = ?$

Charle's law,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{2}{296.4} = \frac{V_2}{299.1}$$

$$V_2 = \frac{2 \times 2991}{2964} = \frac{5982}{2964} = 2.018 L$$

$$= 2.018 L$$

13. A gas Sample occupies a volume of 3.25 L at 24.5°C and 1825 mm of Hg. Determine the temperature at which the gas would occupy a volume of 4250 mL at 1.50 atm.

Given,

$V_1 = 3.25$ L $= 3250$ mL

$T_1 = 24.5°C = 24.5 + 273 = 297.5$ K

$P_1 = 1825$ mm of Hg

$V_2 = 4250$ mL

$T_2 = ?$

$P_2 = 1.50$ atm. $= \frac{1.50 \times 760}{100} = 1140$ mm of Hg

We know that,

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{1825 \times 3250 \times 10}{2975} = \frac{1140 \times 4250}{T_2}$$

$$T_2 = \frac{1140 \times 4250 \times 2975}{1825 \times 3250 \times 19} = \frac{114 \times 17 \times 119}{73 \times 13} = \frac{230622}{949} = 243.015 K$$

$$= 243 K$$

$T_2 = 278 - 240.48 = 22.52°C$ $278 - 243 = 30°C$

14. At 0°C and 760 mm of Hg pressure, a gas occupies a volume of 100 cm³. The kelvin temp (Absolute temp) of the gas is increased by one-fifth while the pressure is increased by one and a half times. Calculate the final volume of the gas.

Given,

$T_1 = 0°C = 0 + 273 = 273\ K$

$P_1 = 760$ mm of Hg

$V_1 = 100\ cm^3$

$T_2 = T_1 + \frac{T_1}{5} = 273 + \frac{273}{5} = \frac{1365 + 273}{5} = \frac{1638}{5}$

one fifth of $T_1 = \frac{T_1}{5}$

$T_2 = T_1 + \frac{T_1}{5} = 273 + \frac{273}{5} = \frac{1365 + 273}{5} = \frac{1638}{5}$

$T_2 = 327.6\ K$

One and half times of $P_1 = 1 \times \frac{1}{2} = \frac{1}{2} P_1$

$P_2 = P_1 + \frac{P_1}{2} = 1 + \frac{1}{2} = \frac{2+1}{2} = \frac{3}{2}$ atm $= \frac{3}{2} \times 760 = 1140$ mm of Hg

We know that,

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{760 \times 100}{273} = \frac{1140 \times V_2}{327.6}$$

$$\frac{760 \times 100 \times 327.6}{273 \times 1140} = V_2$$

$$\frac{38 \times 100}{57} = V_2$$

$$V_2 = 8 \times 10 = 80$$

$$V_2 = \frac{\frac{3}{2} \times 100 \times 327.6}{273 \times 10} = 180\ cm^3$$

BALANCING CHEMICAL EQUATION

Balance the following chemical Equations:-

1. $8CO_2 + 3S_8 \longrightarrow 8CS_2 + 8SO_2$
2. $SO_2 + H_2O \longrightarrow H_2SO_3$
3. $FeS + H_2SO_4 \longrightarrow H_2S + FeSO_4$
4. $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
5. $Al_2O_3 + Na_2CO_3 \longrightarrow 2NaAlO_2 + CO_2$
6. $2NaOH + Zn(NO_3)_2 \longrightarrow 2NaNO_3 + Zn(OH)_2$
7. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
8. $3KOH + AlCl_3 \longrightarrow 3KCl + Al(OH)_3$
9. $C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$
10. $Pb_3O_4 + 4HNO_3 \longrightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$
11. $3Fe + 2H_2O \longrightarrow Fe_3O_4 + 4H_2$
12. $3H_2SO_4 + 2Al(OH)_3 \longrightarrow Al_2(SO_4)_3 + 6H_2O$
13. $4KMnO_4 + 6H_2SO_4 \longrightarrow 2K_2SO_4 + MnO_2 + H_2$
14. $2C_6H_6 + 15O_2 \longrightarrow 12CO_2 + 6H_2O$
15. $2C_4H_{10} + 13O_2 \longrightarrow 8CO_2 + 10H_2O$

