SCIENCE NOTES – PART III
CHEMISTRY

51. SUBSTANCES

Millions of substances are known to us.
Substances can be Pure or Impure.

PURE SUBSTANCE: A pure substance is a homogeneous material with a definite, invariable chemical composition, and definite invariable physical and chemical properties.

Example:- Sodium Chloride (common salt) is a pure substance. This is because all samples of Sodium Chloride have the same composition. 23 parts by weight of Sodium and 35.5 parts by weight of Chlorine.

IMPURE SUBSTANCES: Impure substances consist of two or more different kinds of molecules whose composition by weight per unit volume is not fixed.

Ex. Air, sea water, solution of Sodium Chloride and water.

52. ELEMENTS:

An element is a pure substance. It cannot be converted in to anything simpler than itself by any physical or chemical process.
Elements are the basic substances from which all other substances are made.
An element is a pure substance composed of only one kind of atoms.

53. FACTS ABOUT ELEMENTS

- 117 elements are known
- 92 elements occur in nature
- 13 elements occur as non-metals
- 5 elements occur as metalloids
- 6 elements occur as noble gases
- 11 elements are in gaseous state at room temperature
- two elements mercury and bromine are liquid at room temperature
- Gallium and Caesium become liquid at a temperature slightly above room temperature

Some elements are called radioactive elements such as thorium because they emit radiations.
Over 90% of the earth's crust consists of only five elements:- Oxygen, Silicon, Aluminium, Iron and Calcium.
Carbon and Hydrogen account for 90% mass of the human body.

54. METALS

Metals are hard solids. They have lustre. They are good conductor of heat and electricity. They are ductile. They are malleable. Most of them high melting and high boiling point. They produce sound when struck.

Example:- Gold, Iron, Lead, Tin, Copper, Aluminium

55. NON-METALS

They exist in all three states- solids liquids and gas.
Example:- Carbon, Sulphur, Iodine are solids
Bromine is a liquid
Hydrogen, Oxygen, Nitrogen are Gases
They do not have lustre. They are bad conductor of heat and electricity. They are neither malleable nor ductile. They have low melting and boiling point.
Exceptions:
Graphite and Iodine have lustre.
Carbon fibre is ductile.
Graphite is good conductor of electricity. It also has high melting point.
Diamond has high melting point and boiling point.

56. METALLOID

They show the properties of both metals and non-metals.
Ex. Arsenic, Antimony, Germanium, Bismuth.

57. NOBLE GASES

They are gaseous in nature.
They are chemically inactive or inert.
Example:- Helium, Neon, Argon, Krypton, Xenon, Radon

58. MOLECULE

Most atoms do not exist in a free state. They exist in a combined state. They combine with the atoms of same element or atoms of different element.
The combined state of atoms is called Molecule.
Molecule is capable of existing in a free state.
A molecule is the smallest particle of a pure substance.

Molecule of same type of atoms Ex. Oxygen. O_2 called Molecule of an Element. It is made up of two atoms of Oxygen.
Ozone O_3 It is made up of three atoms of Oxygen.
Molecule of different types of atoms
Example:- Water. H_2O Two atoms of Hydrogen and one of Oxygen.

59. COMPOUNDS

A compound is a pure substance composed of two or more elements combined chemically in a fixed proportion by mass.
The properties of a compound are different from the properties of its constituent elements.
Example:- Common or table salt is Sodium Chloride. It is made up of two elements Sodium and Chlorine.
Sodium: is a soft metal. It reacts violently with water. Poisonous if swallowed.
Chlorine: is a greenish yellow gas with a choking smell. It is poisonous in nature.
Combining these two element is formed is Common Salt is non-poisonous and we eat every day.
Same elements can combine with each other in different proportions and can give different compounds.
Ex. Hydrogen combining with Oxygen can give:
- Water H_2O
- Hydrogen Peroxide. H_2O_2

  In Water two hydrogen atoms are combined with one atom of Oxygen
  In Hydrogen Peroxide two atoms of Oxygen combine with two atoms of Hydrogen.

