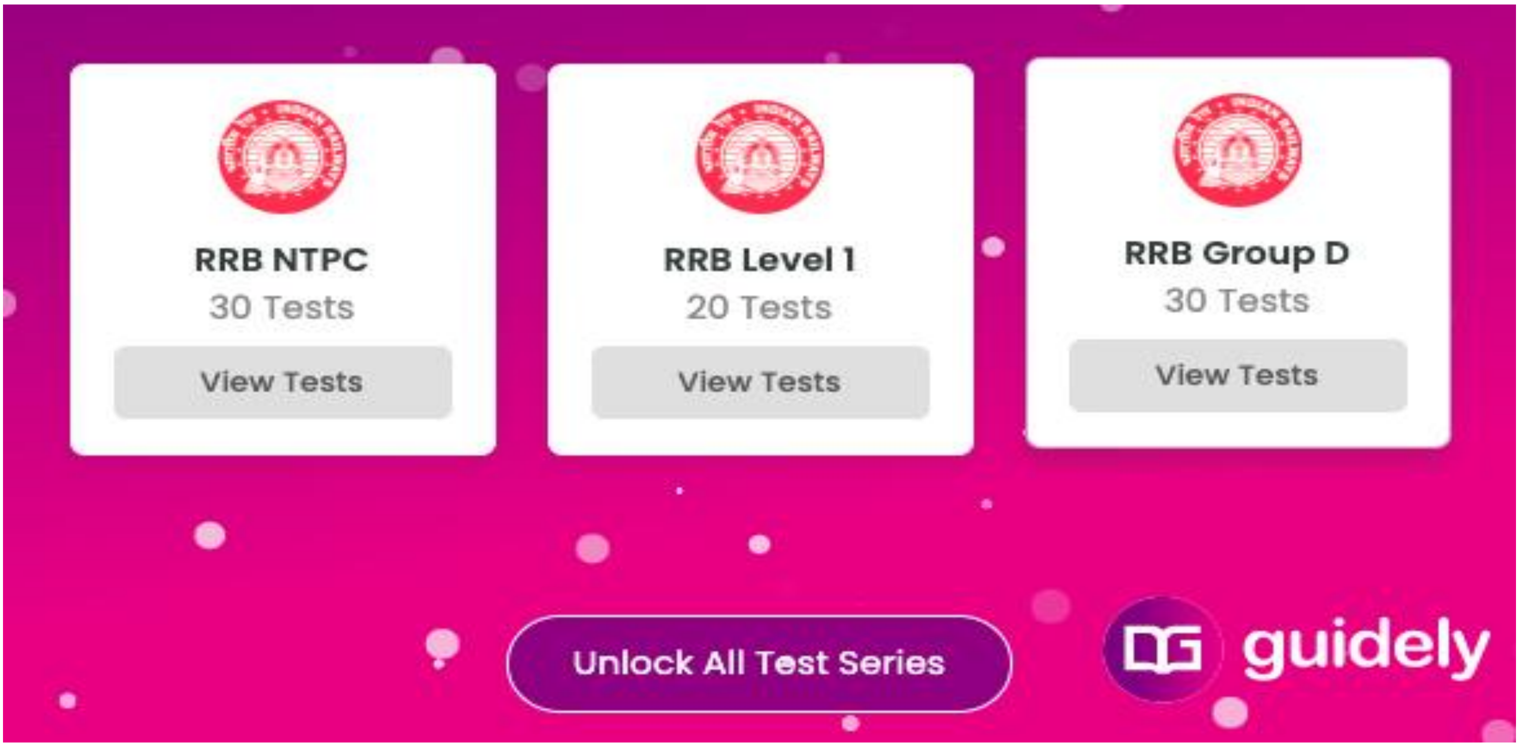
THE COMPLETE General Science Notes (Chemistry) for Railway Exams



General Science - Chemistry

CHEMICAL REACTIONS AND EQUATIONS

PHYSICAL CHANGES

Properties such as shape, size, colour and state of a substance are called its physical properties. A change in which a substance undergoes a change in its physical properties is called a physical change. A physical change is generally reversible. In such a change no new substance is formed.

CHEMICAL CHANGE

A change in which one or more new substances are formed is called a chemical change. A chemical change is also called a chemical reaction

CHEMICAL REACTION & EQUATIONS

- A complete chemical equation represents the **reactants**, **products** and their **physical**

State symbolically.

- Following observations helps us to determine whether a chemical reaction has taken place
  - Change in state
  - Change in colour
  - Evolution of a gas
  - Change in temperature.
- Some of the **example of chemical reactions** in everyday life
  - Photosynthesis
  - Aerobic Cellular Respiration
  - Combustion of wood

  - Rusting of iron
  - Metathesis
  - Digestion
  - Cooking an egg
  - Souring of milk
  - Rotting bananas
- **Exothermic reactions** are reactions or processes that release energy, usually in the form of heat or light
- Reactions in which **energy is absorbed** are known as **endothermic reactions**.

BALANCED CHEMICAL EQUATIONS

- Mass can neither be created nor destroyed in a chemical reaction. That is, the total mass of the elements present in the products of a chemical reaction has to be equal to the total mass of the elements present in the reactants
- The number of atoms of each element remains the same, before and after a chemical reaction

  Some of the example of balanced equations

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

TYPES OF CHEMICAL REACTIONS

1. COMBINATION REACTION

- In a combination reaction two or more substances combine to form a new single Substance.

Example of combination reaction

- Calcium oxide reacts vigorously with water to produce **slaked lime(calcium hydroxide)** Releasing a large amount of heat

$$CaO\ (s) + H_2O\ (l) \dashrightarrow Ca\ (OH)_2 + Heat$$

- A solution of **slaked lime** produced by the above reaction is used for **white washing wall**

NOTE: **Calcium hydroxide** reacts slowly with the **carbon dioxide** in air to form a thin layer of calcium carbonate on the walls. **Calcium carbonate** is formed after two to three days of **whitewashing** and gives a shiny finish to the walls. It is interesting to note that the **chemical formula** for **marble is also $CaCO_3$.**

$Ca(OH)_2 + CO2 (g) \rightarrow CaCO3 (s) + H2O (l)$

(Calcium hydroxide) (Calcium Carbonate)

2. **DECOMPOSITION REACTION**

- Decomposition reactions are opposite to combination reactions. In a decomposition reaction, a single substance decomposes to give two or more substances
- In this reaction, you can observe that a single reactant breaks down to give simpler products. This is a decomposition reaction.

2FeSO4(s) Heat---->Fe2O3(s) + SO_2(g) + SO_3(g)

- Decomposition of Silver bromide into silver and chlorine by light.

Sunlight

2AgBr(s) ---------->2Ag(s) + Br_2(g)

- **Silver bromide** used in black and white **photography**
- Decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating is an important decomposition reaction used in various industries. **Calcium oxide** is called **lime or quick lime**. It has many uses – one is in the **manufacture of cement.** When a **decomposition reaction is carried out by heating**, it is called **thermal decomposition**

Heat

$CaCO_3$ (s) ------------- > CaO(s) + CO_2 (g)

(Limestone)

3. **DISPLACEMENT RECTION**

- It is a reaction between an element and a compound. When they react, one of the elements of the compound-reactant is replaced by the element-reactant to form a new compound and an element.

  Fe+ $CuSO4$ --> $FeSO4$ + Cu
- In this reaction, iron has displaced or removed another element copper from copper sulphate solution. This reaction is known as displacement reaction

4. **DOUBLE DISPLACEMENT REACTIONS**

- When two compounds react, if their ions are interchanged, then the reaction is called double displacement reaction. The ion of one compound is replaced by the ion of the another compound

  Na_2SO_4 (aq) + $BaCl_2$ (aq) → $BaSO_4$ (s) + 2NaCl(aq)

PRECIPITATION REACTIONS

- When aqueous solutions of two compounds are mixed, if they react to form an insoluble compound and a soluble compound, then it is called precipitation reaction. Because the insoluble compound, formed as one of the products, is a precipitate and hence the reaction is so called.
- Precipitation reactions produce insoluble salts.

NEUTRALISATION REACTION

- The reaction between an acid and a base is known as neutralisation. Salt and water are produced in this process with the evolution of heat.

  HCl + NaOH → H2O + NaCl

NEUTRALISATION IN EVERYDAY LIFE

Ant bite

When an ant bites, it injects the acidic liquid (formic acid) into the skin. The effect of the acid can be neutralised by rubbing moist baking soda (sodium hydrogencarbonate) or calamine solution, which contains zinc carbonate.

Soil treatment

Excessive use of chemical fertilisers makes the soil acidic. Plants do not grow well when the soil is either too acidic or too basic. When the soil is too acidic, it is treated with bases like quick lime (calcium oxide) or slaked lime (calcium hydroxide). If the soil is basic, organic matter (compost) is added to it. Organic matter releases acids which neutralises the basic nature of the soil.

Factory wastes

The wastes of many factories contain acids. If they are allowed to flow into the water bodies, the acids will kill fish and other organisms. The factory wastes are, therefore, neutralised by adding basic substances.

OXIDATION AND REDUCTION

OXIDATION

- The chemical reaction which involves addition of oxygen or removal of hydrogen or loss of electrons is called oxidation.

  $2\ Mg + O_2 \rightarrow 2\ MgO$ (addition of oxygen)

  $CaH_2 \rightarrow Ca + H_2$ (removal of hydrogen)

  $Fe^{2+} \rightarrow Fe^{3+} + e^-$ (loss of electron)

REDUCTION

- The chemical reaction which involves addition of hydrogen or removal of oxygen or gain of electrons is called reduction.

  $2\ Na + H_2 \rightarrow 2\ NaH$ (addition of hydrogen)

  $CuO + H_2 \rightarrow Cu + H_2O$ (removal of oxygen)

  $Fe^{3+} + e^- \rightarrow Fe^{2+}$ (gain of electron)

REDOX REACTIONS

- Generally, the oxidation and reduction occurs in the same reaction (simultaneously). If one reactant gets oxidized, the other gets reduced. Such reactions are called oxidation-reduction reactions or Redox reactions.

  $2\ PbO + C \rightarrow 2\ Pb + CO_2$

  $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

Oxidation	Reduction
Addition of oxygen	Removal of oxygen
Removal of hydrogen	Addition of hydrogen
Loss of electron	Gain of electron

OXIDATION AND REDUCTION AGENTS

- Substance that loses oxygen or gains hydrogen is known as an oxidizing agent
- Substance that loses hydrogen or gains oxygen is known as a reducing agent
- Compounds with oxygen atom are called oxidizing agent and compounds with hydrogen atom are called reducing agent
- Some compounds can act as either oxidizing agents or reducing agents. One example is hydrogen gas, which acts as an oxidizing agent when it combines with metals and As a reducing agent when it reacts with non-metals.

