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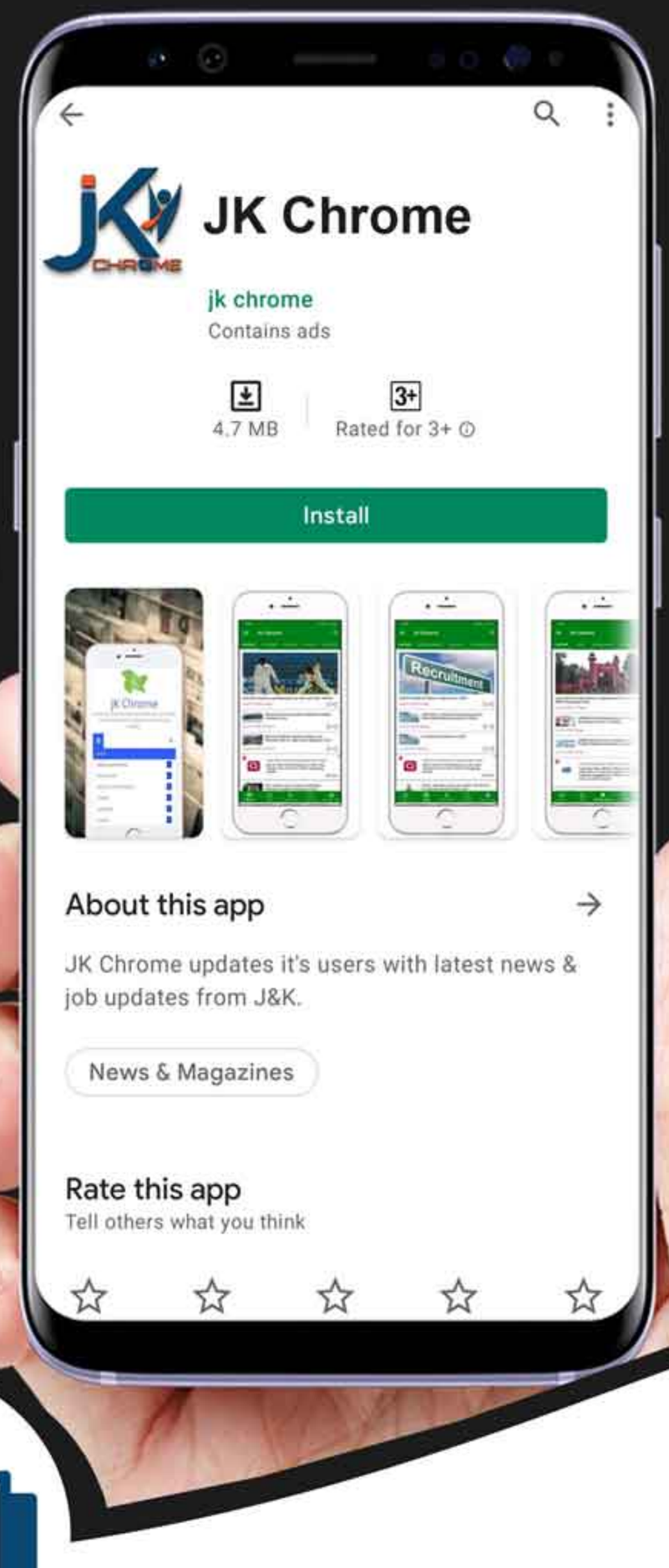

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Substance & its Nature

Introduction

Chemistry is the branch of science which deals with the composition of matter and also the Physical and Chemical characteristics associated with the different material objects.

A French chemist, Lavoisier (1743–1793) is regarded as father of modern chemistry.

Substance and its nature : Anything that occupies space, possesses mass and can be felt by any one or more of our senses is called matter.

Solid State : A solid possesses definite shape and definite volume which means that it can not be compressed on applying pressure. Solids are generally hard and rigid. Example—metals, wood, bricks, copper etc.

Liquid State : A liquid possesses definite volume but no definite shape. This means that the liquid can take up the shape of container in which it is placed. Example—water, milk, oil, alcohol etc.

Gaseous State : A gas does not have either a definite volume or definite shape. It can be compressed to large extent on applying pressure and also takes the shape of the container where it is enclosed. Examples— Air, Oxygen, Nitrogen, Ammonia, Carbondioxide etc.

Pure substances : A single substance (or matter) which can not be separated into other kinds of matter by any physical process is called pure substance. Pure substances have been classified as elements and compounds.

E**lements :** The simplest form of a pure substance which can neither be broken into nor built from simpler substances by ordinary physical and chemical methods is called element.

Elements are further classified into three types (i) Metals (ii) Non-metals and (iii) Metalloids.

Metals : Metals are solids (exception mercury which is liquid at room temperature) are normally hard. They have lustre, high mp and bp and also good conductor of electricity and heat. The conductivity of metal decreases with

increase in temperature due to vibration of positive ions at their Lattice points. Examples—Iron, Copper, Silver, Gold, Aluminium, Zinc etc.