60. CHARACTERISTICS OF A COMPOUND

- A compound contains atoms of two or more elements combined by chemical forces
- It has homogeneous composition. All sample of compound will show same some composition

Example:- Water from lake, river or pond will have same composition.

Water is composed of two elements, hydrogen and oxygen. They are combined in a fixed proportion. (8:1) by mass. 89% of Oxygen and 11% of Hydrogen
The properties of water are different from those of its constituent elements, as water is a liquid, while its constituent elements hydrogen and oxygen are gases.

61. MIXTURE

A matter composed of two or more substances whose particles are in contact but are not chemically combined and have not lost their individual properties.
Ex. A mixture of common salt and water will have different properties like density, boiling point etc. depending upon the amounts of the two components present in it. These properties will differ with different proportions however, the properties of water and salt are not lost or altered in the mixture.

62. HOMOGENEOUS MIXTURE

Homogeneous mixture have the same composition and properties throughout their mass
Example:- Sugar solution

63. HETROGENEOUS MIXTURES

Heterogeneous mixture have the different compositions and properties in different parts of their mass.
Example:- Sand mixed with Salt, Atmospheric Air, Sea water

64. SOLUTIONS

A homogeneous mixture of two or more substances chemically non-reacting whose composition can be varied is called a solution.

The substances which make up the solution are called components.
Solvent is the substance in which solute is to be dissolved.
Solute is the substance to be dissolved in a solvent.

Solvent + Solute = Solution.

If the two substances are in the same phase (State), then the component which is in excess is termed the solvent.

A SOLUTION can be formed by mixing:-
LIQUID WITH ANOTHER LIQUID. Ex. Water and Alcohol
SOLID WITH A LIQUID. Ex. Sugar Solution
A LIQUID WITH GAS. Ex. Soda Water, Coke
A SOLID WITH ANOTHER SOLID. Ex. Alloys. Brass has 70% copper and 30% zinc Hence copper is solvent.

Water is the most common solvent.
Aqueous solution: A solution produced by dissolving a substance in water is known as aqueous solution.

TRUE SOLUTION: A solution in which the size of the solute particles is about 10^{-10}m is called a true solution. In a true solution the solute and solvent particles can not be distinguished.

65. SUSPENSION

A suspension is a heterogeneous mixture in which very fine particles about 10^{-7}m of a solid are dispersed in any medium. (Gas or Liquid).
Fine particles of the solid remain suspended in the medium.
Example:- Smoke coming out of a chimney
Chalk dissolved in water
Muddy pond water

66. COLLOIDS

Colloids have particles larger than the particles of true solution but smaller than those of suspension.
A colloid has properties that are intermediate between those of a true solution and a suspension.
A homogeneous looking heterogenous mixture in which particles having a size between 10^{-10} and 10^{-7} m dispersed in a continuous medium is called COLLOID.

67. TYNDALL EFFECT

The scattering of a beam of light by colloidal particles present in a colloidal solution is called as Tyndall Effect.
Zone of scattered light is much larger than the particle itself. This is why colloidal particles look like bright spots when viewed at right angles to the beam of light.

TYNDALL EFFECT IN DAILY LIFE
Tyndall effect can 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.

Tyndall effect can also be observed when sunlight passes through a dense forest. In the thick forest, mist contains tiny droplets of water acts as colloidal particles inter dispersed in air.

68. CHROMATOGRAPHY

It is a modern technique used for the separation of a mixture of substances. It involved the separation of mixtures containing coloured substances when separated, formed distinct coloured rings. These zones or rings are named chromatograms.
Chromatography is used extensively in forensic investigations.

69. FRACTIONAL DISTILLATION

Fractional distillation is a process which involves distillation and collection of fractions of different liquids boiling at different temperatures.
If the liquids in a mixture are miscible and have different boiling points they can be separated by distillation.

