

## PERIODIC TABLE

- There are 116 elements known today, out of which 90 are naturally existing.
- The first man made element is Technetium (atomic no: 43)
- Promethium is also a man made element (atomic no: 63)
- Man made elements are known as **transuranics**.
- Modern Periodic Table is based on atomic number of elements.
- **Mendeleev's** Periodic Table is based on atomic weights.
- The father of periodic table is **Mendeleev**.
- The most common element in the universe - hydrogen.
- The most ionic compound is caesium fluoride.
- Most electronegative element is Fluorine.
- Most electropositive element is Francium (or Caesium).
- The element which shows highest electron affinity is chlorine.
- Noble gases are listed in group 18 of modern periodic table.
- Enemy of copper is Sulphur.
- Non-ferrous metal is Aluminium.
- White phosphorus is a strong poison. As it burns itself in the air it is preserved under water.
- Red phosphorus is non-poisonous - It is used in the manufacture of match boxes.
- The most abundant metal in earth's crust is *Aluminium*
- The most common element by weight in earth's crust is Oxygen.
- The most common element in the atmosphere - Nitrogen.

- The metal which regulates Blood Pressure in human beings is sodium.
- The metal related to arthritis is Potassium.
- The metal present in Insulin is zinc.
- Zinc is concentrated in the eyes of human beings.
- The most common halide by weight in earth's crust is Fluoride.
- Liquid metals at room temperature are Mercury, Gallium, Caesium, Francium.
- Liquid non-metal at room temperature is Bromine.
- The non-metal, which shows electric conductivity Graphite (Carbon)
- The natural element having highest atomic weight is - Uranium.
- The element with highest melting point is Carbon (diamond) (4000K)



### The father of periodic table

Dmitri Ivanovich Mendeleev was a Russian chemist and inventor. He is credited as being the creator of the first version of the periodic table of elements.

- The metal with highest melting point is **Tungsten**. (3868K)
- The most harmful metal to human beings is Lead.
- Lead has poorest electrical conductivity, silver has highest electrical and thermal conductivity.
- The lightest and simplest element (gas) - hydrogen.
- Metals kept under kerosene are Sodium, Potassium, Caesium etc.
- Iodine is also kept under kerosene.
- The lightest metal element - lithium
- The heaviest gaseous element - radon
- The heaviest (densest) element - osmium
- Most stable element - Lead
- Lithium is kept by covering with paraffin wax.

## METALS AND METALLURGY

- Metallurgy is the various process involved in the extraction of metal from its ores.
- Ore is the mineral from which the metal is conveniently and economically extracted
- Ore has definite composition (formula)
- Clay is the mineral of Aluminium.
- Bauxite and cryolite are the main ores of Aluminium.
- Sulphide ores are purified by Froth-floatation process.
- Tinstone, Pyrolusite etc are purified by magnetic separation.
- **Calcination** is the process of heating the ore below its

Metal	Ore
1. Aluminium	Bauxite
2. Iron	Haematite, Magnetite, Iron pyrites
3. Copper	Copper pyrites, copper glance, malachite
4. Zinc	Zinc blend, calamine
5. Uranium	Pitch blend, Carnotite
6. Thorium	Monozite
7. Lead	Galena, Litharge, Cerussite
8. Magnesium	Magnesite
9. Sodium	Rock salt (Halite)
10. Antimony	Stibnite
11. Manganese	Pyrolusite
12. Chromium	Chromite
13. Nickel	Garnierite, pentlandite
14. Titanium	Rutile
15. Silver	Argentite, Pyrargyrite, Stephanite, Born silver
16. Mercury	Cinnabar
17. Lithium	Petalite, Lepidolite
18. Potassium	Carnallite, Sylvine kainite
19. Calcium	Gypsum, Limestone, Dolomite, Fluorspar
20. Barium	Barite
21. Zinc	Zincite, Sphalerite
22. Tin	Cassiterite

### Important minerals and major places in India

**Nitre (Potassium)**

Bengal & Haryana

**Magnesite, Dolomite (Magnesium)**

Tamil Nadu

**Gypsum, Limestone (Calcium)**

Rajasthan, Tamil Nadu, J & K, M.P.

**Bauxite (Aluminium)**

Orissa, Tamil Nadu, J & K

**Tinstone (Tin)**

Bihar, Orissa

**Chromite (Chromium)**

Bihar, Karnataka, Orissa, Tamil Nadu.

**Pyrolusite (Manganese)**

Bihar, Maharashtra, Karnataka.

**Haematite (Iron)**

Bihar, Karnataka

**Cobaltite (Cobalt)**

Rajasthan

**Copper pyrites (Copper)**

Bihar, M.P, Orissa

**Native Gold (Gold)**

Karnataka, A.P

**Zinc Blende (Zinc)**

Rajasthan

melting point in absence of air to remove volatile impurities like, Arsenic etc.