CHEMISTRY IMP NUMERICAL

Concentration of Solution → The ratio of amount of solute to the volume of solution in litre is known as Concentration of Solution.

$$\text{Conc. of Sol}^n = \frac{\text{Amount of Solute in gm}}{\text{Vol of Solution in litre or ml or gm}} \times 100$$

$$\text{Strength percentage by wt} = \frac{\text{wt of Solute}}{\text{wt of Solution}} \times 100$$

$$\text{Strength percentage by Volume} = \frac{\text{wt of Solute}}{\text{Vol of Sol}^n} \times 100$$

$$\text{Solubility} = \frac{\text{wt of Solute}}{\text{wt of Solvent}} \times 100$$

Numerical -

① If 30 gm Nacl is dissolved in 50 gm water then Calculate its strength %age by wt.

Given,

wt of Solute (Nacl) = 30 gm
" " Solvent (H_2O) = 50 gm
" " Solution = 30 + 50 = 80 gm

we know that,

$$\text{strength \%age by wt} = \frac{\text{wt of Solute}}{\text{wt of Solution}} \times 100$$

$$= \frac{30}{80} \times 100 = \frac{150}{4} = 37.5\%$$

② If 20 gm Nacl is dissolved in 80 gm water. Find its Concentration.

Given,

wt of Solute = 20 gm
" " Solvent = 80 gm
" " Sol^n = 20 + 80 = 100 gm

$$\text{Concentration of Sol}^n = \frac{\text{Amount of Solute in gm}}{\text{Vol. of Solution in ltr/ml/gm. or Amount}} \times 100$$

$$= \frac{20}{100} \times 100 = 20 \text{ gm/ltr}$$

③ If 40 gm of Solute is dissolved in 100 ml Sol^n then Calculate strength %age by volume.

Given,

wt of Solute = 40 gm
volume of Sol^n = 100 ml

$$\text{Strength \%age by volume} = \frac{\text{wt of Solute}}{\text{Vol. of Sol}^n} \times 100$$

$$= \frac{40}{100} \times 100 = 40\%$$

④ If 50 gm Nacl is dissolved in 1 ltr Sol^n then Calculate its strength (gm/l).

Given,

wt of Solute = 50 gm
vol of Sol^n = 1 ltr

$$\text{strength by volume (gm/l)} = \frac{\text{wt of Solute}}{\text{vol. of Sol}^n} = \frac{50}{1} = 50 \text{ gm/l}$$

⑤ To make saturated Sol^n 36 gm Nacl is dissolved in 100 gm water at 293 K. Find its Concentration at this temp.

Given,

wt of Solute = 36 gm
" " Solvent = 100 gm
" " Sol^n = 36 + 100 = 136 gm

$$\text{Concentration of Sol}^n = \frac{\text{Amount of Solute in gm}}{\text{Amount of Solution in gm}} \times 100 = \frac{36}{136} \times 100 = \frac{900}{34} = 26.47\%$$

(6) A solⁿ Contain 60 gm NaCl in 400 gm water. Calculate Conc. in terms of mass by mass % of solⁿ.

Given,

wt of Solute = 60 gm

" " Solvent = 400 gm

" " Solution = 60 + 400 = 460 gm

$$\text{Conc. of Solⁿ} = \frac{\text{Amount of solute in gm}}{\text{Amount of solution in gm}} \times 100$$

$$= \frac{60}{460} \times 100 = \frac{300}{23} = 13.04\%$$

(7) If 20 gm of Sugar is dissolved in 80 gm water. Find its Solubility at 20°C.

Given, wt of Solute = 20 gm

wt of Solvent = 80 gm

~~" " Solution = 20 + 80 = 100 gm~~

We know that

$$\text{Solubility} = \frac{\text{wt of Solute}}{\text{wt of Solvent}} \times 100$$

$$= \frac{20}{80} \times 100 = 25$$

(8) If 40 gm NaCl is dissolved in water and make Solⁿ 90 gm at 20°C. Find its solubility.