SEPARATION OF COMPONENTS OF CRUDE PETROLEUM:
Crude petroleum is fractionally distilled to get various fractions, at different temperatures some of which are:-
- Natural gases
- Naphtha
- Kerosene oil
- Diesel
- Lubricating oil

70. PHYSICAL CHANGE

A physical change is one that changes the shape, size, physical state, and appearance of a substance but not its chemical composition.

Example:-

- Ice is heated changed to water than into steam. There is no change in the chemical composition
- Iron piece is changed into nails, hanger or rod.
- when solid sugar is dissolved in water, it disappears and resultant solution becomes sweet. Sugar can be recovered by evaporation : removing water
- Formation of dew
- Breaking of glass
- Melting of solids
- Drying of wet clothes

Characteristics of a physical change:

- the change is temporary
- no new substance is formed
- there is no alteration in mass
- generally the reaction can be reversed

71. CHEMICAL CHANGE

A Chemical change is a permanent change, in which the original substance loses its own composition and properties and gives rise to one or more new substances with different compositions and properties.

Example:-

- Rusting of Iron: iron on rust changes into a brittle brownish powdery substance called rust. Rust is not iron but Iron oxide. So there is a formation of new substance different from iron.
- Clotting of blood
- Digestion of food
- Ripening of fruit
- Burning of wood
- Making of wine
- Decomposition of a compound
- Photosynthesis

72. BURNING COMBUSTION

Burning or combustion is a chemical change, in which combustible substances combine with oxygen to produce new compounds, called oxides. In the reaction there is a liberation of large amount of energy in the form of heat and light.
The oxygen in air is mainly responsible for burning.

Example:-

- If building is on fire and there is strong wind it is difficult to put out the fire
- If a small object catches fire, the fire is put out by covering it up with sand or a blanket. We are cutting out the oxygen availability thus fire is put out.

73. CONDITIONS NECESSARY FOR BURNING

- There must be a combustible substance
- There must be a continuous supply of supporter of combustion like air or oxygen
- The temperature of combustible substance should be above its ignition temperature.

COMBUSTIBLE SUBSTANCE: Substances that burn in air are said to be combustible.
Example:- Wood, coal, sulphur, petrol, hydrogen, gas etc.

INFLAMMABLE SUBSTANCE:A combustible liquid or gas which burns with a flame is called inflammable substance.
Example:- Petrol, kerosene etc.

SUPPORTER OF COMBUSTION: The gaseous environment that supports combustion are called supporter of combustion. Air oxygen is the most commonly known supporter of combustion.
Other supporters are nitrous oxide, fluorine and chlorine
The gaseous environment that does not allow oxidation to occur is called non-supporter of combustion.
Ex. Hydrogen, nitrogen, hydrogen chloride gas, carbon monoxide, carbon dioxide

IGNITION TEMPERATURE: It is the minimum temperature at which a substance catches fire and starts burning.
Ignition temperature is different for different substances
Phosphorus 35^{o} C
Petrol and Diesel have low ignition temperature that's why smoking is ban at petrol pumps.

74. OXIDATION OF LEAD AND COPPER

A white deposit is formed on the surface of lead when it is exposed to moist air.
White deposit is the lead hydroxide.
Copper forms a green deposit on its surface when exposed to moist air. This deposit is copper sulphate.

75. IMPORTANCE OF NITROGEN

Nitrogen is an inactive gas. Air has about 79% of Nitrogen. Nitrogen moderates the activity of Oxygen. It helps in keeping the rates of combustion, respiration and of oxidation of food at its proper level.
Nitrogen is essential for producing plant protein and thus plant growth.
Proteins are essential for building body tissues.
Nitrogen is an essential constituent of all living cells of plants, animals and human beings. It is present in cells as proteins.
Animals and human beings depend on plants for their food, containing proteins, and plants in turn depend on nitrogenous compounds like nitrates.
The nitrogen content of the soil gets depleted after the crops of cereal like wheat and rice. The level of nitrogen in soil is restored by growing leguminous plants.
Leguminous plants have nodules. In their roots. Bacteria present in nodules fix nitrogen for the plants. This process of fixing nitrogen is called Nitrogen Fixation.
During Lightening discharge also nitrogen is fixed in the atmosphere.