- **Roasting** is the process in which the ore is heated below its melting point in presence of air to oxidise the impurities. eg: Carbon, Sulphur etc removed as their gaseous oxides.
- **Gangue** is the impurity present in the ore.
- Generally gangue is silica.
- Flux is the substance used to neutralise and remove gangue as slag.
- Acidic flux is silica.
- Basic flux is limestone.
- Metals extracted from sea-water are magnesium and sodium.
- Metals generally accumulated

in Living Organisms ----- Vanadium, Potassium.

- Most abundant metal present in developed animals ..... Calcium.
- Most abundant element present in our body — oxygen.
- Most abundant compound present in animals ..... Water.
- Magnesium is concentrated in chloroplast.
- Major metals present in chloroplast are magnesium, manganese, copper and iron.
- Some elements behave chemically both as metals and non-metals. Such metals are called metalloids. Eg: Boron, Silicon, Germanium etc.
- Major elements present in sea-

water are chlorine, sodium, magnesium, sulphur, calcium, potassium, carbon etc.

- The halogens extracted from sea-water are chlorine and bromine.
- The atmosphere mainly consists of nitrogen (78.09%) and oxygen(20.95%)
- **Lithosphere** is the solid phase of the earth and is made of different types of rocks.
- Lithosphere is the major source of metals.
- Most abundant elements of earth's crust are silicon and oxygen - (about 75%)
- **Core** is the central portion of earth.

- **Metallic Core** valuable metals like Manganese, Iron, Cobalt, Nickel, Copper, Iridium, Platinum, Gold etc.
- **Sulphide Layer** contains phosphorus, sulphur, zinc, cadmium, tin, antimony, bismuth, lead, mercury etc.
- Most abundant metal present in blood is Potassium.
- The elements which lose electrons in chemical reaction are called metals.
- A metal is an electropositive element which is hard, lustrous, malleable, ductile with tensile strength, and a good conductor of heat and electricity.
- Metals form basic or amphoteric oxides.
- A non-metal is an electro negative element which occurs as solids, liquids and gases.. They are generally poor conductors of heat and electricity.
- Non-metallic solids are usually soft and brittle.
- Non-metals form acidic or neutral oxides.
- Silver is the best conductor of heat and electricity.
- Metals can be hammered into very thin sheets. This property is called malleability. Gold and silver are among the best malleable metals.
- The property of metals capable of being drawn into wires is known as ductility. Gold is the most ductile of all the metals.
- The metal, silver is an excellent reflector.
- Metals can be stretched to some degree without fractur-



**Georg Agricola**, author of *De re metallica*, an important early book on metal extraction

- ing. This is a measure of their *tensile strength*. Some metals like tungsten have very high tensile strength.
- Mercury and gallium are metals which are liquids at room temperature.
  - The hardest metal is *chromium*.
  - Heaviest metal occurring in nature is *uranium*.
  - The first known super conductor is *mercury*.
  - Metals like gold and copper are mostly found in old igneous rocks.
  - The metal which is least affected by the exposure to the atmosphere is *tin*.
  - Radium is used in the dials of clocks.
  - Cobalt is useful in making rust resistant alloys.
  - 'King of metal' is *gold*.
  - Silver, platinum and gold are known as noble metals.
  - Platinum metal occurs in its pure form in earth's crust.
  - Mercury flows so easily and rapidly that it is sometimes called quick silver.

- Metal present in the bath soap is potassium.
- Metals usually combine with oxygen to form basic oxides.
- The first metal to be used by man is *copper*.
- Some metals react with water. Sodium reacts violently even with cold water forming sodium hydroxide and hydrogen. Gold does not react even with steam.
- Some metals react with acid and replace the hydrogen atom in their molecules. Gold, Copper and silver are unaffected with hydrochloric acid.
- Mercury is the metal having lowest melting point ( $-39^{\circ}\text{C}$ ).
- Wrought iron is the purest type of iron that contains least amount of carbon.
- When iron rusts, its weight increases.
- Aluminium is the most abundant metal in the earth's crust.
- Extraction of metals from their ores and refining them for use is called metallurgy.
- Titanium is the metal of future.
- Sparkling and colour after the blast of fire cracker is due to the presence of strontium.
- Enamels are mixtures of silicates, backed on to iron or steel object.
- Iron coated with zinc is called galvanised iron and with tin is called tin - plate.
- Element extracted from monozite sand is thorium.
- White phosphorous is a strong poison.
- In high temperature thermometers, the space above the mercury column is filled with nitrogen to reduce its evaporation.