Given, wt of Solute (NaCl) = 40 gm

" " Solution = 90 gm

" " Solvent (H_2O) = 90 - 40 = 50 gm

We know that

$$\text{Solubility} = \frac{\text{wt of Solute}}{\text{wt of Solvent}} \times 100$$

$$= \frac{40}{50} \times 100 = 80 \text{ Ans}$$

MIX NUMERICALS

(1) How many gram of moles persent in 11 gm CO_2.

Given,

wt of Substance (CO_2) = 11 gm

Atomic wt of CO_2 = 12 + 16×2 = 12 + 32 = 44 gm.

$$\text{No. of Moles} = \frac{\text{wt of Substance in gm}}{\text{Atomic wt}} = \frac{11}{44} = 0.25$$

(2) Calculate OH^- Conc of Solution whose pH is 10.

(3) Calculate the pH of $\frac{N}{10}$ NaOH solution.

(4) Calculate pH of a solution, its pOH is 4.

5. Find the pH of a Solution whose hydrogen ion Concentration is 2×10^{-3}

6. Calculate the hydrolysis Constant of NaOH ($K_a = 1.2 \times 10^{-5}$).

7. 1.62 gm of metal was dissolved in Nitric acid to prepare its Nitrate on strong heating of Nitrate 2.02 gm oxide obtained. Find Equivalent wt of Metal.

8. Calculate the normality of Solution containing 6.3 gm of oxalic acid crystal (mol wt = 126) dissolved in 500 ml solution.

9. The volume of gas sample is 100 ml at 100°C. If the pressure is held Constant at what temperature volume become 200 ml.

10. Calculate the amount of 400 ml of N/10 Na_2CO_3 Solution.

11. A Current of 3A passing through $AgNO_3$ solution for 20 min deposited 4 gm of Silver. What is the Electrochemical Equivalent of water.

12. If the Equivalent wt of a substance is 40 and its valency is 2 find its atomic wt.

13. 2.46 gm of NaOH are dissolved in water and solution is made to 100 cm³. Calculate the molarity of Solution.

14. Calculate the no. of moles of 0.032 mg of Methane.

15. Find out weight of Magnesium oxide formed when 3 gm of Mg are burned in oxygen.

16. Calculate the molarity of water. Density of water is 1 gm/ml.
17. If the hydrogen ion conc is 0.00001 M, what is OH^- conc and its POH.
18. If H^+ conc is 5×10^{-5}. Calculate its PH.
19. A gas at -20°c occupies the volume of 140 ml. Calculate the temp. at which volume of gas become 65 ml, pressure remain constant.
20. What current will be reqd to liberate 10^{-3} kg of Iodine from KI solution in two hours (ECE of I is 10^{-4} kg/c)
21. Calculate the PH of 0.001 M HCl.
22. A current of 0.5 Ampere is passed for 30 min through CuSO4 solution. Calculate wt of Cu deposit (at wt of Cu = 63.6)
23. Calculate the mole fraction of water in a mixture of 12gm water, 108 gm oxalic acid and 92 gm Ethyl alcohol, (molar mass of water = 18, for acetic acid = 60, for Ethyl alcohol = 46)
24. Helium has isotopic mass 4.0026 amu. Calculate mass defect. (m_p = 1.00815 amu, m_n = 1.00867 amu)
25. An organic compound have C = 57.8%, H = 3.6%, O = 38.6%. If molecular wt of compound is 166. Find molecular Formula. (Ans - $C_8H_6O_4$)
26. The H^+ ion conc of a fruit juice is 3.3×10^{-3}. Find its PH value.
27. The dissociation constant of formic acid and acetic acid are 21.4×10^{-5} and 1.81×10^{-5}. Find their relative strength.
28. 10 gm of Hydrogen is burnt in the presence of oxygen. Determine the mass of water formed. (Ans - 90gm)
29. Calculate the PH of ~~1000~~ HCl solution. (Ans - 3)
30. 15 ml 0.1N NaOH solution is neutralized by 10 ml HCl solution. Find out Normality of HCl. (Ans - 0.15N)