76. BALANCING OF OXYGEN AND CARBON DIOXIDE IN THE ATMOSPHERE

Both Carbon Dioxide and Oxygen are essential for sustenance of life. Nature maintains the right level of Oxygen and Carbon Dioxide. These processes are called Oxygen cycle and Carbon (Dioxide) cycle.

Oxygen Cycle:
Oxygen present in air is removed or used up in the processes:-
- Decomposition of waste materials
- Combustion of Fuels
- Breathing/ Respiration
- Corrosion of metallic objects

Oxygen is added in atmosphere mainly by Photosynthesis. Oxygen is also added slightly (Very Little) by breakdown of Ozone.

77. PHOTOSYNTHESIS

Photosynthesis is a process in which carbon dioxide and water are converted into sugar and oxygen in the presence of sunlight. Solar energy is absorbed by chlorophyll present in the cells of green plants.

Carbon Dioxide + Water + Energy (Sunlight) -→ Sugar + Oxygen

CO_2 + H_2O + Energy (Sunlight) -→ $C_2H_{12}O_6$ + O_2.

With Photosynthesis the balance of Oxygen is maintained in Nature.

78. CARBON CYCLE IN NATURE

The various processes by which the percentage proportion of Carbon Dioxide is kept constant constitute the carbon cycle.

In the atmosphere, the proportion of carbon dioxide is maintained at 0.03% to 0.04% by volume. The cycle of removal and addition of carbon dioxide in nature is continuing un-interrupt.

Addition of Carbon Dioxide:

1. Animals and human beings burn food taken from plant by consuming Oxygen and release Carbon Dioxide.
2. At night plants take in oxygen and give out carbon dioxide.
3. The decay of plants and animals and other organic material also added carbon dioxide to atmosphere.
4. The burning of fuels, such as wood, coke, coal, petrol, diesel, gas etc. produces Carbon Dioxide.
5. Volcanic activity also adds Carbon Dioxide to atmosphere.
6. Industry and human settlements also releases lot of Carbon Dioxide to atmosphere.

Removal of Carbon Dioxide:

Carbon Dioxide is used in photosynthesis and is also absorbed by water.

There is carbon dioxide dissolved in sea water. When atmospheric carbon dioxide levels increase, the excess gas dissolves in sea water. Conversely, when carbon dioxide level decreases in the atmosphere the sea gives up some of the dissolved carbon dioxide to restore the required level.

Thus, the balance of Carbon Dioxide and Oxygen are maintained in the atmosphere with dynamic cycles of absorption and release of them incessantly.

79. WATER

Water is the most important natural resource.
More than 70% of earth's area in under water.
HARDLY 2.5% MAKES UP THE TOTAL WORLDs SUPPLY OF FRESH WATER INCLUDING THE FROZEN WATER IN THE POLAR ICE CAPS AND GLACIERS.

Source of water	Percentage of Total
Oceans	97.33
Saline Lakes	0.008
Polar Ice and Glaciers	2.04
Ground Water	0.61
Lakes	0.009
Soil Moisture	0.005
Atmospheric water Vapours	0.001
Rivers	0.0001

Water exists in all three states: Ice, Water, Vapour

Water is major constituent of all living viz. Plants, Animals and Human being and of the atmospheric environment in which we live and thrive. Nearly 70% of our body weight is water.
Water is a chemical compound. It has a definite composition by mass
The ratio of H to O is 1:8 by mass.
The H and O in water cannot be separated by physical means.
They can be separated by chemical means only.
Method: Electrolysis

