Stoichiometric Relationships

Solids

- Definate shape and Volume
- Constituent particles are closely packed
- Very high intermolecular forces of attraction
- Very low (almost negligible) kinetic Energy
- Incompressible and Rigid
- Do not flow

Liquids

- no Definate shape (takes shape of container), Definate Volume
- Constituent particles are loosely packed
- Comparitively less strong intermolecular forces of attraction
- Comparitively higher kinetic Energy (than solids)
- Compressable
- have fluidity

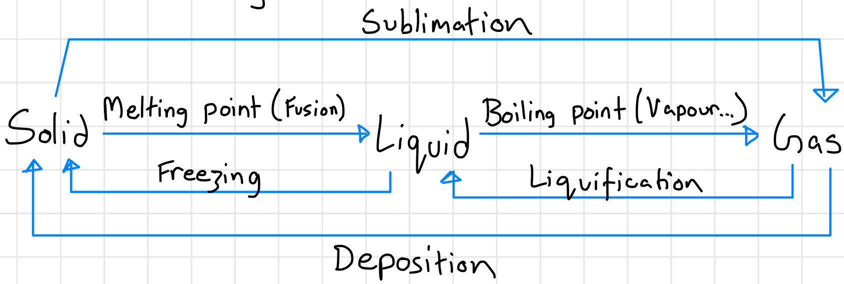
Gases $\longrightarrow$

- no Definate shape or volume (fill container)
- Constituent particles are far apart
- Almost negligible intermolecular forces of attraction
- Very high kinetic Energy
- Highly Compressible
- High fluidity

Physical Change $\longrightarrow$ is a change of phase/state and is reversable where energy is either given out or taken in. During this, only physical properties change where as chemical properties remain the same.

Chemical Change $\longrightarrow$ is a change of properties or nature of substance where energy is either given out or taken in. It is irreversable.

State Changes ⟹



Vapour Pressure ⟹ pressure exerted by particles of liquid in vapour state over the surface of liquid at equillibrium

rate of vapourisation = rate of condensation

Boiling Point ⟹ is the temperature at which vapour pressure (VP) of liquid is equal to atmospheric pressure.

→ At boiling point, particles throughout the liquid start escaping to vapour state.

Melting Point ⟹ is the temperature at which vapour pressure (VP) of liquid state is equal to VP of solid state ie solid and liquid co-exist.

Cause of Sublimation ⟹ is when vapour pressure at solid state is equal to the atmospheric pressure

→ Volatile ⟹ Liquids which evapourate at room temperature

→ Example → Ether, Alcohol

→ Critical Temperature ⟹ Minimum temperature upto which a gas must be cooled so that it can be liquified upon applying pressure

→ Critical Pressure ⟹ Minimum pressure upto which a gas must be compressed so that it can be liquified upon cooling it

x ——— x

→ Element ⟹ Simplest type of pure substance consisting of same type of atoms and have characteristic physical and chemical properties.

Metals

Elements which are electro-positive in nature, solid at room temperature, good conductor of heat and electric current, malleable, ductile, etc.

Metaloids

Show properties of both metals and non-metals.

Non-metals

Elements which are electro-negative in nature, in all three states, non-lustrous, brittle, bad conductors, etc.

→ Best Conductor → Silver (Ag)

Poorest Conductor → Lead (Pb)

↳ **Compound** ⟹ when two or more elements combine together in a definate proportion by mass. They have different properties compared to its constituent elements.

Organic

compounds which are generally obtained from organic matter (plants, etc). They are also known as hydrocarbons since they contain hydrogen and carbon along with or without {O, N, P, S} and or halogens.

InOrganic

compounds which are generally obtained from rocks and minerals and contain any of the known elements combined in a definate proportion by mass.

↳ **Mixture** ⟹ when two or more elements or compounds are mixed together in an indefinate proportion by mass. The properties of a mixture is the same as its constituent substances.

Homogenous

have uniform composition throughout the mixture.

Hetrogenous

have non-uniform composition throughout the mixture.

→ **Chemical Change** → processes during which chemical nature of substances changes thus causing substances to loose their identities and for new substances. They are generally irreversable in nature.

x ———————————————————— x

→ **Kinetic Theory of Matter** →

- Matter consists of small particles called atoms
- State of matter depends upon the intermolecular forces of attraction between particles.
- Average kinetic energy of particles $\propto$ temperature
- kinetic energy $= \frac{1}{2}mv^2$

x ———————————————————— x

→ **Mole** and **Mole Concept** →

→ fundamental unit used to meassure the amount of a substance.

→ the amount of substance which contains as many entities (atoms, compounds, etc) as are present in 12g of C-12 isotope.

→ **Avagadro's Number** → no. of entities present in one mole of a substance.

→ 6.02×10^{23}

↳ Stoichiometric Formulas ⟶

$$\text{Mole} = \frac{\text{Mass}}{M_r} = \frac{\text{Volume}}{\text{Molar V.}} = \text{Concentration} \times \text{Volume}$$

Molar V. ⟶ 22.7 dm^3

↳ Stoichiometry ⟶ the mole-mass or volume relationship between various reactants or products involved in a balanced chemical equation.

↳ Limiting Reagent ⟶ the reactant which is present in smaller amount. It therefore gets used up and hence limits the reaction.