Oxidation reactions in daily life

- The shining surface of metals tarnishes due to the formation of respective metal oxides on their surfaces. This is called corrosion.
- The freshly cut surfaces of vegetables and fruits turn brown after some time because of the oxidation of compounds present in them

RANCIDITY

- When oils and fats or foods containing oils and fats are exposed to air, they get oxidized due to which the food becomes stale and gives a bad taste or smell. This is called Rancidity.

  Following ways to **preventing rancidity**
  - Adding antioxidants
  - Refrigerating
  - Storing food in airtight containers with nitrogen gas

When carbon dioxide is passed through lime water, calcium carbonate is formed, which makes lime water milky. The turning of lime water into milky is a standard test of carbon dioxide.

Carbon dioxide ($CO2$) + Lime water [$Ca(OH)2$] → Calcium Carbonate ($CaCO3$) + Water ($H2O$)

COMMON NAME AND FORMULA OF CHEMICAL COMPOUNDS

Chemical Compounds	Chemical formula	Common names
Calcium oxide	Cao	Quick lime
Calcium hydroxide	$Ca(OH)_2$	Slaked lime
Calcium carbonate	$CaCO_3$	Limestone
Trichloro Methane	$CHCl_3$	Chloroform
Calcium Oxychloride	$CaOCl_2$	Bleaching powder
sodium hydrogencarbonate	$NaHCO_3$	Baking soda
Sodium carbonate	Na_2CO_3	Washing soda
Calcium sulphate hemihydrate	$CaSO4 .1/2H_2O$	Plaster of Paris
calcium sulfate dihydrate	$CaSO_4 .2H_2O$	Gypsum
Acetic acid	CH_3COOH	Vinegar
Silicon Oxide	$SiO2$	Sand
Methane	CH_4	Marsh Gas

Nitrous oxide	N2O	Laughing Gas
Deuterium Oxide	D2O	Heavy water
Solid Carbondixide	CO2	Dry ice
Calcium Carbonate	$CaCo_3$	Chalk
Sulphuric Acid	H2SO4	Oil of vitriol
Zinc sulphate	ZnSO4	White Vitriol
Copper sulphate	$CuSO_4$.5H2O	Blue Vitriol
Sodium hydroxide	NaOH	Caustic Soda
Potassium carbonate	K_2CO_3	Potash Ash
Mercurous chloride	Hg_2Cl_2	Calomel
Sucrose	$C_{12}H_{22}O_{11}$	Sugar
Silver nitrate	$AgNO_3$	Lunar caustic
Ethyl Alcohol	C_2H_6O	Alcohol
Hydrochloric acid	HCl	Muriatic acid

CHEMICAL COMPOUNDS AND FORMULA

Chemical Compounds	Chemical formula
Sodium chloride	NaCl
Zinc sulphate	$ZnSO_4$

Glucose	$C_6H_{12}O_6$
Ferric oxide	Fe2O3
Ferrous sulphate	FeSO4
Lead oxide	PbO
Lead nitrate	$Pb(NO_3)_2$
silver chloride	AgCl
Silver bromide	AgBr
Sodium sulphate	Na_2SO_4

CHEMICAL BONDING

Attraction between atoms, ions or molecules that enables the formation of chemical compounds is called chemical bonding

TYPES OF CHEMICAL BONDING

1. Ionic bond

Chemical bond formed between two atoms due to transfer of electron from one atom to the other atom

2. Covalent bond

A covalent bond is a chemical bond that involves the sharing of electron between two atoms

3. Metallic bond

Metallic bond is the force of attraction between metal ions to a number of electrons within its sphere of influence.

MATTER

- Matter is made up of small particles

- The matter around us exists in three states— solid, liquid and gas.
- The forces of attraction between the particles are maximum in solids, intermediate in liquids and minimum in gases
- The spaces in between the constituent particles and kinetic energy of the particles are minimum in the case of solids, intermediate in liquids and maximum in gases
- Particles of matter are continuously moving, that is, they possess what we call the kinetic energy. As the temperature rises, particles move faster. So, we can say that with increase in temperature the kinetic energy of the particles also increases
- The states of matter are inter-convertible. The state of matter can be changed by changing temperature or pressure.

DIFFUSION

- The mixing of a substance with another substance due to the motion of its particles is called diffusion. It is one of the properties of material. The diffusion of one substance to another substance goes on until a uniform mixture is formed. Diffusion takes place in gases, liquids and solids. **Diffusion** increases on increasing the temperature of the diffusing substance.

STATES OF MATTER

- Matter around us exists in three different states– solid, liquid and gas. These states of matter arise due to the variation in the characteristics of the particles of matter

1. THE SOLID STATE

- Solid have a definite shape, distinct boundaries and fixed volumes, that is, have negligible compressibility. Solids have a tendency to maintain their shape when subjected to outside force. Solids may break under force but it is difficult to change their shape, so they are rigid.

2. THE LIQUID STATE

- Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept. Liquids flow and change shape, so they are not rigid but can be called fluid

- The rate of diffusion of liquids is higher than that of solids
- Particles move freely and have greater space between each other as compared to particles in the solid state

3. THE GASEOUSSTATE

- Gases are highly compressible as compared to solids and liquids
- Gases have lower density than other states of matters
- The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas
- The oxygen supplied to hospitals in cylinders is compressed gas.
- Compressed natural gas (CNG) is used as fuel these days in vehicles.
- The rate of diffusion of gas is higher than that of solids and liquids
- We come to know of what is being cooked in the kitchen without even entering there, the smell of hot cooked food reaches us in seconds because rate of diffusion of gas is higher than that of solids and liquids.

MATTERS CHANGE ITS STATE?

Water can exist in three states of matter–

- Solid, as ice,
- Liquid, as the familiar water, and
- Gas, as water vapour.

1. EFFECT OF CHANGE OF TEMPARATURE

Increasing the temperature of solids, the kinetic energy of the particles increases.Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat overcomes the forces of attraction between the particles. The particles leave their fixed positions and start moving more freely. A stage is reached when the solid melts and is converted to a liquid. The minimum temperature at which a solid melts to become a liquid at the atmospheric pressure is called its **melting point**

- The melting point of ice is 273.15 K

The melting point of a solid is an indication of the strength of the force of attraction between its particles.

The process of melting, that is, change of solid state into liquid state is also known as **fusion**.

Supply heat energy to water, particles start moving even faster. At a certain temperature, a point is reached when the particles have enough energy to break free from the forces of attraction of each other. At this temperature the liquid starts changing into gas. The temperature at which a liquid starts boiling at the atmospheric pressure is known as its boiling point

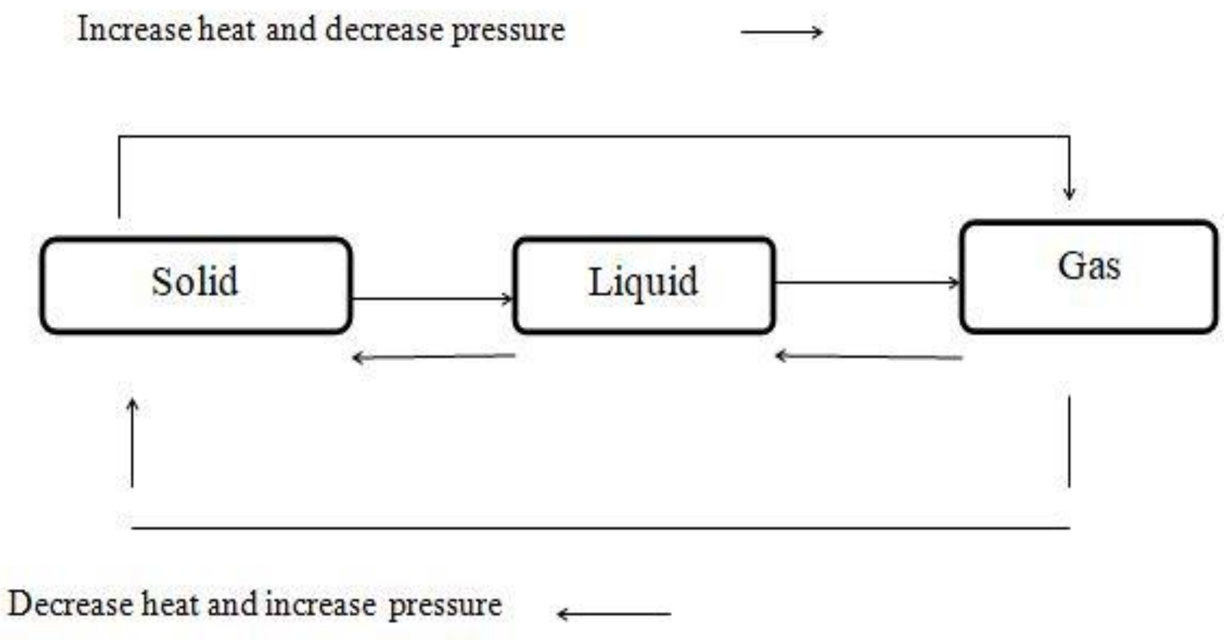
- State of matter can be changed into another state by changing the **temperature**

LATENT HEAT

The heat energy required to convert a solid into a liquid or vapour, or a liquid into a vapour, without change of temperature known as latent heat

2. EFFECT OF CHANGE OF PRESSURE

- Increasing or decreasing the pressure can change the state of matter
- Pressure and temperature determine the state of a substance, whether it will be solid, liquid or gas
- Gases can be liquefied by applying pressure and lowering temperature and liquid also convert to solid by applying the pressure and lowering the temperature



- Atmosphere (atm) is a unit of measuring pressure exerted by a gas
- The unit of pressure is Pascal (1 atmosphere = $1.01 * 10^5$ Pa)

Solid carbon dioxide

- It is stored under high pressure.
- Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere* without coming into liquid state. This is the reason that solid carbon dioxide is also known as dry ice

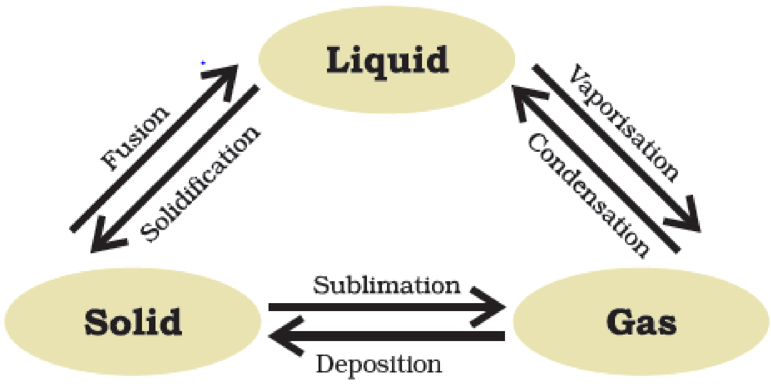
Sublimation & Deposition

A change of state directly from solid to gas without changing into liquid state is called sublimation and the direct change of gas to solid without changing into liquid is called deposition.