80. PHYSICAL PROPERTIES OF WATER

- Pure water is a clear transparent liquid
- It is colourless, odourless and tasteless
- Sometime we say water is tasty: the taste in water is due to the dissolved gases and dissolved solids which really speaking are impurities present in it.
- Under normal pressure, pure water boils at 100^{o} C.
- With increase in pressure , the higher the boiling water (Pressure cooker works on this principle). In the hills, water boils at temperature lower than 100^{o} C. On Mount Everest the boiling temperature of water drops to 70^{o} C
- The boiling point of water also increases due to the presence of dissolved impurities in it.
- Freezing point of water or melting point of ice is 0^{o} C. under normal pressure. The freezing point of water decreases with increase in pressure.
- Kulfiwalas put salt in ice to lower its freezing point to keep kulfi in frozen state. The temperature gets lower to up to -15^{o} C
- *Density of water*: At 4^{o} C water has its maximum density that is $1g/cm^3$ and it has minimum volume. Water expands on freezing. 92 volumes of water becomes 100 volume of ice. Therefore ice is lighter than water and thus it floats.
- ANOMALOUS EXPANSION OF WATER:
  Water has an unusual physical property.
  When cooled it first contracts in volume as do other liquids, but at 4^{o}C it starts EXPANDING and continues to do so till the temperature reaches 0^{o}C. At this point it freezes in to ice.
  Advantage: The property of anomalous expansion of water enables marine life to exist in the colder regions of the world, because even when the water freezes on top, it is still liquid below the ice layer.
- Pure water is non-conductor of electricity. But water containing dissolved impurities like salt and gases conducts electricity.

81. LATENT HEAT

It is the heat energy required or used for change of a state of matter from one state to another during which there is no change in the temperature.
LATENT HEAT OF FUSION OF ICE: -
The latent heat of fusion is the amount of heat required to change a substance from the solid state to its liquid state at its melting point without any change in temperature.
It is 80 calories/g
The same amount of heat is released when 1 g of water solidifies to form 1g of ice at 0^{o} C.
IT IS ON ACCOUNT OF HIGH SPECIFIC LATENT HEAT OF SOLIDIFICATION THAT LAKES AND RIVERS DO NOT FREEZE SUDDENLY.

LATENT HEAT OF VAPORIZATION OF WATER:-
The energy required to change water into its vapour at its boiling point without any

change in temperature is called Latent Heat of Vaporization of Water and its specific value is 540 calories/g
The same amount of heat is released when 1 g of steam condenses to form 1g of water at 100°C.
Steam burns more severely than water at the same temperature because steam is having more energy.
SPECIFIC HEAT CAPACITY:
1g of water when heated through 1°C requires 1 calorie of heat energy. It is called its specific heat capacity.
It is on account of high specific heat capacity that water is used as coolant in motor car radiators.
Due to its high specific heat capacity, the presence of a large amount of water is able to modify the climate of the nearby land areas, making them warmer in winter and cooler in summer.
Land and sea breeze are also set up because of this great moderating property of water.

82. UNIVERSAL SOLVENT

Water is called the universal solvent.
IMPORTANCE OF DISSOLVED SALTS IN WATER:
The solids which are dissolved in water are salts, minerals and impurities.
- They are essential for the growth and development of plants.
- They add taste to water
- They supply the essential minerals needed by our bodies.

83. AIR DISSOLVED IN WATER

Air is present in dissolved state in all the natural sources of water.
Of the two main components of air nitrogen and oxygen, oxygen is more soluble in water than nitrogen.
The composition of air dissolved in water is 33% oxygen, 66% nitrogen and 1% carbon dioxide.
IMPORTANCE of AIR DISSOLVE IN WATER:
- Marine life like fish have fins. Fins are used for respiration. Water is moved across the fins. Fins absorb oxygen from water.
1 dm^3 of water contains nearly 40 cm^3 of dissolved oxygen.
Carbon Dioxide: Aquatic plants make use of dissolved carbon dioxide for photosynthesis to prepare their food.