<b>Alloys</b>	<b>Constituent Metals</b>	<b>Uses</b>
1. Steel	Iron (Fe), Carbon (C)	Construction of ships, tanks, railway lines, bridges and machinery.
2. Aluminium, Bronze	Aluminium (Al), Copper (Cu)	To make coins, statues.
3. Invar	Iron (Fe), Nickel (Ni)	To make clock pendulum.
4. Bronze (Bell metal)	Copper (Cu) Tin (Sn)	Statues, Ornaments, coins, cooking utensils, bells and medals.
5. Alnico	Aluminium (Al), Nickel (Ni), Cobalt (CO), Iron (Fe)	To make magnets
6. Nichrome	Nickel (Ni), Chromium (Cr), Iron (Fe)	To make heating elements
7. Manganese Steel	Iron (Fe), Manganese (Mn)	To make rock driller, plates, rails, protecting shields etc.
8. Constantan	Copper (Cu), Nickel (Ni)	To make electrical instruments.
9. Brass	Copper (Cu), Zinc (Zn)	Utensils, parts of machinery, wires, musical instruments, Ornamental objects.
10. Duralumin	Aluminium (Al), Copper (Cu), Magnesium (Mg), Manganese (Mn)	aircraft parts
11. Magnesium	Aluminium (Al), Magnesium (Mg)	external parts of trolley, steamer etc.
12. Phosphor Bronze	Copper (Cu), Tin (Sn), Phosphorous (P)	Springs and suspension filament in electrical instruments.
13. Silumin	Aluminium (Al), Silicon (Si)	engine parts
14. Type metal	Copper (Cu), Lead (Pb), Tin (Sn), Antimony (Sb)	To make types in printing
15. Chrome Vanadium Steel	Iron (Fe), Chromium (Cr), Vanadium (V),	axles of motor cars
16. Sterling silver	Copper (Cu), Silver (Ag)	Silver coins
17. Coinage silver	Copper (Cu), Nickel (Ni)	Coins
18. Chrome Steel	Iron (Fe), Chromium (Cr)	Springs, tools etc
19. Gun metal	Copper (Cu), Zinc (Zn) Tin (Sn)	barrels of gun
20. Nickel steel	Iron (Fe), Nickel (Ni)	drills crankshaft bearings
21. German Silver	Copper (Cu), Nickel (Ni), Zinc (Zn)	Utensils, resistance wire etc
22. Stainless Steel	Iron (Fe), Chromium (Cr), Nickel (Ni)	Cooking utensils Cutlery, surgical instruments.
23. Solder	Lead (Pb), Tin (Sn)	Electrical connections

- ❑ White phosphorous is kept under water because it burns in air.
- ❑ The natural element which possess greater atomic weight is Uranium.
- ❑ The most common element in the atmosphere is nitrogen.
- ❑ Compounds of fluorine are used as cooling agents in refrigerators
- ❑ Fluorinated polymer, teflon, finds numerous uses as it is tough and fire- resistant.
- ❑ Chlorine, either as liquid chlorine or chlorine water, is used for bleaching.
- ❑ Chlorine is used as an oxidising agent.
- ❑ Chloroform is an anaesthetic, sodium hypochloride is an antiseptic, PVC is a plastic etc are compounds of chlorine.
- ❑ Rhombic sulphur is the most stable form of sulphur and exists at room temperature.
- ❑ Element stored in kerosene to prevent oxidation is sodium.
- ❑ The lightest and simplest element or gas is hydrogen.
- ❑ Most abundant metal on the earth crust is aluminium.
- ❑ The most common element by weight in earth's crust is oxygen.
- ❑ The lightest metal element - Lithium
- ❑ Commercially, aluminium is extracted from Bauxite through a combination of the Bayer's process and the Heroult - Hall process.
- ❑ Zinc is used in galvanisation and dry cells.
- ❑ Zinc, as a reducing agent, is used in the manufacture of

Materials are sometimes classified by the type of bonding present between the atoms:

**Ionic crystals, Covalent crystals, Metals, Inter-metallics, Semiconductors, Polymers, Composite materials, Vitreous materials**

**Metallurgy** – the study of metals and their alloys, including their extraction, microstructure and processing.

- perfumes and synthetic drugs.
- ❑ Pig Iron is used in the manufacturing of steel and cast iron.
- ❑ Phosphorous is used in the fertiliser industry.
- ❑ The element used to increase the hardness of rubber is sulphur.
- ❑ The heaviest gaseous element - Radon
- ❑ The heaviest or densest element - Osmium
- ❑ The most chemically active element - Fluorine
- ❑ The second most chemically active element is chlorine.
- ❑ Chlorine is used to kill germs in an indoor swimming pool.
- ❑ Chlorine is also used as a bleaching agent.
- ❑ Silicon is used for making integrated chips used in computers, wax, greases and polish.
- ❑ In noble gases, radon is not present in air.
- ❑ Neon is used for making advertising signs.
- ❑ Most stable element is lead.
- ❑ In a dry cell, zinc and carbon act as electrodes.

- ❑ The inert gas, which produces crimson glow when an electric discharge passes through it is, neon.
- ❑ In the Halogen family, iodine exists as a solid and bromine as a liquid.
- ❑ The element present in the largest amount in rocks and minerals is silicon.
- ❑ Metallurgy is the process of extracting metal, in a pure state on a large scale from its ore by physical and chemical means.
- ❑ Ores are commercially viable minerals.
- ❑ Minerals are solid, naturally occurring as deposits in the earth's crust and contain metals in the combined state, along with associated earthly impurities (gangue).
- ❑ Liquefaction is used to refine metals having a low melting point. eg: lead and tin.
- ❑ The method used for refining metals containing volatile impurities is oxidation.
- ❑ Distillation is used to refine volatile metals like mercury and zinc which contain non-volatile impurities.
- ❑ Electro - refining is an economical and effective method for purifying metals. eg: Cu, Al, Pb
- ❑ Flux is a chemical substance added to the ore during the extraction of metals by carbon reduction, which combines with the gangue and results in the formation of a fusible compound called slag.
- ❑ In extraction of iron, calcium carbonate acts as a flux.