2. Given,

$PH = 10$

$[H^+] = 10^{-PH}$ $\quad PH + POH = 14$

$= \cancel{10^{-10}}$ $\quad POH = 14 - 10 = 4$

$[OH^-] = 10^{-POH}$

$= 10^{-4}$

3. Given,

$[OH^-] = \frac{1}{10}$

$= 10^{-1}$

$[OH^-] = 10^{-POH}$

$POH = 1$

$PH + POH = 14$

$PH = 14 - 1 = 13$ Ans

4.

$POH = 4$

$PH + POH = 14$

$PH = 14 - 4 = 10$ Ans

5.

$[H^+] = 2 \times 10^{-3}$

$\cancel{[H^+] = 10^{-PH}}$

$PH = -\log[H^+]$

$= -\log(2 \times 10^{-3})$

$= -(\log 2 - 3 \log 10)$

$= -(0.3010 - 3) = -(-2.6990)$

$= 2.6990$

18.

$[H^+] = 5 \times 10^{-5}$

$PH = -\log[H^+]$

$= -\log(5 \times 10^{-5})$

$= -(\log 5 - 5 \log 10)$

$= -(0.6990 - 5) = -(-4.3110) = 4.3110$ Ans

(6) $K_b = \frac{K_w}{K_a}$

we know that,

$K_w = 10^{-14}$

Given,

$K_a = 1.8 \times 10^{-5}$

$K_b = \frac{10^{-14}}{1.8 \times 10^{-5}} = \frac{1}{1.8 \times 10^{-1}} = \frac{50}{9} = 5.56$

(8) Given,

$(C_2H_2O_4)$

wt of Solute (~~ACOOH~~) = 6.3 gm

molar mass = 126 gm.

Vol. of solution = 500 ml = $\frac{1}{2}$ l

No. of H^+ ion = 2

Eq wt = $\frac{\text{Atomic wt}}{\text{Valency}} = \frac{126}{2} = 63$ gm.

Normality = $\frac{\text{wt of Solute in gm}}{\text{Eq wt} \times \text{vol of sol}^n \text{ in lit}}$

$= \frac{6.3}{63 \times \frac{1}{2}} = \frac{6.3 \times 2}{63 \times 10} = 0.2\ N$

9. Given,

$V_1 = 100$ ml

$T_1 = 100°C = 100 + 273 = 373K$

$V_2 = 200$ ml

$T_2 = ?$

Pressure is constant.

Charle's law,

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{100}{373} = \frac{200}{T_2}$

$T_2 = \frac{200 \times 373}{100} = 746\ K$

$T_2 = 746 - 273 = 473°C$

At 473°C temp. volume become 200 ml.

10. Given,

Volume of Solution = 400 ml = $\frac{400}{1000}$ = 0.4 l

Normality (N) = $\frac{1}{10}$ N

Atomic wt of Na_2CO_3 = 23×2 + 12 + 16×3

= 46 + 12 + 48 = 106

Valancy = 2

Eq wt = $\frac{\text{At wt}}{\text{Valancy}} = \frac{106}{2} = 53$

Normality (N) = $\frac{\text{wt of Solute in gm}}{\text{Eq wt × vol of sol}^n \text{ in ltr}}$

$\frac{1}{10} = \frac{\text{wt of Solute}}{53 \times \frac{4}{10}}$

wt of Solute = $\frac{53 \times 4}{100} = \frac{212}{100}$

= 2.12 gm

11. Given,

Current (i) = 3A

Time (t) = 20 min = 1200 sec

mass (m) = 4 g

E.C.E = ?