Evaporation

Evaporation is a surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.

Rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed.



Some measurable quantities and their units

Quantity	Unit
Temperature	Kelvin
Length	Metre
Mass	Kilogram
Weight	Newton
Volume	Cubic Metre
Density	kilogram per cubic metre
Pressure	Pascal

Now scientists are talking of five states of matter: Solid, Liquid, Gas, Plasma and BoseEinstein Condensate.

- **Plasma**: The state consists of super energetic and super excited particles. These particles are in the form of ionised gases. The fluorescent tube and neon sign bulbs consist of plasma. Inside a neon sign bulb there is neon gas and inside a fluorescent tube there is helium gas or some other gas. The gas gets ionised, that is, gets charged when electrical energy flows through it. This charging up creates a plasma glowing inside the tube or bulb. The plasma glows with a special colour depending on the nature of gas. The Sun and the stars glow because of the presence of plasma in them. The plasma is created in stars because of very high temperature.
- **Bose-Einstein Condensate**: In 1920, Indian physicist Satyendra Nath Bose had done some calculations for a fifth state of matter. Building on his calculations, Albert Einstein predicted a new state of matter – the Bose-Einstein Condensate (BEC). In 2001, Eric A. Cornell, Wolfgang Ketterle and Carl E. Wieman of USA received the Nobel prize in physics for achieving "Bose-Einstein condensation". The BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to super low temperatures.

IS MATTER AROUND US PURE

- Depending upon the chemical composition, matter is classified into elements, compounds and mixtures
- A mixture contains more than one substance mixed in any proportion
- Air is a mixture of nitrogen, oxygen, carbon dioxide, water vapour and other gases. Soil is a mixture of clay, sand and various salts. Milk, ice cream, rock salt, tea, smoke, wood, sea water, blood, tooth paste and paint are some other examples of mixtures. Alloys are mixtures of metals.
- Mixtures can be separated into pure substances using appropriate separation techniques

TYPES OF MIXTURES

1. Homogeneous mixture
2. Heterogeneous mixture

Homogeneous mixture

1. A mixture in which the components cannot be seen separately is called a homogeneous mixture.
2. It has a uniform composition and every part of the mixture has the same properties
3. Tap water, milk, air, ice cream, sugar syrup, ink, steel, bronze and salt solutions are homogeneous mixtures

Heterogeneous mixture

1. A mixture in which the components can be seen separately is called a heterogeneous mixture.
2. It does not have a uniform composition and properties.
3. Soil, a mixture of iodine and common salt, a mixture of sugar and sand, a mixture of oil and water, a mixture of sulphur and iron filings and a mixture of milk and cereals are heterogeneous mixture.

SOLUTIONS

- A solution is a homogeneous mixture of two or more substances. You come across various types of solutions in your daily life. Lemonade, soda water etc.

Aerated drinks like soda water etc., are gas in liquid solutions. These contain carbon dioxide (gas) as solute and water (liquid) as solvent.

- We can also have solid solutions (alloys) and gaseous solutions (air)
- The particles of a solution are smaller than 1 nm (10-9 metre) in diameter. So, they cannot be seen by naked eyes
- Because of very small particle size, they do not scatter a beam of light passing through the solution. So, the path of light is not visible in a solution
- The solute particles cannot be separated from the mixture by the process of filtration. The solute particles do not settle down when left undisturbed, that is, a solution is stable.
- A solution has a solvent and a solute as its components. The component of the solution that dissolves the other component in it (usually the component present in larger amount) is called the solvent. The component of the solution that is dissolved in the solvent (usually present in lesser quantity) is called the solute.
- The concentration of a solution is the amount of solute present per unit volume or per unit mass of the solution.

Alloys: Alloys are mixtures of two or more metals or a metal andanon-metal and cannot be separated into their components by physical methods. But still, an alloy is considered as a mixture because it shows the properties of its constituents and can have variable composition. For example, brass is a mixture of approximately 30% zinc and 70% copper.

SUSPENSION

- Materials that are insoluble in a solvent and have particles that are visible to naked eyes , form a suspension.

A suspension is a heterogeneous mixture.

- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The particles of a suspension can be seen by the naked eye.

COLLOIDS

- A colloid is a heterogeneous mixture.
- The size of particles of a colloid is too small to be individually seen by naked eyes.
- Colloids are big enough to scatter a beam of light passing through it and make its path visible.

- Tyndall effect can also be observed when a fine beam of light enters a room through a small hole. This happens due to the scattering of light by the particles of dust and smoke in the air

EXAMPLES OF COLLOIDS

Dispersed phase	Dispersing Medium	Type	Example
Liquid	Gas	**Aerosol**	Fog, clouds, mist
Solid	Gas	**Aerosol**	Smoke, automobile exhaust
Gas	Liquid	**Foam**	Shaving cream
Liquid	Liquid	**Emulsion**	Milk, face cream

Gas	Solid	**Foam**	Foam, rubber, sponge, pumice
Solid	Liquid	**Sol**	Milk of magnesia, mud
Liquid	Solid	**Gel**	Jelly, cheese, butter
Solid	Solid	**Solid Sol**	Coloured gemstone, milky glass

SEPARATING THE COMPONENTS OF A MIXTURE

- Separate the volatile component (solvent) from its non-volatile solute by the method of **evaporation.**

  Applications:

  1. Ink is a mixture of a dye in water

- **Centrifugation** is the process by which fine insoluble solids from a solid- liquid mixture can be separated in a machine called a centrifuge. A centrifuge rotates at a very high speed. On being rotated by centrifugal force, the heavier solid particles move down and the lighter liquid remains at the top.

  Applications:

  1. Used in diagnostic laboratories for blood and urine tests.
  2. Used in dairies and home to separate butter from cream.
  3. Used in washing machines to squeeze out water from wet clothes

- Separation of components of a mixture containing two miscible liquids that boil without decomposition and have sufficient difference in their boiling points this method is called **distillation**

  Applications:

  1. Salt water turned to fresh water using distillation process

- The **crystallization** method is used to purify solids. Crystallisation is a process that separates a pure solid in the form of its crystals from a solution.

  Applications:

  1. Purification of salt that we get from sea water.
  2. Separation of crystals of alum from impure samples.

- Chromatography is a separation technique. It is used to separate different components of a mixture based on their different solubilities in the same solvent

Applications

1. To separate colours in a dye
2. To separate pigments from natural colours
3. To separate drugs from blood.

HOMOGENEOUS & HETEROGENEOUS MIXTURE

Homogeneous mixture	**Heterogeneous mixture**
Consists of single phase	Consists of two or more phases
Has the same uniform appearance and composition	Has different non uniform appearance and composition
Components are unrecognizable	Components are recognizable
Examples: Air, saline solution and bitumen	Example: Sand, oil and water

Types of Pure Substances

On the basis of their chemical composition, substances can be classified either as elements or compounds.

ELEMENTS

- Robert Boyle was the first scientist to use the term element in 1661. Antoine Laurent Lavoisier (1743-94), a French chemist, was the first to establish an experimentally useful definition of an element. He defined an element as a basic form of matter that cannot be broken down into simpler substances by chemical reactions.
- Elements can be normally divided into metals, non-metals and metalloids
- Majority of the elements are solid.
- Eleven elements are in gaseous state at room temperature.

- Two elements are liquid at room temperature–mercury and bromine.
- Elements, gallium and cesium become liquid at a temperature slightly above room temperature (303 K).

COMPOUNDS

- A compound is a substance composed of two or more elements, chemically combined with one another in a fixed proportion.

ATOMS AND MOLECULES

- Antoine L. Lavoisier laid the foundation of chemical sciences by establishing two important laws of chemical combination.

LAW OF CONSERVATION OF MASS

Law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction.

LAW OF CONSTANT PROPORTIONS

This law was stated by **Proust** as "In a chemical substance the elements are always present in definite proportions by mass". This Law known as the Law of Definite Proportions or Law of definite proportions.

- British chemist John Dalton provided the basic theory about the nature of matter. Dalton picked up the idea of divisibility of matter, which was till then just a philosophy. He took the name 'atoms' as given by the Greeks and said that the smallest particles of matter are atoms. His theory was based on the laws of chemical combination. Dalton's atomic theory provided an explanation for the law of conservation of mass and the law of definite proportions.

According to Dalton's atomic theory

- All matter is made of very tiny particles called atoms, which participate in chemical reactions
- Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction
- Atoms of a given element are identical in mass and chemical properties.
- Atoms of different elements have different masses and chemical properties

ATOMS

- An atom is the smallest particle of an element that can take part in a chemical reaction
- Atomic radius is measured in nanometers.

$1/10^9$ m = 1 nm

1 m = 10^9 nm

- Hydrogen atom is smallest atom of all. Atomic radius of hydrogen atom is

  0.037×10^{-9}

Radii	**Example**
10^{-10}	Atom of hydrogen
10^{-9}	Molecule of water
10^{-8}	Molecule of hemoglobin
10^{-4}	Grain of sand
10^{-3}	Ant
10^{-1}	Apple

- Atoms of most elements are not able to exist independently. Atoms form molecules and ions. These molecules or ions aggregate in large numbers to form the matter that we can see, feel or touch.

ATOMIC MASS

- The most remarkable concept that Dalton's atomic theory proposed was that of the atomic mass. According to him, each element had a characteristic atomic mass.
- Atomic mass is defined as the mass of a single atom of a chemical element
- One atomic mass unit is a mass unit equal to exactly one-twelfth (1/12th) the mass of one atom of carbon-12. The relative atomic masses of all elements have been found with respect to an atom of carbon-12

ATOMIC MASS OF SOME ELEMENTS

Element	Atomic mass

Hydrogen	1
Carbon	12
Nitrogen	14
Oxygen	16
Sodium	23
Magnesium	24
Sulphur	32
Chlorine	35.5
Calcium	40

Avogadro constant

- The Avogadro constant 6.022×10^{23} is defined as the number of atoms in exactly 12 g of carbon-12.

MOLECULE

- A molecule is in general a group of two or more atoms that are chemically bonded together, that is, tightly held together by attractive forces. A molecule can be defined as the smallest particle of an element or a compound that is capable of an independent existence and shows all the properties of that substance. Atoms of the same element or of different elements can join together to form molecules.