- ❑ Malachite is the mineral of copper.
- ❑ The most plentiful mineral is felspar.
- ❑ Calamine is zinc carbonate.
- ❑ Monozite is an ore of thorium.
- ❑ Vermilion is made from the mercury ore, Cinnabar (Mercury-sulphide).
- ❑ Gold and platinum occur exclusively in free state.
- ❑ Copper, mercury and silver occur partly in free state.
- ❑ Most of the metals occur in the form of oxides, sulphides, carbonates, sulphates, chlorides and silicates.
- ❑ Tungsten has the highest melting point (metals).
- ❑ Silver is the best conductor of heat.
- ❑ Lead is the poorest conductor of heat.
- ❑ Osmium is the densest element.
- ❑ Tungsten has the highest boiling point of all the elements. Hence, it is used for filaments in electric bulbs.
- ❑ Cesium is used in atomic clocks.
- ❑ Pure silicon is a semi-conductor and is used in electronic devices as the base for minute integrated circuits (ICs).

### Alloys

- ❑ Alloys are generally made by mixing the metals in a molten state.
- ❑ Electrium is an alloy of gold and silver.
- ❑ Metals blended with other metallic or non-metallic substances.
- ❑ Diamond is the purest form of

crystalline rock.

- ❑ Amalgam is an alloy in which one of the components is mercury.
- ❑ Silunite is the commercial name of mica or asbestos which is used for making electrical insulators.
- ❑ Carborundum is used as an abrasive for cutting and grinding glasses.
- ❑ An alloy is homogenous mixture of a metal with other metals and non-metals.
- ❑ Alloys are generally harder and more resistant to corrosion.
- ❑ The properties of an alloy are different from those of the constituent metals.
- ❑ Duralumin is used for making aircraft parts.
- ❑ Pewter is an alloy of tin and lead.
- ❑ Sterling silver is an alloy of silver and copper.

### ACIDS

- ❑ Acids are substances which produces hydronium ion ( $H_3O^+$ ) in its aqueous solution.
- The major acid present in grapes is **Tartaric Acid**.
- ❑ *Oil of vitriol* is sulphuric acid.
- The acid present in vinegar is **acetic acid**.
- Oranges and lemons contain **citric acid**.
- Curd contains **lactic acid**.
- Old name of hydrochloric acid (HCl): **muratic acid**.
- Tamarind contains **tartaric acid**.
- Tea contains **tannic acid**.
- Urine contains **uric acid**.

- Ants contain **formic acid** in their body.
- Sulphuric acid is called the '**King of Chemicals**.'
- Sulphuric acid is mainly manufactured by *contact process*.
- The chemical name of aspirin is **acetylsalicylic acid**.
- The acid used in lead storage batteries is *sulphuric acid*.
- Earliest known acid is **acetic acid**.
- To purify gold, it should be treated with concentrated nitric acid.
- ❑ The acid that can be used as a hypnotic is **barbituric acid**
- Vitamin C is chemically ascorbic acid
- Dilute phenol is called Carboic Acid.
- Weakest (inorganic) acid is **Hydrocyanic Acid**.
- The acid functions as digesting agent in our body is hydrochloric acid.
- ❑ The acid which fumigates when exposed to air is **nitric acid**.
- Apple contains ascorbic acid and malic acid.
- Pure milk contains no acid but sour milk contains lactic acid.
- Boric acid is a mild antiseptic, used as a eye-lotion
- Cola contains phosphoric acid.
- Ordinary soda water is chemically Carbonic Acid.
- ❑ Sulphuric acid is used in the manufacture of dynamite (explosive).
- ❑ Sulphuric acid and nitric acid

are used in the manufacture of fertilizer, chemicals, explosives, paints etc.

- ❑ The acid used in tanning and printing industry is hydrochloric acid.
- ❑ Old name of nitric acid is Aquafortis.
- ❑ The acid which fumes in air is nitric acid.
- ❑ Benzoic acid is used for food preservation.
- ❑ Gastric juice contains hydrochloric acid
- ❑ Potassium hydroxide is used in alkaline batteries, sodium hydroxide in the manufacture of soap, calcium hydroxide in softening of hard water.

### Bases

- ❑ Oxides and hydroxides of metals (or metal like radicals) are called bases.

#### Sodium hydroxide:

Manufacture of soap.

#### Calcium hydroxide:

i) Manufacture of bleaching powder, mortar

ii) Softening of hard water,

iii) Neutralizing acid in the soil and in water supplies.

#### Potassium hydroxide:

Alkaline batteries.