According to Faraday's first law,

m = zit

4 = z × 3 × 1200

~~z = 4/1200 = 0.067~~

z = $\frac{4}{3600} = \frac{1}{900}$ g/C

12. Given

~~E.C.E =~~ Eq wt = 40

valancy = 2

Eq wt = $\frac{\text{Atomic wt}}{\text{valancy}}$

40 = $\frac{\text{At wt}}{2}$

Atomic wt = 40×2 = 80 gm

13. wt of Solute (aNaOH) = 2.46 gm

Volume of Solution = 100 cm^3 = 0.1 ltr

Atomic wt of NaOH = 23 + 16 + 1 = 40 gm

we know that,

Molarity (M) = $\frac{\text{wt of Solute in gm}}{\text{Atomic wt × vol of solution in ltr}}$

= $\frac{2.46}{40 \times 0.1} = \frac{246 \times 10}{40 \times 1 \times 100} = \frac{123}{2 \times 100}$

= $\frac{61.5}{100}$ = 0.615 M/ltr

14. Given,

methane = CH_4

wt of (CH_4) = 0.032 mg

Atomic wt = ~~2×6 + 1×4 = 12+16 = 18~~ 12+4 = 16

No. of moles = $\frac{\text{wt of Solution}}{\text{Atomic wt}} = \frac{0.032}{16} = 0.02$

15. $2Mg + O_2 \xrightarrow{heat} 2MgO$

At wt of 2Mg = 2×24 = 48

" " " 2MgO = 2×24 + 2×16

= 48 + 32 = 80

48 gm mg formed the MgO on burning = 80 gm

1 gm " " " " " " = $\frac{80}{48}$ gm

3 gm " " " " " " = $\frac{80}{48} \times 3$

= 5 gm

16. Density of Solution = 1 gm/ml

At wt of H_2O = 1x2+16 = 18

wt of soln should be = 1gm

vol. of solution = 1ml = $\frac{1}{1000}$ l

molarity (M) = $\frac{\text{wt of solute in gm}}{\text{At wt x vol of soln in ltr}}$

$= \frac{1}{18 \times \frac{1}{1000}} = \frac{1000}{18} = 55.56$ M

17. $[H^+] = 0.00001$ M $= 10^{-5}$

$[H^+] = 10^{-PH}$

PH = 5

PH + POH = 14

5 + POH = 14

POH = 9

$[OH^-] = 10^{-POH}$

$[OH^-] = 10^{-9}$

19. $T_1 = -20°C = -20 + 273 = 253$ K

$V_1 = 140$ ml

$V_2 = 65$ ml

$T_2 = ?$

∵ Pressure is Constant,

Ac. to Charle's law,

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{140}{253} = \frac{65}{T_2}$

$T_2 = \frac{65 \times 253}{28}$

$T_2 = 117.46 - 273$

$= -155.54$ °C

$= \frac{3289}{28} = 117.46$ K

20. i = ?

m = 10^{-3} kg

t = 2 hours = 7200 sec

z = 10^{-6} kg/C

Faraday's 1st law,

m = zit

$10^{-3} = 10^{-6} \times i \times 7200$

$i = \frac{10^{-3}}{10^{-6} \times 7200} = \frac{10^6}{10^3 \times 7200} = \frac{1000}{7200} = 0.138$ A

21. $[H^+] = 0.001$ M $= 10^{-3}$

$[H^+] = 10^{-PH}$

PH = 3

22. i = 0.5 A

t = 30 min = 1800 sec

at wt of Cu = 63.6

Valency of Cu = 2

we know that,

$\frac{\text{mass} \times \text{Charge}}{\text{Atomic wt}} = \frac{it}{96500}$

$\text{mass} = \frac{63.6 \times 0.5 \times 1800}{2 \times 96500} = \frac{636 \times 9}{965 \times 100} = \frac{1431}{4825}$

m = 0.296 gm.