MOLECULES OF ELEMENTS

- The molecules of an element are constituted by the same type of atoms. Molecules of many elements, such as argon (Ar), helium (He) etc. are made up of only one atom of that element. But this is not the case with most of the nonmetals. For example, a molecule of oxygen consists of two atoms of oxygen and hence it is known as a diatomic molecule, O_2 . If 3 atoms of oxygen unite into a molecule, instead of the usual 2, we get ozone, O_3 . **The number of atoms constituting a molecule is known as its atomicity.**

Atomicity of some elements	
Argon	Monoatomic
Helium	Monoatomic
Oxygen	Diatomic
Hydrogen	Diatomic
Nitrogen	Diatomic
Chlorine	Diatomic
Phosphorus	Tetra-atomic
Sulphur	Poly-atomic

MOLECULES OF COMPOUNDS

- Atoms of different elements join together in definite proportions to form molecules of compounds

Molecules of some compounds	
Compound	Ratio by Mass
Water (H_2O)	1:8
Ammonia (NH_3)	14:3
Carbon dioxide (CO_2)	3:8

The ratio by number of atoms for water is H:O = 2:1.

ION

- Compounds composed of metals and nonmetals contain charged species. The charged species are known as ions. Ions may consist of a single charged atom or a group of atoms that have a net charge on them.
- An ion can be negatively or positively charged. A negatively charged ion is called an 'anion' and the positively charged ion, a 'cation'. Take, for example, sodium chloride (NaCl). Its constituent particles are positively charged sodium ions (Na^+) and negatively charged chloride ions (Cl^-).

MOLECULAR MASS

- The molecular mass of a substance is the sum of the atomic masses of all the atoms in a molecule of the substance. It is therefore the relative mass of a molecule expressed in atomic mass units (u).

THE STRUCTURE OF AN ATOM

- J.J. Thomson was the first one to propose a Model for the structure of an atom.
- Thomson proposed that:
  (i) An atom consists of a positively charged sphere and the electrons are embedded in it.
  (ii) The negative and positive charges are equal in magnitude. So, the atom as a whole is electrically neutral
- Rutherford's model of the atom proposed that a very tiny nucleus is present inside the atom and electrons revolve around this nucleus. The stability of the atom could not be explained by this model
- Neils Bohr's model of the atom was more successful. He proposed that electrons are distributed in different shells with discrete energy around the nucleus. If the atomic shells are complete, then the atom will be stable and less reactive.
- Electron was discovered by JJ Thomson
- Proton was discovered by Rutherford

J.J. Thomson (1856- 1940), a British physicist, was born in Cheetham Hill, a suburb of Manchester, on 18 December 1856. He was awarded the Nobel prize in Physics in 1906 for his work on the discovery of electrons. He directed the Cavendish Laboratory at Cambridge for 35 years and seven of his research assistants subsequently won Nobel prizes.

RUTHERFORD'S ATOMIC MODEL

According to this model:

1. The atom contains large empty space.
2. There is a positively charged mass at the centre of the atom, known as nucleus.
3. The size of the nucleus of an atom is very small compared to the size of an atom.
4. The electrons revolve around the nucleus in close circular paths called orbits.
5. An atom as a whole is electrically neutral, i.e., the number of protons and electrons in an atom are equal.

E. Rutherford (1871-1937) was born at Spring Grove on 30 August 1871. He was known as the 'Father' of nuclear physics. He is famous for his work on radioactivity and the discovery of the nucleus of an atom with the gold foil experiment. He got the Nobel prize in chemistry in 1908.

BOHR'S MODEL OF AN ATOM

- In order to overcome the objections raised against Rutherford's model of the atom, Neils Bohr put forward the following postulates about the model of an atom:
    1. Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.
    2. While revolving in discrete orbits the electrons do not radiate energy.
- These orbits or shells are called energy levels

Neils Bohr (1885-1962) was born in Copenhagen on 7 October 1885. He was appointed professor of physics at Copenhagen University in 1916. He got the Nobel prize for his work on the structure of atom in 1922. Among Professor Bohr's numerous writings, three appearing as books are: (i) The Theory of Spectra and Atomic Constitution, (ii) Atomic Theory and, (iii) The Description of Nature.

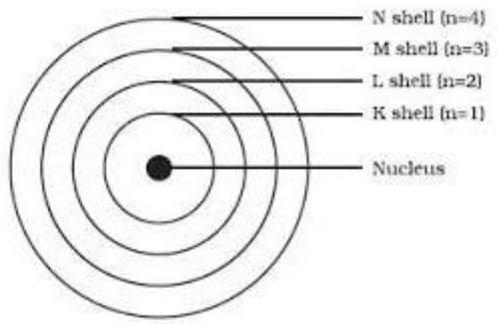
NEUTRONS

- J. Chadwick discovered the neutron
- Neutrons are present in the nucleus of all atoms, except hydrogen
- Mass of an atom equal to sum of the masses of protons and neutrons present in the nucleus

ELECTRONS DISTRIBUTED IN DIFFERENT ORBITS (SHELLS)

- Distribution of electrons into different orbits of an atom was suggested by Bohr and Bury.
- Maximum number of electrons present in a shell is given by the formula $2n^2$

  Where n=1,2,3,4,….
- These orbits or shells are represented by the letters K,L,M,N,…
- The maximum number of electrons that can be accommodated in the outermost orbit is 8.
- Electrons are not accommodated in a given shell, unless the inner shells are filled. That is, the shells are filled in a step-wise manner.



VALENCE ELECTRONS

- **Electrons** present in the outermost shell of an atom are known as the **valence electrons**
- The elements with same number of electrons in the valence shell show similar properties and those with different number of valence electrons show different chemical properties
- Elements, which have 1 or 2 or 3 valence electrons (except Hydrogen), are **metals**.
- Elements with 4 to 7 electrons in their valence shell are **non-metals**.

VALANCY

- Valency of an element is the combining capacity of the element with other elements and is equal to the number of electrons that take part in a **chemical reaction**
- Valency of the elements having valence electrons **1, 2, 3, 4 is 1, 2, 3, 4** respectively

- Valency of an element with **5, 6 and 7** valence electrons is **3, 2 and 1 (8–valence electrons)** respectively. Because 8 is the number of electrons required by an element to attain stable electronic configuration
- Elements having completely filled outermost shell show **Zero valency**

ATOMIC NUMBER

- Atomic number of an element is the same as the number of protons in the nucleus of its atom.

MASS NUMBER

- Mass number of an atom is equal to the number of protons and neutrons in a nucleus

ISOTOPES

- Two or more forms of an element having the same atomic number, but different mass number are called Isotopes ($_{17}Cl^{35}$, $_{17}Cl^{37}$).
- Many elements consist of a mixture of isotopes. Each isotope of an element is a pure substance. The chemical properties of isotopes are similar but their physical properties are different.
- **Applications**
    1. An isotope of uranium is used as a fuel in nuclear reactors.
    2. An isotope of cobalt is used in the treatment of cancer.
    3. An isotope of iodine is used in the treatment of goitre.

Isotopes of Hydrogen

- Hydrogen has three isotopes: protium, $_1H^1$, deuterium, $_1H^2$ or D and tritium, $_1H^3$ or T.
- These isotopes differ from one another in respect of the presence of neutrons. Ordinary hydrogen, protium, has no neutrons, deuterium (also known as heavy hydrogen) has one and tritium has two neutrons in the nucleus.
- In the year 1934, an American scientist, Harold C. Urey, got Nobel Prize for separating hydrogen isotope of mass number 2 by physical methods.
- Hydrogen is the first element in the periodic table

ISOBARS

- Atoms of different elements having the same mass number, but different atomic numbers are called Isobars ($_{18}Ar^{40}$, $_{20}Ca^{40}$).

ISOTONES

- Atoms of different elements having the same number of neutrons, but different atomic number and different mass number are called Isotones ($_6C^{13}$, $_7N^{14}$).

CARBON AND ITS COMPOUNDS

- All living structures are carbon based.
- Carbon is found both in free state as well as combined state in nature
- Earth's crust has only 0.02% carbon in the form of minerals like carbonates, hydro carbonates,coal and petroleum and the atmosphere has 0.03% of carbon dioxide. In spite of this small amount of carbon available in nature
- Both diamond and graphite are formed by carbon atoms. They are allotrope of carbon
- The gas/kerosene stove used at home has inlets for air so that a sufficiently oxygen-rich mixture is burnt to give a clean **blue flame**.
- If bottoms of cooking vessels getting blackened, it means that the air holes are blocked and fuel is getting wasted
- Cooking Gas mainly consist of **Butane**
- **Ethanol** is used as a fuel in cars along with petrol
- **Ethyl alcohol is** used as an antiseptic to sterilize wounds and syringes in hospitals
- **Methane** popularly known as marsh gas. Natural consists of over 90 percent methane and some amount of propane and butane
- **Paddy field** is biggest source of methane gas
- **Bio gas** consists of 55to 70 percent methane and 30 to 45 percent carbon
- **Ethylene** used for

    1. Preparation of mustard gas

2. Preservation and artificial ripening of green fruits

3. Manufacturing of PVC pipes

COVALENT BOND

- Carbon always have a covalent bond
- The bond formed by sharing of electrons between two atoms are known as covalent bond
- The boiling and melting points of the carbon compounds is low
- Most carbon compounds are poor conductors of electricity because they form covalent bond so it does not give rise to free electrons. All electrons are used in making the covalent bond
- **Graphite** is **a good conductor of heat and electricity** because it has free electrons

Melting & boiling points compounds of carbon

Compound	Formula	Melting point (K)	Boiling point (K)
Acetic acid	CH_3COOH	290	391
Chloroform	CHC_{l3}	209	334
Ethanol	CH_3CH_2OH	156	351
Methane	CH_4	90	111

Allotropes of carbon

- Allotropy is a property by which an element can exist in more than one form that are physically different and chemically similar. The different forms of that element are called its allotropes
- The element carbon occurs in different forms in nature with widely varying physical properties. Both diamond and graphite are formed by carbon atoms, the difference lies in the manner in which the carbon atoms are bonded to one another
- Carbon exists in different allotropic forms and based on their physical nature they are classified as below.

  Crystalline forms of Carbon

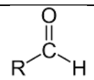
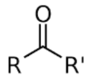
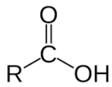
  1. Diamond

2. Graphite
3. Fullerene

Amorphous forms of carbon

1. Charcoal
2. coke
3. Lamp black
4. Gas carbon

SOME FUCTIONAL GROUPS OF CARBON COMPOUNDS

Hetero atom	Class of compounds	Formula of functional group
Cl/Br	Halo- (Chloro/bromo) Alkane	—Cl, —Br (substitutes for hydrogen atom)
Oxygen	1. Alcohol	—OH
	2. Aldehyde	
	3. Ketone	
	4. Carboxylic acid	

FORMULA OF SATURATED COMPOUNDS OF CARBON AND HYDROGEN’S

No of C atoms	Name	Formula
1	Methane	CH4

2	Ethane	C_2H_6
3	Propane	C_3H_8
4	Butane	C_4H_{10}
5	Pentane	C_5H_{12}
6	Hexane	C_6H_{14}
7	Heptane	C_7H_{16}
8	Octane	C_8H_{18}
9	Nonane	C_9H_{20}
10	Decane	$C_{10}H_{22}$

ETHANOL

- Ethanol is commonly known as alcohol. All alcoholic beverages and some cough syrups contain ethanol. Its molecular formula is C_2H_5OH
- Ethanol and ethanoic acid are carbon compounds of importance in our daily lives
- Ethanol is a liquid at room temperature. Ethanol is commonly called alcohol and is the active ingredient of all alcoholic drinks
- Ethanol is a colourless liquid, having a pleasant smell and a burning taste.
- Ethanol is used as an anti-freeze in automobile radiators
- Ethanol is used in medical wipes, as an antiseptic
- Ethanol is a good solvent, it is also used in medicines such as tincture iodine, cough syrups, and many tonics
- Ethanol is used for effectively killing microorganisms like bacteria, fungi, etc., by including it in many hand sanitizers.