⟶ smallest ratio of :}
$$\frac{\text{no. of moles of a reactant}}{\text{stoichiometric coefficient}}$$

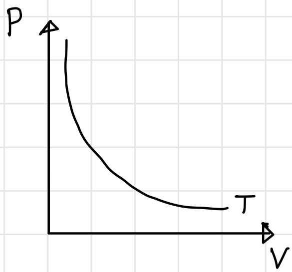
↳ Percentage Yield ⟶
$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

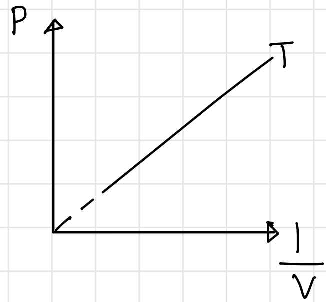
Theoretical Yield ⟶ the amount of product which must be produced during a reaction using stoichiometric relationships.

→ Gas Laws ⟹

- **Boyle's Law** ⟹ Pressure $\propto \frac{1}{\text{Volume}}$

$$\therefore P = \frac{k}{V} \Longrightarrow PV = k \Longrightarrow P_1V_1 = P_2V_2$$

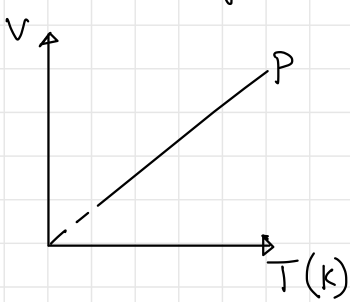




- **Charles Law** ⟹ Volume $\propto$ Temperature

$$\therefore V \propto kT \Longrightarrow \frac{V}{T} = k \Longrightarrow \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

→ **Significance** ⟹ gases expand on heating which cause the hot air to rise creating a low pressure area which causes winds to flow.



- Amonton | Gay Lussac | Pressure Law $\Longrightarrow$ $P \propto T$

$$P = kT \Longrightarrow \frac{P}{T} = k \Longrightarrow \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Significance $\Longrightarrow$ Compressed gasses explode on heating.

Ideal gas Equation $\Longrightarrow$ a gas which follows all gas laws under all conditions of temperatures and pressures.

$$PV = nRT \longrightarrow \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{Mass}{M_r} = Moles$$

$$\frac{M}{V}$$

$$P = \frac{MRT}{M_rV} = \frac{\rho RT}{M_r}$$

Kinetic Theory of Gases

- Every gas is made-up of tiny particles called molecules which are considered hard spheres.
- These molecules are in contineous random motion during which they collide with each other and with the walls of the container.
- Collisions between gas molecules are completely elastic.
- Pressure of the gas is the force with which the molecules collide with the wall of the container.
- Actual volume of gas molecules is negligible compared to the volume occupied by them.
- No attractive or repulsive force is exerted on gas molecules by other gas molecules.
- Negligible force of gravity exerted on gas molecules.
- KE of gas molecules $\propto$ temperature

Real Gases

Gases which obey all gas laws and kinetic theory of gases under all conditions of pressure and temperature are ideal gases but under conditions of low temperature and high pressure, gases deviate from ideal behaviour.

This is because, a force attraction develops between the molecules and the actual volume of the gas can no longer be considered negligible compared to the volume occupied by the gas.

Van der waal's correction

pressure correction → under conditions of ↑ pressure and ↓ temperature, when gas molecules are near each other, a force of attraction develops. Hence, a molecule moving towards the walls of a container is pulled back by the molecules present nearby ∴ it exerts less pressure.

$$\boxed{P_{ideal} > P_{actual}}$$

$$\boxed{P_a = P_i + \frac{an^2}{V^2}}$$

→ volume correction → under conditions of high pressure and low temperature, when gas molecules are close to each other, the actual volume can no longer be considered negligible. Hence, the volume available for movement of gas molecules is less and is called excluded volume

→ $\boxed{V_i - nb}$

→ Van der waal's Equation →

→ $$\boxed{\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT}$$

Here, 'a' tells us about the magnitude of attractive forces between the gas molecules.

$\boxed{a \propto \text{intermolecular force of attraction}}$

'b' tells us about the effective size of gas molecules which is always 4 times of the actual volume of the gas.

Solutions and Concentrations →

→ Solution → homogenous mixture of two or more components.

Solute

it is the dispersed phase which is the component present in small quantity

Solvent

it is the dispersion medium which is the component present in larger quantity

→ Types of Solution →

- Unsaturated: solution in which more amount of solute can be added at a given temperature.
- Saturated: solution in which no more amount of solute can be added at a given temperature.
- Supersaturated: solution which is heated, allowing more amount of solute to dissolve. Cooling this solution will cause the excess solute to precipitate out.

→ Concentration → Moles (n) / Volume (dm^3)

→ $C_1V_1 = C_2V_2$

→ $C_1V_1 + C_2V_2 = C_3(V_1 + V_2)$

→ Titration →

→ the process of determining concentration of an unknown solution by the help of a known standard solution.

→ solution having known concentration. It is produced by disolving a fixed amount of solute in a definate amount of solvent.

→ primary standard

→
- Available in pure form
- Relatively higher molar mass
- Must be stable in solid or solution
- Readily soluble in H_2O
- React completely in a known manner

Indicator → a substance which indicates the end-point of a titration process by showing an abrupt change in colours

Examples: phenolphthlein, methyl-orange