84. ATOMIC STRUCTURE

Matter is made up of atoms. The name ATOM was suggested by Greek philosopher Democritus. Greek word 'atoms' means indivisible.
First scientific theory of atomic structure was given by John Dalton in 1808. He said atoms are indivisible particles and are the fundamental building blocks of matter.
He also said Atoms of one element combine with atoms of another element in simple ratio to form molecules of compound.
He also concluded that atoms are the smallest units of matter that can take part in a chemical reaction.
Atoms are made up of small charged particles was the conclusion of Faraday in 1833 while he conducted experiments on conduction of electricity. He showed that flow of electricity is due to the flow of charged particles.
Stoney in 1874 suggested the name electron for these electrical particles.
Thomson showed the existence of electrons as an essential constituent of all matter.
He also could established that electrons are negatively charged particles.
Electron means atom of negative electricity.

85. PROPERTIES OF ELECTRONS

- Electrons from all sources are alike having same mass
- They are a constituent part of all atoms
- The mass of an electron is 9.108 x $10^{(-)31}$ kg
- An electron carries negative charge of (-) 1.602 x $10^{(-)19}$ coulombs
- The electron is extremely small its radius is less than 1x $10^{(-)15}$ m

86. Atoms are found to be electrically neutral, so they must contain particles that are positively charged. And total negative charged must be equal to positive charged to make atom neutral. This realization led to the discovery of positively charged particles which were named as Protons.

87. Rutherford experiments further lead to discovery of nucleus. He suggested atomic model stating how atom is made up.

- The atom is heavy at the centre called Nucleus
- The atom contains large empty space surrounding nucleus
- The nucleus has +vely charged particles called Protons
- The electrons which are -vely charged particles are present in empty space surrounding nucleus
- The electrons revolve around the nucleus in orbits
- The atom is electrically neutral

The atomic model is similar to the structure of the solar system.

88. BOHR'S ATOMIC MODEL

In 1913 Neils Bohr expanded the model which was proposed by Rutherford.
He called orbits as energy levels.
Electrons move in different orbits of different energy levels. When electrons are excited energised move to higher level energy.

89. NEUTRONS

The mass of nucleus was found to be much more than what could be explained by the presence of Protons alone. Chadwick discovered particles other than Protons having no charge on them but the mass equal to that of protons.

IT WAS FOUND THAT ALL ATOMS HAVE SIMILAR FOLLOWING THE SAME BASIC STRUCTURE.

89. ATOMIC NUMBER

ATOMS of all elements (Matter) have similar structure. However all atoms have characteristic number of Protons. No two elements have same number of protons. All atoms have same number of electrons as of protons as atom has to be electronically neutral.

Element	Number of Protons
Hydrogen	Nil
Helium	2
Carbon	6
Neon	10
Calcium	20

The number of PROTONS is known as Atomic Number of that element.
RULE OF OCTET: 8 electrons in the outermost shell is known as OCTET
All Noble gases have eight electrons in the outermost shell (except Helium which has 2).

90. REASON FOR CHEMICAL ACTIVITY OF AN ATOM

The chemical activity of an element depends upon the number of electrons in the outermost shell of its atom.
These electrons are called valence electrons.
Atoms of different elements come together and try to make OCTET. Who ever elements can make OCTET will react to form the stable compound.
Bond is formed by these atoms of different elements.

Example:-
Sodium Atom 2,8,1
Chlorine Atom 2,8,7
When they combine it becomes 2,8,8 for both
Sodium Chloride is stable compound.

91. THE PERIODIC TABLE

We know more than 100 elements today. The elements can be studied and understood better if we classify them into various groups according to their nature and behaviour with other elements. We are able to correlate the properties of the elements in an organized them.
In 1869, Mendeleev, a Russian chemist, arranged all the 63 elements known at that time in the increasing order of their atomic masses. Atomic mass = Number of Protons + Number of Neutrons.
He observed that elements with similar properties occurred at regular intervals. This is called periodicity of the properties of the elements.
Later on it was noticed Atomic Number is more important in deciding and predicting the behaviour of elements.

Atomic Number = Number of Protons = Number of Electrons

The Periodic table prepared with the basis of Atomic Number is called Modern Periodic Table.
The objections or limitation of Mendeleev Periodic Table gets removed in Modern Periodic Table.
The Modern Periodic Table is divided in to eighteen Vertical Columns and nine Horizontal Rows.
The cause of periodicity is the recurrence of similar electronic configuration.