Sugarcane plants are one of the most efficient convertors of sunlight into chemical energy. Sugarcane juice can be used to prepare molasses which is fermented to give alcohol (ethanol). Some countries now use alcohol as an additive in petrol since it is a cleaner fuel which gives rise to only carbon dioxide and water on burning in sufficient air (oxygen).

ETHANOIC ACID

- Ethanoic acid or acetic acid is one of the most important members of the carboxylic acid family. Its molecular formula is $C_2H_4O_2$.
- Ethanoic acid is commonly called acetic acid and belongs to a group of acids called carboxylic acids
- 5-8% solution of acetic acid in water is called vinegar and is used widely as a preservative in pickles.
- Ethanoic acid is used in printing on fabrics
- The melting point of pure **ethanoic acid is 290k** and hence it often **freezes during winter**. They look like glaciers, so it is called **glacial acetic acid**

SOAPS & DETERGENTS

- Soap is a sodium or potassium salt of long chain carboxylic acid
- Soap is effective only in soft water
- Detergent is ammonium or sulphonate salt of long chain of carboxylic acid
- Detergent are effective both soft and hard water

ORGANIC COMPOUNDS IN DAILY LIFE

- Organic compounds are inseparable in human life
- Various classes of organic compounds and their uses in our daily life as follows:

  Hydrocarbons

  1. Fuels like LPG, Petrol, Kerosene.
  2. Raw materials for various important synthetic materials.
  3. Polymeric materials like tyre, plastic containers.

  Alcohols

  1. As a solvent and an antiseptic agent.
  2. Raw materials for various important synthetic materials.

  Aldehydes

1. Formaldehyde as a disinfectant.
2. Raw materials for synthetic materials.

Ketones

1. As a solvent.
2. Stain Remover.

PERIODIC CLASSIFICATION OF ELEMENTS

- In 1800, there were only 31 known elements. By 1865, their number became 63. Now 118 elements have been discovered.
- Presently, **118** elements are known. All these have different Properties. Out of these 118, only 94 are naturally occurring.
- All the elements are unique in their nature and property. To categorize these elements according to their properties, scientists started to look for a way.
- Scientists made several attempts to classify elements according to their properties Such as Newlands Law of Octaves, Dobereiner triads Law and Mendeleev

DOBEREINER'STRIADS LAW

- He tried to arrange the elements with similar properties into groups. He identified some groups having three elements each. So he called these groups 'triads' Dobereiner showed that when the three elements in a triad were written in the order of increasing atomic masses. The atomic mass of the middle element was roughly the average of the atomic masses of the other two elements
- **Example**: In the triad group (1), arithmetic mean of atomic masses of 1st and 3rd elements, (6.9 + 39.1)/2 = 23. So the atomic mass of Na (middle element) is 23.

Limitations

- Dobereiner could identify only three triads from the elements known at that time and all elements could not be classified in the form of triads. „
- The law was **not applicable** to elements having **very low and very high atomic mass.**

Newlands Law of Octaves

- In 1866, John Newlands arranged **56 known elements** in the increasing order of their atomic mass.

- He started with the element having the lowest atomic mass (hydrogen) and ended at thorium which was the **56th** element. He found that every eighth element had properties similar to that of the first. This arrangement was known as **'law of octaves'**
- Law of Octaves was applicable only upto calcium, as after calcium every eighth element did not possess properties similar to that of the first.
- Newlands' Law of Octaves worked well with lighter elements only
- Newlands' table was restricted to only 56 elements and did not leave any room for new elements

Mendeleev periodic table

- At the time of Mendeleev started his work, **63** elements were known. He examined the relationship between the atomic masses of the elements and their physical and chemical properties
- He observed that most of the elements got a place in a Periodic Table and were arranged in the order of their increasing atomic masses
- Mendeleev's Periodic Table contains vertical columns called 'groups' and horizontal rows called 'periods'
- It has eight vertical columns called 'groups' and seven horizontal rows called 'period'.

Limitations

- The increasing order of atomic mass was not strictly followed throughout.
  Eg. Co & Ni, Te & I.
- No place for isotopes in the periodic table
- No proper position could be given to the element hydrogen. Non-metallic hydrogen was placed along with metals like lithium (Li), sodium (Na) and potassium (K).

Modern Periodic Table

- Elements are arranged in order of **increasing atomic number**
- Modern Periodic Law can be stated as follows "The chemical and physical properties of the elements are the periodic functions of their atomic numbers". Based on the modern periodic law, the modern periodic table is derived
- Modern Periodic Table has 18 vertical columns known as groups and 7 horizontal rows known as 'periods'.
- Elements present in any one group have the same number of valence electrons

- The valence of an element is determined by the number of valence electrons present in the outermost shell of its atom
- **Metals** are found on the **left-hand side** of the Periodic Table
- **Non-metals** are found on the **right-hand side** of the Periodic Table
- Modern Periodic Table, a zig-zag line separates metals from non-metals. The borderline elements boron, silicon, germanium, arsenic, antimony, tellurium and polonium are intermediate in properties and are called **metalloids**
- **Halogens** are located on the 17^{th} group on the periodic table
- **Noble gases** are located on the 18^{th} group on the periodic table
- Based on the physical and chemical properties of elements, they are grouped into various families.

Groups in modern periodic table

Group 1	Alkali metals
Group 2	Alkaline earth metals
Group 3 o 12	Transition metals
Group 13	Boron Family
Group 14	Carbon Family
Group 15	Nitrogen Family
Group 16	Oxygen Family (or) Chalcogen Family
Group 17	Halogens
Group 18	Noble gases

Period ↓ / Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

Lanthanides	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
Actinides	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Modern Periodic Table

Position of hydrogen in the periodic table

- Hydrogen is the lightest, smallest and first element of the periodic table. Its electronic configuration (1s1) is the simplest of all the elements.
- It occupies a unique position in the periodic table. It behaves like alkali metals as well as halogens in its properties
- In the periodic table, it is placed at the top of the alkali metals.
  1. Hydrogen can lose its only one electron to form a hydrogen ion (H+) like alkali metals.
  2. It can also gain one electron to form the hydride ion (H-) like halogens.
  3. Alkali metals are solids while hydrogen is a gas
- The position of hydrogen in the modern periodic table is still under debate as the properties of hydrogen are unique.

Position of Noble gases in the periodic table

- The elements Helium, Neon, Argon, Krypton, Xenon and Radon of group 18 in the periodic table are called as Noble gases or Rare gases. They are monoatomic gases and do not react with other substances easily, due to completely filled subshells. Hence they are called as inert gases. They are found in very small quantities and hence they are called as rare gases.

ATOMIC NUMBERS

Atomic number	Symbol	Elements
1	H	Hydrogen
2	He	Helium
3	Li	Lithium
4	Be	Beryllium
5	B	Boron
6	C	Carbon
7	N	Nitrogen
8	O	Oxygen
9	F	Fluorine
10	Ne	Neon
11	Na	Sodium
12	Mg	Magnesium
13	Al	Aluminum
14	Si	Silicon
15	P	Phosphorus
16	S	Sulfur
17	Cl	Chlorine
18	Ar	Argon
19	K	Potassium
20	Ca	Calcium
21	Sc	Scandium
22	Ti	Titanium
23	V	Vanadium
24	Cr	Chromium
25	Mn	Manganese
26	Fe	Iron
27	Co	Cobalt
28	Ni	Nickel
29	Cu	Copper

30	Zn	Zinc
31	Ga	Gallium
32	Ge	Germanium
33	As	Arsenic
34	Se	Selenium
35	Br	Bromine
36	Kr	Krypton
37	Rb	Rubidium
38	Sr	Strontium
39	Y	Yttrium
40	Zr	Zirconium
41	Nb	Niobium
42	Mo	Molybdenum
43	Tc	Technetium
44	Ru	Ruthenium
45	Rh	Rhodium
46	Pd	Palladium
47	Ag	Silver
48	Cd	Cadmium
49	In	Indium
50	Sn	Tin
51	Sb	Antimony
52	Te	Tellurium
53	I	Iodine
54	Xe	Xenon
55	Cs	Cesium
56	Ba	Barium
57	La	Lanthanum
58	Ce	Cerium
59	Pr	Praseodymium

60	Nd	Neodymium
61	Pm	Promethium
62	Sm	Samarium
63	Eu	Europium
64	Gd	Gadolinium
65	Tb	Terbium
66	Dy	Dysprosium
67	Ho	Holmium
68	Er	Erbium
69	Tm	Thulium
70	Yb	Ytterbium
71	Lu	Lutetium
72	Hf	Hafnium
73	Ta	Tantalum
74	W	Tungsten
75	Re	Rhenium
76	Os	Osmium
77	Ir	Iridium
78	Pt	Platinum
79	Au	Gold
80	Hg	Mercury
81	Tl	Thallium
82	Pb	Lead
83	Bi	Bismuth
84	Po	Polonium
85	At	Astatine
86	Rn	Radon
87	Fr	Francium
88	Ra	Radium
89	Ac	Actinium

90	Th	Thorium
91	Pa	Protactinium
92	U	Uranium
93	Np	Neptunium
94	Pu	Plutonium
95	Am	Americium
96	Cm	Curium
97	Bk	Berkelium
98	Cf	Californium
99	Es	Einsteinium
100	Fm	Fermium
101	Md	Mendelevium
102	No	Nobelium
103	Lr	Lawrencium
104	Rf	Rutherfordium
105	Db	Dubnium
106	Sg	Seaborgium
107	Bh	Bohrium
108	Hs	Hassium
109	Mt	Meitnerium
110	Ds	Darmstadtium
111	Rg	Roentgenium
112	Cn	Copernicium
113	Nh	Nihonium
114	Fl	Flerovium
115	Mc	Moscovium
116	Lv	Livermorium
117	Ts	Tennessine
118	Og	Oganesson

COAL AND PETROLEUM

- Coal, petroleum and natural gas are fossil fuels.
- Fossil fuels were formed from the dead remains of living organisms millions of years ago.