23. wt of water = 12 gm
wt of oxalic acid = 108 gm
wt of Ethyl alcohol = 92 gm

Atomic wt of water = 18
" " " oxalic acid = 60
" " " Ethyl alcohol = 46

we know that
no. of mole = $\frac{\text{wt of substance}}{\text{atomic wt}}$

no. of mole of water = $\frac{12}{18} = 0.67$
" " " " oxalic acid = $\frac{108}{60} = \frac{27}{15} = 1.8$
" " " " Ethyl alcohol = $\frac{92}{46} = 2$

mole fraction = $\frac{\text{no. of mole of } x \text{ subs}}{\text{Total no of mole in soln}}$
of X substance

mole fraction of water = $\frac{0.67}{0.67+1.8+2} = \frac{0.67}{4.47}$

$= \frac{67}{447} = 0.149$

24. $_2He^4$
Atomic No. (Z) = 2 No. of e^- = 2
Atomic Mass (A) = 4 " " Proton = 2
" " Neutron = A − Z = 4 − 2 = 2

Calculated mass of He = (Total No. of Neutron × mass of Neutron) + (Total No. of proton × mass of proton)
= (2 × 1.00867) + (2 × 1.00815)
= 2.01724 + 2.01630
= 4.03364 amu

Isotopic mass of He = 4.0026 amu

Mass Defect ΔM = (calculated mass of He − Isotopic mass of nucleus)
= 4.03364 − 4.0026
= 0.03104

25. C = 57.8%, H = 3.6%, O = 38.6%
molecular wt of Compound = 166.
molecular formula = ?

Element	wt % age	At wt	$\frac{\text{% age wt}}{\text{at wt}}$	Simple Ratio	Simple Integer
C	57.8 %	12	$\frac{57.8}{12} = 4.82$	$\frac{4.82}{2.41} = 2$	2×2 = 4
H	3.6 %	1	$\frac{3.6}{1} = 3.6$	$\frac{3.60}{2.41} = 1.5$	2×1.5 = 3
O	38.6 %	16	$\frac{38.6}{16} = 2.41$	$\frac{2.41}{2.41} = 1$	2×1 = 2

Emperical formula = $C_4H_3O_2$
" wt = 12×4 + 1×3 + 16×2
= 48 + 3 + 32 = 83

$n = \frac{\text{molecular wt}}{\text{Emperical wt}} = \frac{166}{83} = 2$

Molecular formula = n (Emperical formula)
= 2 ($C_4H_3O_2$)
= $C_8H_6O_4$

26. $[H^+] = 3.3 \times 10^{-2}$

$pH = -\log [H^+]$

$= -\log (3.3 \times 10^{-2})$

$= -(\log 3.3 - 2 \log 10)$

$= -(0.5185 - 2 \times 1)$

$= -(-1.4815) = 1.4815$

27. Dissociation constant of formic acid $(K_1) = 21.4 \times 10^{-5}$

" " " acetic acid $(K_2) = 1.81 \times 10^{-5}$

~~Relative~~ Strength of formic acid $(C_1) = ?$

" " " acetic " $(C_2) = ?$

Relative strength $\left(\frac{C_1}{C_2}\right)$

$$\frac{C_1}{C_2} = \sqrt{\frac{K_1}{K_2}}$$

$$= \sqrt{\frac{21.4 \times 10^{-5}}{1.81 \times 10^{-5}}} = \sqrt{\frac{2140}{181}}$$

28. $2H_2 + O_2 \longrightarrow 2H_2O$

$2(2 \times 1)$ $\quad$ $2(2 \times 1 + 16)$

4 gm $\quad$ $2(2 + 16)$

36

4gm Hydrogen made Water on burning = 36

1 gm " " " " = $\frac{36}{4} = 9$

10 gm ——————— $= 9 \times 10 = 90$ gm.

29. $[H^+] = \frac{1}{1000}$ m $= 10^{-3}$

$[H^+] = 10^{-pH}$

$\boxed{pH = 3}$ Ans

30. Given,

$V_1 = 15$ ml

$N_1 = 0.1$ N

$V_2 = 10$ ml

$N_2 = ?$

We know that,

$N_1 V_1 = N_2 V_2$

$0.1 \times 15 = N_2 \times 10$

$N_2 = \frac{1 \times 15}{10 \times 10} = 0.15$ N

DISSOCIATION

2017, 2020

★ **Defination :-** Any acid or base on dissolving in water gives H^+ or OH^-.