Example:-

Element	**Sodium**	**Magnesium**	**Aluminium**	**Silica**	**Phosphorus**	**Sulphur**	**Chlorine**	**Argon**
Atomic Number	11	12	13	14	15	16	17	18

92. HYDROGEN

Hydrogen is the first element in the periodic table. Its atomic number is 1. It has only one electron in the outermost shell that is first shell.
Cavendish in 1766 discovered hydrogen gas.
In the free state, hydrogen is found in traces in the earth's crust and atmosphere.
The atmospheres of the Sun and the stars are found to contain 1.1% hydrogen.

Hydrogen in combined state:
- Plants and animals tissues are made up of compounds of hydrogen with carbon, oxygen and nitrogen
- Hydrogen is constituent of acids, alkalies, hydrocarbons and proteins. In addition to these, sugar, petroleum products, fats, carbohydrates also contain hydrogen

USES OF HYDROGEN:
- As a fuel: Hydrogen has a high heat of combustion. It is used as a fuel in the form of a) Coal gas b) Water gas (CO + Hydrogen) c) Liquid hydrogen (Non polluting and easy to store)
- Oxy-hydrogen torch: A mixture of hydrogen and oxygen is burnt in a specially designed oxy-hydrogen torch. It can produce temperature up to 2500°C. The flame is used for cutting and welding metals, for melting platinum and quartz, and for fusing alumina to produce synthetic rubies and sapphires that are used as jewels in watches.
- Atomic hydrogen torch: Creates a high temperature 2800°C which is used for welding alloys containing metals like tungsten, manganese, chromium, etc.
- Hydrogen is used in self-lighting gas jets and automatic lighters
- It is used for manufacture of ammonia
- For hydrogenation of vegetable oil- Hydrogen is used in the preparation of solid Vanaspati ghee from vegetable fats like groundnut oil, coconut oil etc.

93. ACIDS & BASES

The word acid was originally applied to substances with a 'sour' taste. Vinegar, Lemon juice and spoilt milk are all sour tasting because of the presence of acids. A number of acids are also corrosive. They can eat their way through clothing, are dangerous on the skin, and some are able to attack stonework and metals.

LITMUS: Litmus is extracted from Lichens. Litmus is purple in neutral solution. When added to an acidic solution, it turned red.
pH scale is a measure of strength of an acid solution. The scale runs from 1 to 14.
- Acids have a pH less than 7
- The more acidic a solution, the lower the pH.
- Natural substances such as pure water, have a pH of 7.
- Alkalies have a pH greater than 7.

All acids contain Hydrogen.
All acids dissolve in water produce hydrogen ions H^+ ions
All alkalis dissolve in water produce hydroxide ions OH^- ions.

ALKAI (BASES): are substance that dissolve in water to produce hydroxide ions OH^-
Alkali turns litmus blue.
Alkalis have a pH higher than 7.

94. ACID REACTIONS IN EVERYDAY LIFE

INDIGESTION, HEADACHES and NEUTRALISATION
The dilute hydrochloric acid in our stomach is there to help digest our food. However, excess acid causes indigestion, and eventually give rise to ulcers.
To ease this we can take Antacids.
They are used to neutralise the effects of acid indigestion.
Ex. Milk of Magnesia- it contains magnesium hydroxide.
Fizzy Antacids contain sodium hydrogen carbonate. The tablet also contain some citric acid. On adding water the acid and sodium hydrogen carbonate react, producing carbon dioxide gas- the fizz in the glass. The sodium hydrogencarbonate neutralizes the excess hydrochloric acid in the stomach, thus easing the indigestion.

DESCALING KETTLES:
Limescale collects inside kettles and water heaters in hard water areas.
Hard water contains more dissolved calcium than normal water. Calcium carbonate is formed when water is boiled.
This limescale can be removed by treatment with an acid which will react with calcium carbonate. Vinegar can be used to descale kettles.