Inexhaustible Natural Resources: These resources are present in unlimited quantity in nature and are not likely to be exhausted by human activities. Examples are: sunlight, air.

Exhaustible Natural Resources: The amount of these resources in nature is limited. They can be exhausted by human activities. Examples of these resources are forests, wildlife, minerals, coal, petroleum, natural gas etc.

COAL

- It is as hard as stone and is black in colour
- Coal is processed in industry get some useful products such as coke, coal tar and coal gas
- Coke is a tough, porous and black substance. It is an almost pure form of carbon. Coke is used in the manufacture of steel and in the extraction of many metals.
- Coal Tar is a black, thick liquid with an unpleasant smell. Products obtained from coal tar are used as starting materials for manufacturing various substances used in everyday life and in industry, like synthetic dyes, drugs, explosives, perfumes, plastics, paints, photographic materials, Roofing materials.
- Coal gas is obtained during the processing of coal to get coke
- Different types of coals are peat, lignite, bituminous, and anthracite
- Anthracite is one of variety of coal contains the highest percentage of carbon
- Lignite coal is called brown coal, is the lowest grade coal with the least concentration of carbon

Petroleum and Natural Gas

- Petrol and diesel are obtained from a natural resource called petroleum. Petroleum is a mixture of Hydrocarbon

- Petroleum is a dark oily liquid. It has an unpleasant odour. It is a mixture of various constituents such as petroleum gas, petrol, diesel, lubricating oil, paraffin wax, etc.
- The process of separating the various constituents/ fractions of petroleum is known as refining
- Petroleum was formed from organisms living in the sea. As these organisms died, their bodies settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum and natural gas.
- Natural gas is a very important fossil fuel because it is easy to transport through pipes.
- Natural gas is stored under high pressure as compressed natural gas (CNG). CNG is used for power generation. It is a cleaner fuel.
- Many useful substances are obtained from petroleum and natural gas. These are termed as 'Petrochemicals'. These are used in the manufacture of detergents, fibres (polyester, nylon, acrylic etc.), polythene and other man-made plastics. Hydrogen gas obtained from natural gas, is used in the production of fertilisers (urea). Due to its great commercial importance, petroleum is also called 'black gold'.

The world's first oil well was drilled in Pennsylvania, USA, in 1859. Eight years later, in 1867, oil was struck at Makum in Assam. In India, oil is found in Assam, Gujarat, Mumbai High and in the river basins of Godavari and Krishna.

Constituents of Petroleum and their Uses below

Constituents of Petroleum	**Uses**
LPG	Fuel for home and industry
Petrol	Motor fuel, aviation fuel
Lubricating oil	Lubrication

Paraffin wax	Ointments, candles, Vaseline
Bitumen	Paints, road surfacing
Kerosene	Fuel for stoves, lamps and jet aircrafts

ACIDS, BASES AND SALTS

- **Acids** are **sour** in taste and change the colour of **blue litmus** to **red**, whereas, **bases** are **bitter** and change the colour of the **red litmus** to **blue**
- Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain acids. The chemical nature of such substances is acidic.
- An acid and a base neutralize each other and form a salt and water. A salt may be acidic, basic or neutral in nature.
- Special types of substances are used to test whether a substance is acidic or basic. These substances are known as indicators. The indicators change their colour when added to a solution containing an acidic or a basic substance. Turmeric, litmus, China rose petal are some of the naturally occurring indicators.
- The solutions which do not change the colour of either red or blue litmus are known as neutral solutions. These substances are neither acidic nor basic.

LITMUS

- Litmus solution is a purple dye, which is extracted from lichen, a plant belonging to the division **Thallophyta**, and is commonly used as an indicator. When the litmus solution is neither acidic nor basic, its colour is purple. There are many other natural materials like red cabbage leaves, turmeric, coloured petals of some flowers such as Hydrangea, Petunia and Geranium, which indicate the presence of acid or base in a solution. These are called acid-base indicators or sometimes simply indicators.

ACIDS

- Acidic nature of a substance is due to the formation of $H+$ ions in solution
- When an acid reacts with a metal, hydrogen gas is evolved and a corresponding salt is formed

  Acid + Metal → Salt + Hydrogen gas

- Some metals do not react with acid and liberate hydrogen gas. Example: Ag, Cu.
- When an acid reacts with a metal carbonate or metal hydrogen carbonate, it gives the corresponding salt, carbon dioxide gas and water
  $Na_2 CO_3 + 2HCl \rightarrow 2NaCl + H_2 O + CO2$
  $NaHCO_3 + HCl \rightarrow NaCl + H_2 O + CO2$
- Acidic solutions in water conduct electricity because they produce hydrogen ions
- Acid is a molecule or ion which is capable of donating proton
- An acid is a substance which can accept the electron
- **Some naturally occurring acids**

Natural source	**Acid**
Vinegar	Acetic acid
Orange	Citric acid
Spinach	Oxalic acid
Tomato	Oxalic acid
Sour milk (Curd)	Lactic acid
Lemon	Citric acid
Ant sting	Formic acid
Nettle sting	Formic acid
Apple	Malic acid
Amla, Citrus fruits	Ascorbic acid
Tamarind, grapes, unripe mangoes, etc.	Tartaric acid

Note

- The atmosphere of Venus is made up of thick white and yellowish clouds of sulphuric acid
- The accidental touch of Nettle leaves creates a pain and burning sensation, which is due to inject of Methanoic acid into the skin of the person

BASE

- Basic nature of a substance is due to the formation of OH- ions in solution
- Bases react with metals to form salt with the liberation of hydrogen gas.

  $Zn + 2\ NaOH \rightarrow Na_2\ ZnO_2 + H_2 \uparrow$
- Bases react with acids to form salt and water. The reaction between a base and an acid is known as Neutralisation reaction

  $KOH + HCl \rightarrow KCl + H_2O$
- In neutralisation reaction a new substance is formed. This is called salt. Salt may be acidic, basic or neutral in nature.
- Basic solution in water conduct electricity because they produce hydroxide ions
- Base is a molecule or ion which is capable of accepting proton
- An base is a substance which can produce the electron

Name of base	**Found in**
Calcium hydroxide	Lime water
Ammonium hydroxide	Window cleaner
Sodium hydroxide/Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

- The process of dissolving an acid or a base in water is a highly exothermic one.
- Mixing an acid or base with water results in decrease in the concentration of ions (H_3O^+/OH^-) per unit volume. Such a process is called dilution and the acid or the base is said to be diluted.

HOW STRONG ARE ACIDS AND BASE SOLUTIONS

- A scale for measuring hydrogen ion concentration in a solution is called pH scale. The ‘p’ in pH stands for ‘potenz’ in German meaning power. pH scale is a set of numbers from 0 to 14 which is used to indicate whether a solution is acidic, basic or neutral
- The pH of a neutral solution is 7. Values less than 7 on the pH scale represent an acidic solution. As the pH value increases from 7 to 14, it represents an increase in OH– ion concentration in the solution, that is, increase in the strength of alkali
  1. Acids have pH less than 7
  2. Bases have pH greater than 7
  3. A neutral solution has pH equal to 7
- Strength of acids and bases depends upon the number of H+ ions and OH– ions produced, respectively. If we take hydrochloric acid and acetic acid of the same concentration, say one molar, then these produce different amounts of hydrogen ions. Acids that give rise to more H+ ions are said to be strong acids, and acids that give less H+ ions are said to be weak acids.

Substances	**pH values**
Human blood	7.35-7.45
Pure water	7
Lemon juice	2.2
Gastric juice	1.2
Milk of magnesia	10
Human urine	6
Beers	4.5
Wines	2.8-3.8
Black coffee	5.2
Milk	6.5 – 6.7
Normal rain	5.6 - 6

Acid rain	4.2-4.4

IMPORTANCE OF PH IN EVERYDAY LIFE DAY LIFE

- Our body works within the pH range of 7.0 to 7.8. Living organisms can survive only in a narrow range of pH change
- When pH of rain water is less than 5.6, it is called acid rain. When acid rain flows into the rivers, it lowers the pH of the river water. The survival of aquatic life in such rivers becomes difficult.
- Tooth decay starts when the pH of the mouth is lower than 5.5. Tooth enamel, made up of **calcium hydroxyapatite** (a crystalline form of **calcium phosphate**) is the hardest substance in the body. It does not dissolve in water, but is corroded when the pH in the mouth is below 5.5. Using toothpastes, which are generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay
- It is very interesting to note that **our stomach produces hydrochloric acid**. It **helps in the digestion of food** without harming the stomach. During indigestion the stomach produces too much acid and this causes pain and irritation. To get rid of this pain, people use bases called **antacids**. These antacids neutralize the excess acid. Magnesium hydroxide (Milk of magnesia), a mild base, is often used for this purpose

USES OF ACIDS „

- **Sulphuric acid** is called **King of Chemicals** because it is used in the preparation of many other compounds. It is used in car batteries also.
- Hydrochloric acid is used as a cleansing agent in toilets.
- Carbonic acid is used in aerated drinks. „
- Tartaric acid is a constituent of baking powder
- Citric acid is used in the preparation of effervescent salts and as a food preservative. „
- Nitric acid is used in the manufacture of fertilizers, dyes, paints and drugs. „
- Oxalic acid is used to clean iron and manganese deposits from quartz crystals. It is also used as bleach for wood and removing black stains. „

USES OF BASES

- Sodium hydroxide is used in the manufacture of soap.
- Magnesium hydroxide is used as a medicine for stomach disorder.
- Ammonium hydroxide is used to remove grease stains from cloths.
- Calcium hydroxide is used in white washing of building.

SALTS

- Salt is the product of reaction between acids and bases.
- Salts of a strong acid and a strong base are neutral with pH value of 7. On the other hand, salts of a strong acid and weak base are acidic with pH value less than 7 and those of a strong base and weak acid are basic in nature, with pH value more than 7.
- Most of the salts are soluble in water. For example, chloride salts of potassium and sodium are soluble in water. But, silver chloride is insoluble in water
- Salt is hygroscopic in nature.

USES OF SALTS

COMMON SALT (SODIUM CHLORIDE - NaCl)

- It is used in our daily food and used as a preservative.

BLEACHING POWDER ($CaOCl_2$)

- For bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories and for bleaching washed clothes in laundry.
- Oxidizing agent in many chemical industries.
- To make drinking water free from germs.

BAKING SODA ($NaHCO_3$)

- The baking soda is commonly used in the kitchen for making tasty crispy pakoras, etc. Sometimes it is added for faster cooking

- Baking soda is also an ingredient in antacids. Being alkaline, it neutralizes excess acid in the stomach and provides relief.
- It is also used in soda-acid fire extinguishers

WASHING SODA ($Na_2CO_3.10H_2O$)

- Sodium carbonate (washing soda) is used in glass, soap and paper industries.
- It is used in the manufacture of sodium compounds such as borax.
- Sodium carbonate can be used as a cleaning agent for domestic purposes.
- It is used for removing permanent hardness of water.