#### Magnesium hydroxide:

As an antacid to neutralize acidity caused by hydrochloric acid in the stomach.

#### Aluminium hydroxide:

Foaming agent in fire extinguishers.

#### Ammonium hydroxide

Used to remove grease stains from clothes.

### Salts

- ❑ Salts are ionic compounds

1. **Sulphuric acid:** Manufacture of fertilizers, chemicals, explosives, paints, dyes and drugs.
2. **Nitric acid:** Also used in manufacture of fertilizers, chemicals, explosives, paints, dyes and drugs.
3. **Hydrochloric acid:** Tanning and printing industry.
4. **Citric acid:** In medicine (source of vitamin C), flavouring drinks.
5. **Boric acid:** As an eye-wash, preservation of grains.
6. **Acetic acid:** Flavouring food, food preservation.
7. **Benzoic acid:** Food preservation.
8. **Carbonic acid:** Lends 'fizz' to aerated drinks.
9. **Oxalic acid:** In ink-stain removers.
10. **Tartaric acid:** Constituent of baking powder (reacts with sodium bicarbonate to release carbon dioxide which makes the dough light and spongy).

containing a positive ion (cation) and a negative ion (anion).

- ❑ Sodium chloride (NaCl) is a normal salt.
- ❑ Hydrolysis is a reaction in which a salt reacts with water to form a solution which is either acidic or alkaline.
- ❑ Salts containing water of crystallisation are called hydrated salts.
- ❑ Hygroscopy is the property of salts to absorb atmospheric moisture at ordinary temperature without dissolving in it. Anhydrous calcium chloride, Conc. Sulphuric acid, Phosphorus pentoxide, Calcium oxide (quick lime), Silica gel, Alcohol are the examples of Hygroscopy substances.

### Solutions

- ❑ A solution is a homogenous mixture of two or more substances, whose composition can be varied within certain limits.
- ❑ The substances forming a solution are called components.

- ❑ The component present in larger quantity is called the solvent and the other one, the solute.
- ❑ The process of crystals depositing from a solution is called crystallisation.
- ❑ The finer the particles, the more is the solubility.
- ❑ The more the shaking or agitation, the more is the solubility.
- ❑ The higher the temperature, the greater is its solubility.

### Water

- ❑ Water is known as the 'Universal Solvent' because it is a remarkable solvent and dissolves many substances forming aqueous solutions.
- ❑ Water exists in all three states of matter.
- ❑ pH value of pure water is 7 and it is considered to be neutral.
- ❑ Pure water contains 89% of dissolved water.
- ❑ Oxide of deuterium is called heavy water.
- ❑ Water has the greatest density at 4°C.

This behaviour of water permits fishes to survive in ponds through severe winters.

- ❑ Water is a poor conductor of heat and a pure non conductor of electricity.
- ❑ Permanent hardness of water is due to the presence of sulphates and chlorides of calcium and magnesium. It can be removed by adding washing soda or by distillation.
- ❑ The pleasant taste of good drinking water is due to dissolved air and  $\text{CO}_2$  and mineral water.

## Important Elements

### Hydrogen

- ❑ Hydrogen is produced commercially from water, mainly by the Bosch Process.
- ❑ Pure hydrogen is a colourless gas without any smell or taste.
- ❑ It has the lowest density among the gases.
- ❑ It is almost insoluble in water.
- ❑ It is a constituent of many gaseous *fuels*.
- ❑ Through *hydrogenation of coal*, petrol is produced.
- ❑ Also, used in the production of 'Vanaspati-ghee', through *hydrogenation of vegetable oil*.
- ❑ Hydrogen is used in extraction of certain rare-metals, e.g. *tungsten* (used as electric filaments) and *molybdenum* (used in radio waves).

### Oxygen

- ❑ Oxygen is a colourless, tasteless and odourless gas.
- ❑ Oxygen does not burn but helps things to burn.

## Elements and their occurrence in Earth

- ❑ Earth is a rich source of elements, found either in native state or in compound form.
- ❑ The major elements are chlorine, sodium, magnesium, sulphur, calcium, potassium and carbon in that order.
- ❑ The minor elements are bromine, boron, strontium, silicon, nitrogen, lithium, aluminium and rubidium.
- ❑ Chlorine, Bromine, Sodium and Magnesium are recovered commercially from sea water.
- ❑ The gaseous phase of the earth is called atmosphere.
- ❑ Examples of elements accumulated in living organisms are: Iodine in sea weeds, Vanadium in sea cucumbers, Potassium in plant life
- ❑ Examples of elements concentrated in different parts of living beings are: Iron in blood, Zinc in the eyes of certain animals, Magnesium in chloroplast.

- ❑ Atomic number is 8.
- ❑ It is a member of the chalcogen group on the periodic table.
- ❑ Oxygen is the third most abundant element in the universe by mass after hydrogen and helium.
- ❑ All major classes of structural molecules in living organisms, such as proteins, carbohydrates, and fats, contain oxygen.
- ❑ Uses of oxygen include the production of steel, plastics and textiles; rocket propellant; oxygen therapy; and life support in aircraft, submarines, spaceflight and diving.
- ❑ Smelting of iron ore into steel consumes 55% of commercially produced oxygen..
- ❑ Another commercially produced oxygen is used by the chemical industry.