95. SOIL pH AND PLANT GROWTH

Plant growth is affected by the acidity or alkalinity of the soil. Different crops require different pH for their best growth.

VEGETABLES	Preferred pH
Potatoes	4.5-6.0
Carrot	5.5-6.5
Tomato	5.5-7.5
Onion, Cabbage	6.0-7.5

If the soil is too acidic, it is usually treated by 'Liming'. That is adding of calcium oxide or calcium hydroxide or limestone (calcium carbonate). These compounds have the effect of neutralising the acidity of the soil
If the soil is too alkaline adding manure or decaying organic matter helps.
WASTE FROM FACTORIES is often acidic. If such waste gets into river, the acid will kill fish and planktons. Slaked lime is added to the waste to neutralize it.
Slaked lime is also used to treat streams, rivers and lakes affected by acid rain.

96. SALT

A base will neutralise an acid, and in the process a salt is formed. This type of reaction is known as neutralization reaction.
ACID + BASE --→ SALT + WATER

97. ALKALI AS DEGREASING AGENT

Alkalis feel soapy to the skin. They convert oil in our hand into soluble soap, which can be washed away easily.
Sodium Hydroxide is alkali which is used as degreasing agent in cleaning purposes.

98. SODIUM CHLORIDE (COMMON SALT)

Sodium chloride is essential for life.
Biologically it has a number of functions. It is involved in muscle contraction. It enables the conduction of nerve impulses in the nervous system. It regulates osmosis- the passage of solvent molecules through membranes. It is converted into the hydrochloric acid that aids digestion in the stomach.
When we sweat, we lose both water and sodium chloride. Loss of too much salt during sport and exercise can give us muscle cramp.

99. RATE OF CHEMICAL REACTION

The rate of a reaction is different for different reactions. Some reactions are very slow and some are very fast to happen. If we know the reasons affecting the rate of reaction we can control the rate according to its usefulness to us.

Factors affecting the rate of reaction:

- The surface area of any solid reactants: the rate (speed) of a reaction increases when the surface area of a solid reactant is increased.
- The concentration of the reactants: The rate (speed) of a reaction increases when the concentration of a reactant in solution is increased.
- The temperature at which the reaction is carried out: The rate of a reaction increases when the temperature of the reaction mixture is increased.
- the use of catalyst: Catalyst is a substance that increases the rate of a chemical reaction. The catalyst remains chemically unchanged at the end of the reaction.
- The influence of light on some reactions: photosynthesis, photography
  FOOD IS STORED IN A REFRIGERATOR BECAUSE THE FOOD 'KEEPS BETTER'. THE RATE OF DECAY AND OXIDATION IS SLOWER AT LOWER TEMPERATURES.

INDUSTRIAL CHEMISTS USE CATALYSTS TO MAKE EVERYTHING FROM POLYTHENE AND PAINKILLERS TO FERTILIZERS AND FABRICS.

100. CATALYTIC CONVERTERS

Catalytic converters are used in vehicles to reduce the polluting effects of car exhaust fumes.
Car exhaust fumes contain gases such as carbon monoxide, nitrogen monoxide and unburnt hydrocarbons from the fuel which cause pollution in the air.
The catalytic converter converts these to less harmful products such as carbon dioxide, nitrogen and water.
Reactions:
Carbon monoxide + Oxygen → Carbon dioxide
Nitrogen monoxide + carbon monoxide → nitrogen + carbon dioxide
Nitrogen monoxide → nitrogen + oxygen
hydrocarbons +. Oxygen → carbon dioxide + Water

The catalytic converter therefore 'removes' polluting oxides and completes the oxidation of unburnt hydrocarbon fuel.
It speeds up these reactions considerably by providing a 'honeycombed' surface on which the gases can react.
The converter contains a thin coating of RHODIUM AND PLATINUM CATALYST on a solid honeycomb surface.
These catalysts have many tiny pores which provide a large surface area for the reactions.
Catalytic converters can only be used with unleaded petrol. The presence of lead poison the catalyst and stop it working.

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