$HCl \rightarrow H^+ + Cl^-$ [to break into ions]
$NaOH \rightarrow Na^+ + OH^-$

The dissociation constant for weak acid depend on their str.

$$K \propto s^2$$

I for two weak acid dissociation constant are K_a, K_b and strength are s_1, s_2

Then $\boxed{\frac{s_1^2}{s_2^2} = \frac{K_a}{K_b}}$

(Relative str) or $\boxed{\frac{s_1}{s_2} = \sqrt{\frac{K_a}{K_b}}}$

2018

Q.) The dissociation constant of formic acid and acetic acid are 21.4×10^{-4} and 1.81×10^{-5} respectively. Find the relative str of acid.

Soln

K_1 or $K_a = 21.4 \times 10^{-4}$
K_2 or $K_b = 1.81 \times 10^{-5}$

$$\frac{s_1}{s_2} = \sqrt{\frac{K_1}{K_2}} = \sqrt{\frac{21.4 \times 10^{-4}}{1.81 \times 10^{-5}}} = \sqrt{\frac{21400}{181}} = \sqrt{118.23} = 10.8 \text{ or } 10.9$$ Ans

2019

★ **Hydrolysis Constant**

To dissolve any acid or base in water.

Relation $\boxed{K_w = K_a \times K_h}$

$K_w = 10^{-14}$
K_a = Dissociation Constant
K_h = Hydrolysis Constant

acid base
$[H^+][OH^-] = 10^{-14}$
$K_w = 10^{-14}$

V.V.I

Q.) Calculate the hydrolysis constant of NaCN ($K_a = 1.8 \times 10^{-5}$)

शक्ति और क्षार की कमजोर a. से

2019

$K_w = K_a \times K_h$

$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{1.8 \times 10^{-5}} = \frac{5.6 \times 10^{-9}}{1.8} = 0.55 \times 10^{-9}$$

$= 5.5 \times 10^{-10}$ Ans

V.I.

Hydrolysis Percentage

$$h = \sqrt{\frac{K_h}{C}}$$

K_h = Hydrolysis Constant
C = Concentration
h = degree of dissociation / hydrolysis

$K_w = K_h \times K_a$

$$h = \sqrt{\frac{K_w}{K_a \times C}}$$

Q.) Find hydrolysis % age of $\frac{N}{80}$ NaCN ($K_a = 1.3 \times 10^{-9}$)

Soln

$K_w = K_a \times K_h$
$10^{-14} = 1.3 \times 10^{-9} \times K_h$
$K_h = \frac{10^{-14} \times 10}{1.3 \times 10^{-9}} = 0.77 \times 10^{-5}$

$h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{0.77 \times 10^{-5}}{1/80}}$

$h = \sqrt{0.77 \times 10^{-5} \times 80}$
$h = \sqrt{\frac{77}{100} \times 80 \times 10^{-5}}$
$h = \sqrt{616 \times 10^{-6}}$

$h = 2.48 \times 10^{-2}$

hydrolysis %, = $2.48 \times 10^{-2} \times 100$
$= 24.8\%$

REACTION BASED NUMERICALS

★ Law of Conservation of Mass (Given by Laussier) →

In a chemical reaction mass of Reactant is always equal to mass of product (mass neither be created nor be destroyed)

Ex- In a reaction 5.3 gm of Sodium carbonate reacted with 6 gm of Ethanoic acid. The product were 2.2 gm of CO_2, 0.9 g water and x gm of Sodium Ethanoate. Find the value of x.