PLASTER OF PARIS ($CaSO_4$ .1/2 H_2O)

- Plaster of Paris, the substance which doctors use as plaster for supporting Structured bones in the right position.
- Plaster of Paris is used for making toys, materials for decoration and for making surfaces smooth

> On heating gypsum at 373 K, it loses water molecules and becomes calcium sulphate hemihydrate. This is called Plaster of Paris.

GYPSUM (CaSO4 .2H2O)

- Manufacture of wallboard, cement, plaster of Paris, soil conditioning, a hardening retarder in Portland cement

METALS & NON-METALS

- Metals are lustrous whereas non-metals have no lustre. Metals are malleable and ductile. Non-metals do not have these properties.
- Metals are good conductors of heat and electricity but non-metals are poor Conductors.
- On burning, metals react with oxygen to produce metal oxides which are basic in nature. Non-metals react with oxygen to produce non- metallic oxides which are acidic in nature.
- Some metals react with water to produce metal hydroxides and hydrogen gas. Generally, non-metals do not react with water.

- **Metals** react with acids and produce metal salts and **hydrogen gas**. Generally, **non-metals** do not react with **acids**.
- Some metals react with bases to produce hydrogen gas.

METALS

- Metals, in their pure state, have a shining surface. This property is Called metallic lustre.
- The property of metals by which they can be beaten into thin sheets is called malleability.
- Metals can be beaten into thin sheets. This property is called malleability. **Gold and silver are most malleability metal.**
- Ability of metals to be drawn into thin wires is called ductility. **Gold is the most ductile metal.** You will be surprised to know that a wire of about 2 km length can be drawn from one gram of gold.
- Metals are good conductors of heat and have high melting points. The best conductors of heat are **silver and copper**. Lead and mercury are comparatively poor conductors of heats
- Metals are good conductors of electricity. The **best conductors of electricity is silver**
- Since metals produce ringing sounds, they are said to be sonorous. The materials other than metals are not sonorous.
- When an **acid reacts with a metal, hydrogen gas** is evolved and a corresponding salt is formed

  Acid + Metal → Salt + Hydrogen gas
- All metals except **mercury exist as solids at room temperature**
- **Gallium and cesium have very low melting points.** These two metals will melt if you keep them on your palm
- Alkali metals **(lithium, sodium, potassium)** are so soft that they can be **cut with a knife.** They have low densities and low melting points
- **Concentrated Acid:** It has relatively large amount of acid dissolved in a solvent.
- **Dilute Acid:** It has relatively smaller amount of acid dissolved in solvent.
- Almost all metals combine with oxygen to form metal oxides.

  Metal + Oxygen → Metal oxide

- All metals do not react with oxygen at the same rate. Different metals show different relativities towards oxygen. **Metals such as potassium and sodium react so vigorously**.
- **Metals such as potassium and sodium** react so vigorously that they catch fire if kept in the open. Hence, to protect them and to prevent accidental fires, they are kept immersed in **kerosene oil.**
- **Anodising** is a process of forming a thick oxide layer of aluminium. Aluminium develops a thin oxide layer when exposed to air. This aluminium oxide coat makes it resistant to further corrosion. The resistance can be improved further by making the oxide layer thicker.
- **Silver and gold do not react** with **oxygen** even at **high temperatures**

When a copper vessel is exposed to moist air for long, it acquires a dull green coating. The green material is a mixture of copper hydroxide ($Cu(OH)_2$) and copper carbonate ($CuCO_3$).

$$2Cu+H_2O+CO_2 +O_2 \rightarrow Cu\ (OH)_2 + CuCO_3$$

When Metals react with Water?

- Metals react with water and produce a metal oxide and hydrogen gas. Metal oxides that are soluble in water dissolve in it to further form metal hydroxide. But all metals do not react with water.

  Metal + Water → Metal oxide + Hydrogen

  Metal oxide + Water → Metal hydroxide
- Metals like **potassium and sodium** react **violently with cold water**. In case of sodium and potassium, the reaction is so violent and exothermic that the evolved hydrogen immediately **catches fire.**
- The **reaction of calcium** with water is **less violent.** The heat evolved is not sufficient for the hydrogen to catch fire. **Calcium starts floating** because the bubbles of hydrogen gas formed stick to the surface of the metal.
- **Magnesium does not react with cold water.** It reacts with hot water to form magnesium hydroxide and hydrogen. It also starts floating due to the bubbles of hydrogen gas sticking to its surface.
- Metals like aluminium, iron and zinc do not react either with cold or hot water. But they react with steam to form the metal oxide and hydrogen.

- Metals such as lead, copper, silver and gold do not react with water at all

When Metals react with Acids?

- Metals react with acids to give a salt and hydrogen gas.

  Metal + Acid → Salt + Hydrogen
- **Hydrogen gas is not evolved** when a metal reacts with **nitric acid**. It is because HNO_3 is a strong oxidising agent. It oxidises the H_2 produced to water and itself gets reduced to any of the nitrogen oxides (N_2O, NO, NO_2). But magnesium (Mg) and manganese (Mn) react with very dilute HNO3 to evolve H2 gas.
- **Aqua regia** is a freshly prepared mixture of concentrated **hydrochloric acid** and concentrated **nitric acid** in the ratio of **3:1**. Aqua regia is a highly corrosive, fuming liquid. It is one of the few reagents that is able to dissolve **gold and platinum.** It is used for cleaning and refining gold.

The Reactivity Series

- The reactivity series is a list of metals arranged in the order of their decreasing activities

Symbol	Metal
Sk	Potassium
Na	Sodium
Ca	Calcium
Mg	Magnesium
Al	Aluminum
Zn	Zinc
Fe	Iron
Pb	Lead
H	Hydrogen
Cu	Copper
Hg	Mercury
Ag	Silver

Au	Gold

LIST OF METAL AND THEIR ORES

- Ores mined from the earth are usually contaminated with large amounts of impurities such as soil, sand, etc., called gangue. The impurities must be removed from the ore prior to the extraction of the metal. The processes used for removing the gangue from the ore are based on the differences between the physical or chemical properties of the gangue and the ore.

METALS	ORES
Sodium	Trona Borax Common salt
Aluminum	Bauxite
Potassium	Nitrate Carnalite
Magnesium	Magnesite Dolomite Epsom salt
Silver	Ruby silver Horn silver
Mercury	Cinnabar
Tin	Cassiterite
Lead	Galena
Gold	Calaverite Silvenites

Calcium	Dolomite Gypsum Fluorspar Asbestos
Iron	Haemethite Magnetite
Bismuth	Bismuthate

Refining of Metals

- The most widely used method for refining impure metals is electrolytic refining.
- Many metals, such as copper, zinc,tin, nickel, silver, gold, etc., are refined electrolytically.

NON-METALS

- Examples of non-metals are carbon, sulphur, iodine, oxygen, hydrogen, etc.
- **Non-metals are either solids or gases except bromine which is a liquid at room temperature**
- Iodine is a non-metal but it is lustrous
- Carbon is a non-metal that can exist in different forms. Each form is called an allotrope.
- **Diamond, an allotrope of carbon**, is the hardest natural substance known and has a very high melting and boiling point.**Graphite**, another allotrope of carbon, is a conductor of electricity
- Non-metals produce acidic oxides when dissolve in water

CORROSION

- When a metal is attacked by substances around it such as moisture, acids, etc., it is said to corrode and this process is called corrosion. The **black coating on silver** and the **green coating on copper** are other examples of corrosion

PREVENTION OF CORROSION

- Rusting of iron can be prevented by painting, oiling, greasing, galvanizing , chrome plating, anodizing or making alloys
- **Galvanization** is a method of protecting steel and iron from rusting by coating them with a thin layer of **zinc**.

- The process of rusting can be represented by the following equation:

  Iron (Fe) + Oxygen (O_2 , from the air) + water (H_2O) → rust (iron oxide Fe_2O_3)

  For rusting, the presence of both oxygen and water (or water vapour) is essential.

- Stainless steel is made by mixing iron with carbon and metals like chromium, nickel and manganese. It does not rust.

ALLOYING

- Alloying is a very good **method of improving the properties of a metal.**
- Alloy is a homogeneous mixture of two or more metals, or a metal and a Non-metal.
- Iron is the most widely used metal. But it is never used in its pure state. This is because pure iron is very soft and stretches easily when hot. But, if it is **mixed with a small amount of carbon**, it becomes hard and strong. When iron is mixed with nickel and chromium, we get stainless steel, which is hard and does not rust.
- Pure gold, known as 24 carat gold, is very soft. It is, therefore, not suitable for making jewellery. It is alloyed with either silver or copper to make it hard. Generally, in India, 22 carat gold is used for making ornaments. It means that 22 parts of pure gold is alloyed with 2 parts of either copper or silver.

IMPORTANT ALLOYS

Alloy	**Combinations**
Solder	Lead and Tin
Brass	Copper and zinc
Stainless steel	Iron, Chromium and Nickel

Bronze	Copper and Tin
Invar	Iron and Nickel
Constantan	Copper and Nickel
Gun metal	Copper ,tin and zinc
Sterling silver	Silver and copper
German silver	Copper , zinc and Nickel

- An amalgam is an alloy of mercury.
- Electrical conductivity and melting point of an alloy is less than that of pure metals.
- Some alloys have lower melting point than pure metals (Example: Solder is an alloy of lead and tin which has lower melting point than each of the metals).
- Solder is used for welding electrical wires together.
- Alloys do not get corroded or get corroded to very less extent

COMBUSTION AND FLAME

- A chemical process in which a substance reacts with oxygen to give off heat is called **combustion**. The substance that undergoes combustion is said to be combustible. It is also called a fuel. The fuel may be solid, liquid or gas. Sometimes, light is also given off during combustion, either as a flame or as a glow.
- A good fuel is one which is readily available. It is cheap. It burns easily in air at a moderate rate. It produces a large amount of heat. It does not leave behind any undersirable substances. There is probably no fuel that could be considered as an ideal fuel.

The amount of heat energy produced on complete combustion of 1 kg of a fuel is called its calorific value. The calorific value of a fuel is expressed in a unit called kilojoule per kg (kJ/kg).

- The lowest temperature at which a substance catches fire is called its **ignition temperature.**
- The substances which have very low ignition temperature and can easily catch fire with a flame are called inflammable substances. Examples of inflammable substances are petrol, alcohol, Liquified Petroleum Gas (LPG) etc.