### Nitrogen

- ❑ In the free states, nitrogen constitutes nearly 80% of the air.

- ❑ Nitrogen is the largest single constituent of the Earth's atmosphere (78.082% by volume of dry air, 75.3% by weight in dry air).
- ❑ Atomic number – 7
- ❑ Nitrogen obtained from air through fractional distillation is called *Atmospheric nitrogen*.
- ❑ Nitrogen obtained from nitrogenous compounds is called *Chemical nitrogen*.
- ❑ Nitrogen is neither combustible nor a supporter of combustion.
- ❑ Nitrogen is a non-poisonous gas. Nevertheless animals die in an atmosphere of nitrogen for want of oxygen they need to breathe.
- ❑ **The Nitrogen Cycle** : The sum total of the transformations undergone by nitrogen and nitrogenous compounds in nature in relation to the living organisms.
- ❑ Many industrially important compounds, such as ammonia, nitric acid, organic nitrates



(propellants and explosives), and cyanides, contain nitrogen.

- ❑ The element nitrogen was discovered by Scottish physician **Daniel Rutherford** in 1772.
- ❑ It is a constituent element of amino acids and thus of proteins, and of nucleic acids (DNA and RNA).
- ❑ It resides in the chemical structure of almost all neurotransmitters, and is a defining component of alkaloids, biological molecules produced by many organisms.
- ❑ It is created by fusion processes in stars, and is estimated to be the 7th most abundant chemical element by mass in the universe.

### Ammonia

- ❑ Ammonia is a compound of nitrogen and hydrogen with the formula  $\text{NH}_3$ .
- ❑ It is an intermediate gaseous product in the decaying process of dead organic matter.
- ❑ Industrially, it is manufactured through *Haber's Process*.
- ❑ It is a colourless gas with a strong pungent smell and slightly alkaline taste.
- ❑ It is lighter than air.
- ❑ Highly soluble in water.
- ❑ It is used in the manufacture of fertilizers, nitric acid and sodium carbonate.
- ❑ Nylon, rayon, plastics, dyes, and explosives are all made from ammonia.
- ❑ Ammonia can be liquefied easily and liquid ammonia is highly volatile.

## Noble Gases

- ❑ Noble Gases are: Helium, Neon, Argon, Krypton, Xenon and Radon
- ❑ Also called 'rare gases', as they are present in very small quantities in the air.
- ❑ Radon is not present in air.
- ❑ Also called 'inert gases', as they do not enter into chemical reactions.
- ❑ Helium is used for filling meteorological balloons and also by sea-divers.
- ❑ Neon is used in making advertising signs.
- ❑ Argon is used to create an inert atmosphere in chemical reactions and in electric bulbs.
- ❑ Krypton and Xenon are used in electrical valves and TV tubes and also in lighthouses and miner's lamp.

- ❑ Ammonia emulsifies fats and grease so that they can be removed without leaving any residue. Thus, it acts as a cleansing agent.

### Chlorine

- ❑ Chlorine is a member of halogen group.
- ❑ Other halogens are: Fluorine, Bromine, Iodine, Astatine, of which Astatine is a radioactive element.
- ❑ It is a poisonous gas.
- ❑ Chlorine, either as liquid chlorine or chlorine water, is used for bleaching.
- ❑ Chlorine is used for sterilizing drinking water.
- ❑ Bleaching powder is used as a bleaching agent.
- ❑ Sodium hypochlorite is used as an antiseptic.
- ❑ Chloroform is used as an anaesthetic.
- ❑ Carbon tetrachloride is used as a solvent.
- ❑ Poly-vinyl-chloride is an important plastic.

- ❑ Chlorine is used as an oxidising agent.

### Sulphur

- ❑ In the free state, sulphur is found in volcanic rocks and gases.
- ❑ In combined state, it occurs as, metal sulphates; Gypsum, Glauber's salt, Epsomite, Barite Metal Sulphides; Iron pyrites, copper pyrites, Galena, Zinc blende, Cinnabar (ore of mercury).
- ❑ Coal and crude petroleum contain traces of sulphur.
- ❑ Organic compounds like protein, egg, onion, garlic and wood also contain small quantities of sulphur, which gives them a unique odour.
- ❑ Sulphur is non-poisonous to humans but toxic to lower organisms.
- ❑ Its commercial uses are primarily in fertilizers, but it is also widely used in black gunpowder, matches, insecticides and fungicides.

- ❑ Sulphur is used in ayurvedic medicines. In allopathy, sulphur based ointments are used for the treatment of skin disorders. Sulpha drugs are used as antibiotics to fight bacteria and colloidal sulphur is used in medicines for blood purification.