Sol. Sodium Carbonate + Ethanoic acid → CO_2 + H_2O + Sodium Ethanoate

5.3 g, 6 g, 2.2, 0.9, x

mass of Reactant = mass of product

$5.3 + 6 = 2.2 + 0.9 + x$

$11.3 = 3.1 + x$

$x = 11.3 - 3.1$

$x = 8.2$ gm

★ Law of Constant proportion → Given by proust

According to this law, a chemical compound always consist of the same elements combined together in the same ratio. Ex. H_2O → 1:8

Ex-1 Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. what mass of oxygen gas would be required to react completely with 3gm of H_2 gas.

Sol^n $\frac{1}{8} = \frac{3}{x}$ (x gm O_2)

$x = 24$ g

or

1 gm H_2 → 8 gm O_2

3 gm H_2 → $3 \times 8 = 24$ gm O_2

2016, 2019

Ex-2 Find out wt of Magnesium oxide formed when 3 gm of Magnesium are burned in oxygen.

Sol^n $2Mg + O_2 \longrightarrow 2MgO$

$2 \times 24 = 48$, $2 \times (24+16) = 80$

48 gm Mg → 80 gm MgO

1 " " → $\frac{80}{48} = \frac{5}{3}$

3 " " → $\frac{5}{3} \times 3 = 5$ gm

2020

Q-4 10 gm of H_2 is burnt in presence of oxygen. Calculate how much of water formed.

$2H_2 + O_2 \longrightarrow 2H_2O$

$2 \times 2 \times 1 = 4$, $2 \times (2 \times 1 + 16) = 36$

4 gm H_2 → 36 gm H_2O

1 " " → $\frac{36}{4} = 9$ gm

10 " " → $9 \times 10 = 90$ gm

(3) How much of Copper oxide will be obtained by ~~ha~~ heating 12.35 gm of Copper Carbonate.

Soln

$$\underset{12.35}{CuCo_3} \xrightarrow{Heat} CuO + CO_2$$

at wt $CuCo_3$ = 63.5 + 12 + 48 = 123.5

at wt CuO = 63.5 + 16 = 79.5

123.5 gm $CuCo_3$ on heat → 79.5 CuO

1 gm " " " → $\frac{79.5}{123.5}$

12.35 gm " " " → $\frac{79.5}{\cancel{123.5}_{10}} \times \cancel{12.35}$

= 7.95 gm

Q→ If 53g Na_2Co_3 is dissolved in 100 ml solution. Find the molarity of :- (i) Na_2Co_3 (ii) Na^+ ion (iii) Carbonate ions

Given,

Ans wt of Substance = 53g | vol. of solution = 100 ml = $\frac{1}{10}$ l

molar mass " " = 46+12+48 = 106 g

No. of moles = $\frac{\text{given mass}}{\text{Molar mass}} = \frac{53}{106} = \frac{1}{2}$ mole

molarity of Na_2Co_3 = $\frac{\frac{1}{2}}{\frac{1}{10}} = \frac{10}{2} = 5$ mole/ltr

$Na_2Co_3 \longrightarrow 2Na^+ + Co_3^{--}$

0.5 mole $2 \times \frac{1}{2} = 1$ mole $1 \times \frac{1}{2} = 0.5$ mole

⇒ molarity of Na^+ → $\frac{1}{\frac{1}{10}} = 10$ mole/ltr

⇒ " " Co_3^{-2} → $\frac{\frac{1}{2}}{\frac{1}{10}} = \frac{1}{\cancel{2}} \times \cancel{10}^{5} = 5$ mole/ltr

Q→2 Calculate the no. of moles present in 100 ml of 2m $CaCO_3$ solution. (0.2 M)

Q→3 Find the molarity of 20g NaOH dissolved in 2 cm^3 of solution. (~~[illegible]~~)

Q→4 If 0.85g of ammonia is dissolved in 100 ml of solution, Calculate its molarity. (~~[illegible]~~)

Q→5 Find the mass of KOH present in 150 cm^3 of semimolar aqueous solution. (~~[illegible]~~ g)

Q→6 Find molarity of 10% w/v aqueous solution of H_2SO_4. (1.02 M)

Q→