    - The most common fire extinguisher is water. But water works only when things like wood and paper are on fire. If electrical equipment is on fire, water may conduct electricity and harm those trying to douse the fire. Water is also not suitable for fires involving oil and petrol.
    - For fires involving electrical equipment and inflammable materials like petrol, carbon dioxide (CO_2) is the best extinguisher. CO_2 , being heavier than oxygen, covers the fire like a blanket. Since the contact between the fuel and oxygen is cut off, the fire is controlled. The added advantage of CO_2 is that in most cases it does not harm the electrical equipment

    - Unburnt carbon particles in air are dangerous pollutants causing respiratory problems.
    - Incomplete combustion of a fuel gives poisonous carbon monoxide gas. It is a very poisonous gas. It is dangerous to burn coal in a closed room. The carbon monoxide gas produced can kill persons sleeping in that room.
    - Combustion of most fuels releases carbon dioxide in the environment. Increased concentration of carbon dioxide in the air is believed to cause global warming.

        - Global warming is the rise in temperature of the atmosphere of the earth. This results, among other things, in the melting of polar glaciers, which leads to a rise in the sea level, causing floods in the coastal areas. Low lying coastal areas may even be permanently submerged under water.

    - Burning of coal and diesel releases sulphur dioxide gas. It is an extremely suffocating and corrosive gas. Moreover, petrol engines give off gaseous oxides of nitrogen. Oxides of sulphur and nitrogen dissolve in rain water and form acids. Such rain is called acid rain. It is very harmful for crops, buildings and soil.

IMPORTANT CHEMICAL AND ITS USES

Chemical name	Common name	Uses
Aluminium		Used in Heat resistant clothing, Cookware and manufacturing of aircraft
Acetic Acid	Vinegar	Cooking, baking and pickling
Acetylsalicylic Acid	Aspirin	Medical
Argon		Used in incandescent lighting equipment's such as Bulbs, CFLs
Ammonium Phosphate	Fertilizer	Used as a fertilizer in Agricultural
Aluminium potassium Sulphate	Alum	Used in Water Purification ,Some types of Toothpastes and Pickling Agent
Ammonium Nitrate		Fertilizers and Explosives
Bismuth		Fire detection systems and bullets
Calcium Carbonate	LimeStone	Marble, Limestone and Precipitated Chalk
Calcium oxide	Quicklime	Cement Production
Carbon		Graphite, Fossil Fuels, Clay, Charcoal and Diamond
Copper		Manufacturing of Electrical Wires & cables
Glycerin		Making of Skin Products
Ethanol		Antiseptic, Rocket Fuels, Fuel

		cells and Engine Fuel
Helium		Treating Asthma and Barcode Reading
Lithium		Portable Battery and Making of Optical devices
Mercury	Quicksilver	Barometers and Thermometer
Sodium Nitrate		Gunpowder making and treating of dentine hypersensitivity
Sulphuric acid	Vitriol	Electrolyte and Industrial Cleaning agent
Zinc		Galvanizing

CHEMISTRY ONE LINERS

- **Graphite** is used a lubricant in heavy machines
- **Aspirin** is obtained from latex tree
- Ionic compounds conduct electricity when dissolved in water and They are soluble in water and are also crystalline solids
- Father of modern chemistry is **Lavoisier**
- Cathode rays consists beam of **electrons**
- Nucleus of an atom consists of protons and neutrons
- Proton was discovered by **Rutherford**
- A swimmer finds it easier to swim in sea water than plain water because of sea water has **higher density**
- An electric iron has heating element made of **Nichrome**
- Heaviest naturally occurring element of periodic table **uranium**
- Pungent smell of garlic is due to a**sulphur** compound
- White phosphorous is stored under water because it is dangerously reactive in air

- **Mercury** is known as quick silver
- Red phosphorous present at the tip of the match stick
- **Magnesium** burns with dazzling white flame
- **Sodium benzoate** Is used as food preservative
- **Potassium** is used for the manufacturing of fertilizers
- **Fluorine** is the most electronegative element in of the periodic table
- **Francium** is the most electropositive element in of the periodic table
- Bhopal gas Tragedy of 1984 is related to **Methyl Isocyanate**
- A powerful eye irritate present in smog is **Peroxyacetyl nitrate**
- Plastic is type of polymer
- **Platinum** is known as white gold
- **Petroleum** is a mixture of Hydrocarbon
- Acetyl salicylic acid commonly used as a pain killer
- Iron is commonly used for making an electromagnet
- Halite commonly known as rock salt. Halite is the source of common salt
- **Xenon** is known as a stranger gas
- **Rayon** is known as a artificial silk
- Reinforced glass is used in bullet proof screens
- When quick lime is added to water heat is liberated
- Nail polish remover contains **Acetone**
- **Zeolite** is suitable for water purification
- Silicon used in the manufacture of high voltage insulators
- Chemical name of Green vitriol is **Iron sulphate**
- **Sodium silicate** is chemical name of quartz
- Camphor can easily be purified by the process of sublimation
- The National Chemical Laboratory is located in **Pune**
- Quick silver is another name of **mercury**

- Natural rubber is heated with sulphur in vulcanization process
- Titanium dioxideis the chemical name for marble
- Deep blue colour is imported to glass by the presenceof **Cobalt oxide**
- **Anthracite** is one of variety of coal contains the highest percentage of carbon
- **Henri Becquerel** discovered the radioactivity
- Cooking oil can be converted into vegetable ghee by the process of **Hydrogenation**
- **Silver iodide** is used to produce artificial rain
- Lightest element in the universe is **hydrogen**
- Germanium and silicon is most commonly used in semiconductors
- Silver nitrate is commonly used in voting ink .It is first used in india 1962 in mysore
- **Hydrogen** is the lowest density element and **Osmium** the highest density element
- Silver bromide is commonly used chemical in photography
- **Tungsten** has highest Melting and boiling point
- **Radon** is the heaviest gas
- **Hydrogen peroxide** is used to restore the colour of old oil paintings
- Ethylene Glycol is used in car radiators as it increases the freezing temperature
- Age of fossils and archeological excavation is determined by radioactive carbon (C-14)
- Non-stick utensil is made up of Teflon
- Gelatinused to prevent the melting of ice
- Ferric chloride is used to stop bleedingbecause it is a strong coagulant
- Barium is the responsible for green colour in fireworks
- Liquid hydrogen is used as a rocket fuel
- Fluorescent tube contains helium gas and neon gas
- Copper is the first metal used by man
- Titanium is called strategic metal
- Lithium is the lightest metal. It weighs about half as much as water
- Antacids drugs are used to productive relief burning sensation in stomach

- Backlites used in electrical insulator, switches, handles of cook wares
- Periodic table

Group 13	Boron family
Group 14	Carbon family
Group 15	Nitrogen family
Group 16	Chalcogen family
Group 17	Halogen family
Group 18	Group 18

- Element common to all acids is Hydrogen
- Balloons are filled withHelium
- Most abundant metal in earth's crust is Aluminium
- Carbon occur in the nature in purest form is Diamond
- Gelatineis used to avoid melting of ice
- Tooth enamel is made up of Calcium Phosphate
- **Calcium Phosphate** acid is used in soft drinks
- In the absence of air and under high temperature and pressure the dead organisms are converted into petroleum and natural gas
- Nuclear fuel in the sun is Helium
- Metal constituent of chlorophyll is Magnesium
- **Carbon dioxide** is responsible for the swelling of bread
- Kerosene is a mixture of **Aliphatic hydrocarbons**
- Most of the explosions in mines occurs due to mixing of **Methane with air**
- **Titanium** is known as Metal of Future
- Impurity present in ore is Gangue

- Paper is chemically **Cellulose**
- **Xenon** is also known as Stranger Gas
- **Butane** is used in cigarette lighters
- **Metals** are lustrous because they have free electrons
- Noble gases are **Colourless and Odourless**
- Petroleum is found in **Sedimentary Rocks**
- Lead pencil contains **Graphite**
- Platinum is called white Gold
- **Nickle** is used for the synthesis of Vanaspati Ghee
- Ammonia (NH3) is synthesized through Haber's process
- Ozone is allotrope of oxygen
- Cesium used in photoelectric cells which is used to convert sunlight into electricity
- **Calcium hydride** is used to prepare fire proof and water proof clothes
- During the process of rusting the weight of iron **Increases** increased due to the weight of oxygen which has combined with the iron
- Fuse wire is made up of Lead and Tin
- Gases used by sea divers for breathing are **Oxygen and Helium**
- **Ozone** blackens silver's shine
- Egg shell is made up of **Calcium Carbonate**
- Acid rain is caused when the air is polluted by Nitrous Oxide &Sulphur dioxide Gases
- Alum is used as a Water Purifier
- Electro negative elements are non-metal
- Lignite known as the brown goal
- Black lung disease occurs in people working in coal mines
- Lead pollutes big cities air.Sources of lead is emissions from motor vehicles and industrial sources
- Crook Glass is used to make sun glass
- Acetylsalicylic Acid commonly known as Aspirin

- Barium Hydroxide is known Baryta water
- Benzoic acid is one of the most common preservatives used in food processing industry
- Deuterium is Isotope of hydrogen
- Efficiency of the catalyst depends on its molecular state
- Mine explosions are mostly caused by mixing of Air and Methane
- Natural rubber is a polymer derived from Isoprene
- Iron Pyrite is known as Fools Gold
- Ozone is diamagnetic in nature
- Oxides of metals are alkaline
- Paraffin wax is Saturated hydrocarbon
- Mercury Vapour& Argon is filled inside a Tube light
- Vinegar is an aqueous solution of Acetic acid
- Bee Sting contains a Methanoic Acid
- A Photoelectric cell contains selenium metal
- Zinc Phosphide is used a Rat Poison
- Hydrogen was the first element to be produced after Big Bang
- The nature of saliva is acidic.
- Steel contains 0.1–2 percent carbon
- Commonly used medicine for typhoid is **chloromycetin**.
- The chemical that is used in making artificial rain is **silver nitrate**.
- Aqua regia is a mixture of HCI and NHO_3
- Hematite is ore of iron
- Acid is used to write on glass- Hydrochloric acid
- Calcium and magnesium ion cause hardness of water.
- Pencil “lead” is made up of – Graphite
- The hardest substance available on earth is Diamond
- Lavioser was the first person to classify elements into metals and non-metal.

- Copper and its alloys are natural antimicrobial material
- Dead organisms are transformed into petroleum and natural gas in **absence of air**
- Alum is commonly used in water purification
- Ozone is Allotrope of Oxygen
- Deuterium is Isotope of Hydrogen
- Biogas chiefly contains Methane
- **Carbon dioxide** is responsible for the swelling of bread
- Chemical name of Picric Acid is Tri Nitro Phenol
- Egg shell is made up of Calcium Carbonate ($CaCO_3$)
- Uses of isotopes

Iron 59	Anemia
Iodine 131	Goitre
Cobalt 60	Cancer
Carbon11	Brain scan