### Sulphuric Acid

- ❑ Ferrous sulphate crystals are known as Green Vitriol.
- ❑ Sulphuric Acid is also known as 'Oil of Vitriol' and 'King of Chemicals'.
- ❑ It is manufactured through 'contact process'.
- ❑ Pure, concentrated sulphuric acid is a bad conductor of electricity while the dilute acid is a good conductor of electricity.
- ❑ The acid is highly corrosive in nature and burns the skin, turning it black.
- ❑ The reaction between water and sulphuric acid is exothermic.
- ❑ Sulphuric acid is used in the manufacture of chemicals, dyes and pigments, soaps and detergents, plastics and fibres (rayon).
- ❑ It is used in the manufacture of fertilizers (super phosphate of lime, ammonium sulphate), explosives (nitroglycerine and trinitro toluene i.e., TNT).
- ❑ It is used in petroleum refining, tempering of steel and in lead storage batteries.

### Aluminium

- ❑ Aluminium is the most abundant element in the earth's crust.

- ❑ Important ores of aluminium are bauxite, cryolite and corundum.
- ❑ Commercially, aluminium is extracted from bauxite.
- ❑ Aluminium is one of the lightest metal, weighing only 2720 kg per cubic metre. This is about one-third of the weight of steel.
- ❑ Aluminium is a good conductor of electricity.

### Zinc

- ❑ The most important ore of zinc is zinc blende. Calamine and zincite are other important ores of zinc.
- ❑ Zinc is used in galvanisation and in dry cells.
- ❑ Zinc is used in dye-casting because of its low melting point and high tensile strength.
- ❑ Zinc, as a reducing agent, is used in the manufacture of perfumes and synthetic drugs.
- ❑ Brass, an alloy of zinc with copper, is used in cartridges, musical instruments and electrical fittings.
- ❑ Bronze, an alloy of copper, zinc and tin, is used in statues.
- ❑ German silver, an alloy of zinc with copper and nickel, is used in jewellery and coins.

### Iron and Steel

- ❑ Haematite and magnetite are the richest ores of iron, containing upto 70% iron.
- ❑ Limonite has 60% iron, pyrite and siderite contain 50% iron while taconite contains 30% iron.
- ❑ Pig iron containing 1.0-3.0% silicon is called cast iron.
- ❑ *Types of Iron and Steel:* Pig Iron, Wrought Iron and Steel
- ❑ Stainless steel contains iron, chromium, nickel and carbon.
- ❑ Nickel steel contains iron, nickel and carbon.
- ❑ Tungsten steel contains iron, tungsten and carbon.

## CHEMISTRY IN DAILY LIFE

### Polymers:

Rubber, Cellulose, Starch silk, wool etc are natural polymers. Plastic, Polythene, nylon, rayon, teflon etc. are Human made polymers.

### Rubber:

- ❑ Rubber is a naturally available elastic polymer.
- ❑ Ordinary rubber is a thermoplastic substance.
- ❑ If sulphur is added to rubber and heated, its shape can be

### Difference between natural rubber and synthetic rubber

Natural rubber	Synthetic rubber
Low hardness easily flammable Dissolves in organic solvents	high hardness not easily flammable Does not react with organic solvents
Loses stability at high temperature	keeps stability at high temperature
Less elastic	More elastic

Synthetic rubber	Property	Uses
Styrene Butadiene rubber (SBR)	High frictional force, Not easily broken, Resists ozone, Gets easily oxidised	tyres foot wears
Neoprene rubber	Not easily flammable, Does not easily reacts with oils and solvents, Stable at high temperature	Cable insulation, Conveyer belt in coal mines, Making hose
Thiokol	High elasticity,  Hardness, Doesn't dissolve in organic solvents	Tanks for storing solvents, Making seal, Making hoses

maintained and its hardness increased. The process of heating rubber with sulphur for the betterment of its properties, is called vulcanisation.

- ❑ Vulcanisation enhances the following properties of rubber: tensile strength, hardness, elasticity, ability to withstand heat changes
- ❑ These properties can be varied by changing the quantity of sulphur, temperature and time taken for vulcanisation.

**Cement:**

- ❑ Cement is complex mixture of aluminates and silicates.

- ❑ In 1824, a British Engineer, Joseph Aspidin made a binding material by mixing lime and silica and firstly it was named as 'portland cement'.
- ❑ The setting of cement is due to the hydration of calcium silicates and calcium aluminates.
- ❑ The mixture of cement, silica and water is called cement mortar.
- ❑ Concrete is reinforced by embedding steel in cement.
- ❑ A suitable site of a cement plant requires proximity to limestone and gypsum.
- ❑ Gypsum is  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

**Manufacture of cement:**

The raw material are ground

**Raw materials used for cement production**

Compound	Chemical composition	%
Lime	CaO	60-67
Silica	SiO <sub>2</sub>	17-25
Alumina	Al <sub>2</sub> O <sub>3</sub>	3-8
Iron Oxide	Fe <sub>2</sub> O <sub>3</sub>	0.5-6.0
Magnesia	MgO	0.1-4.0
Sulphur trioxide	SO <sub>3</sub>	1-2
Soda+Potash	Na <sub>2</sub> O + K <sub>2</sub> O	0.5-1.3

into a fine powder and mixed in the fixed proportion. This is heated in a furnace at a high temperature (1500°C). Clinkers, which is a complex mixture of calcium silicate and calcium aluminate is formed. Gypsum is added to clinker and the mixture is powdered to make cement.

- ❑ Complex molecules formed by the addition of simple molecules are called polymers.
- ❑ Cellulose and silk are natural polymers and nylon, rayon, teflon etc., are man made polymers.
- ❑ Thermoplastics and thermosetting plastics are two types of plastics.
- ❑ Polythene, nylon etc., are examples for thermoplastics and polyester, bakelite etc., are examples for thermosetting plastics.
- ❑ Rayon is known as artificial silk and is used in carpets, tyrecode, surgical dressings, fabrics etc.
- ❑ Caprolactum [(C<sub>6</sub>H<sub>11</sub>NO) is produced from cyclohexane.
- ❑ Sodium potassium salt of stearic acid, palmitic acid and oleic acid is called soap.
- ❑ Sodium hydroxide is utilised in washing soap and potassium hydroxide in toilet soap.
- ❑ Tyres filled with air are called pneumatic.
- ❑ The process of adding NaCl, to the solution for the separation of soap from glycerol is called 'Salting Out'.
- ❑ Synthetic detergents are a mixture of sodium salts of aromatic and aliphatic sulphonic acids.
- ❑ Vinyl plastics are used as adhesive.
- ❑ Many man made substances are not bio-degradable.

## Glasses

- ❑ Glass is a super cooled liquid.
- ❑ Safety glass (manufactured by pasting a weightless plastic sheet in between two glass plates) is used in manufacture of bullet proof screens, wind shields etc.
- ❑ Fibre glass is also used for insulating stoves and refrigerators.
- ❑ It is also used for making the body of aircrafts, boats, helmets etc.
- ❑ Metal oxides provides colour to the glass.  
Eg: Cobalt salt provides blue colour, Nickel salt provides red colour etc.

**Different colours can be given to glass using different metallic oxides or ions:**

Metal compound / ion	Colour
Ferric ion	Yellow
Ferrous or Chromium	Green
Cobalt ion	Blue
Manganese dioxide	Purple
Nickel salt	Red
Cupric oxide	Red
Cadmium sulphide	Lemon Yellow
Uranium oxide	Greenish Yellow
Cryolite/Calcium phosphate	Opaque milk white colour

Glasses	Components	Use	Compound
Soda lime glass (soft glass-Silica glass)	Silica (SiO <sub>2</sub> ), Sodium carbonate (Na <sub>2</sub> CO <sub>3</sub> ), Calcium carbonate	Window doors, mirror, bulbs, bottles, jar	Na <sub>2</sub> O.CaO.6SiO <sub>2</sub>
Hard glass (heat resistant glass)	Silica, Potassium carbonate, Calcium carbonate	Laboratory apparatus, factory and kitchen wares	K <sub>2</sub> O.CaO.6SiO <sub>2</sub>
Boro silicate glass	Boric oxide, Aluminium oxide, Silica, K <sub>2</sub> O.Na <sub>2</sub> O	Laboratory apparatus, factory and kitchen wares	K <sub>2</sub> O.CaO.Al <sub>2</sub> O <sub>3</sub> Na <sub>2</sub> O.6SiO <sub>2</sub>
Flint glass (optical glass/lead glass)	Silica, K <sub>2</sub> CO <sub>3</sub> , Lead oxide	Lenses, Prisms	K <sub>2</sub> O.PbO.6SiO <sub>2</sub>
Fibre glass	Silica, Na <sub>2</sub> CO <sub>3</sub> , CaCO <sub>3</sub>	Industry Insulator, Furniture	Na <sub>2</sub> O.CaO.6SiO <sub>2</sub>

## Explosives

- TNT is trinitrotoluene. It is highly explosive substance. It is manufactured by the action of concentrated nitric acid on toluene.
- Explosive power is measured in terms of TNT.
- RDX - Research and Development Explosive is a highly explosive substance.
- PETN-Penta Erythritol Tetra Nitrate is more lethal and deadly explosive than RDX.
- Gun cotton (nitro cellulose) is a powerful explosive formed by the action of nitric acid on cellulose, used in the manufacture of gunpowder.

## pH values

- ❑ The measure of the acidic or basic character of a liquid or solution is the pH value.
- The pH scale is introduced by Sorrenson
- pH value generally starts from 0 and ends at 14
- Pure neutral solutions are having pH exactly 7.
- pH value greater than 7 and upto 14 is basic.
- pH value 0 to 6.9 is acidic.
- Human Blood has pH value 7.3 or 7.4 (slight basic)
- Generally other human secretions have pH 6.1 to 6.9
- Acid rain has pH 3.00 to 4.5
- Sea water has pH 8.5
- pH of human stomach is about 3.5
- pH of Sodium chloride solution is 7
- The pH of Alcohol is 7