Non-metals : Non-metals are the elements with properties opposite to those of the metals. They are found in all states of matter. They do not possess lustre (exception—iodine). They are poor conductors of electricity (exception-graphite) and they are not malleable and ductile. Examples—Hydrogen, Carbon, Oxygen, Nitrogen, Sulphur, Phosphorous etc.

Metalloids : Metalloids are the elements which have common properties of both metals and non-metals. Examples—Arsenic, Antimony, Bismuth etc.

Compounds : Compounds are pure substances that are composed of two or more different elements in fixed proportion by mass. The properties of a compound are entirely different from those of the elements from which it is made. Example—Water, Sugar, Salt, chloroform, Alcohol, Ether etc.

Compounds are classified into two types

(i) Organic Compounds **(ii)** Inorganic Compounds,

Organic Compounds : The Compounds obtained from living sources are called organic compounds. The term organic is now applied to hydrocarbons and their derivatives. Examples—Carbohydrates, Proteins, Oils, Fats etc.

Inorganic Compounds : The Compounds obtained from non-living sources such as rocks and minerals are called inorganic compounds. Examples—Common Salt, Marble, Washing Soda etc.

Mixtures : A material obtained by mixing two or more substances in any indefinite proportion is called a mixture. The properties of the components in a mixture remain unchanged. Example—Milk, Sea water, Petrol, Paint, Glass, Cement, Wood etc.

There are two types of mixture—

(1) Homogeneous mixture **(2)** Heterogeneous mixture.

1. Homogeneous mixture : A mixture is said to be homogeneous if it has a uniform composition through out and there are no visible boundaries of separation between constituents. More over, the constituents can not be seen even by a microscope. Examples—Common salt dissolved in water, sugar dissolved in water, iodine dissolved in CCl_4, benzene in toluene and methyl alcohol in water.

2. Heterogeneous mixture : A mixture is said to be heterogeneous if it does not have a uniform composition throughout and has visible boundaries of separation between the various constituents. The different constituents of the heterogeneous mixture can be seen even with naked eye. Example—-A mixture of Sulphur & Sand, A mixture of Iron filings & Sand etc.

Separation of mixture : Some methods of separation of mixtures are given below—

1. Sublimation : In this process, a solid substance passes direct into its vapours on application of heat. The vapours when cooled, give back the original substance. This method can be used for the substances which are sublime in their separation from non-sublimate materials. Examples of sublimes are Naphthalene, Iodine, Ammonium Chloride etc.

2. Filtration : This is a process for quick and complete removal of suspended solid particles from a liquid, by passing the suspension through a filter paper. Examples—(i) removed of solid particles from the engine oil in car engine. (ii) filtration of tea from tea leaves in the preparation of tea etc.

3. Evaporation : If a solution of solid substance in a liquid is heated, the liquid gets converted into its vapours and slowly goes off completely. This process is called evaporation. Example—(i) Evaporation of water in summer from Ponds, wells & lakes. (ii) Preparation of common salt from sea water by evaporation of water.

4. Crystallization : This method is mostly used for separation and purification of solid substances. In this process, the impure solid or mixture is heated with suitable solvent (e.g. alcohol, water, acetone, chloroform) to its boiling point and the hot solution is filtered. The clear filtrate is cooled slowly to room temperature, when pure solid crystallizes out. This is separated by filtration and dried.

For the separation of more complex mixtures, fractional crystallization is used, in which the components of the mixtures crystallize out at different interval of time.

5. Distillation : It is a process of converting a liquid into its vapour by heating and then condensing the vapour again into the same liquid by cooling. Thus, distillation involves vaporisation and condensation both

Distillation = Vaporisation + Condensation

This method is employed to separate the liquids which have different boiling points or a liquid from non-volatile solid or solids either in solution or suspension.

Example—A mixture of copper sulphate and water or a mixture of water (B.P 100°C) and methyl alcohol (B.P 45°C) can be separated by this method.

6. Fractional distillation : This process is similar to the distillation process except that a fractionating column is used to separate two or more volatile liquid which have different boiling points. Example-(i) Methyl alcohol (bp = 338 K) and acetone (bp = 329 K) can be separated by fractional distillation process. (ii) Separation of petrol, diesel oil, kerosene oil, heavy oil etc from crude petroleum. (iii) Separation of oxygen, nitrogen inert gasses and carbon dioxide from liquid air etc.

7. Chromatography : The name chromatography is derived from Latin word 'Chroma' meaning colour. The technique of chromatography is based on the difference in the rates at which the components of a mixture are absorbed in the suitable absorbent.

There are many types of chromatography.

(a) Column (absorption) Chromatography
(b) Thin layer chromatography
(c) Paper - chromatography
(d) High pressure liquid chromatography
(e) In-exchange chromatography
(f) Gas chromatography

8. Sedimentation and Decantation : This method is used when one component is a liquid and other is an insoluble. Insoluble solid, heavier than liquid. i.e, mud and water.

If muddy water is allowed to stand undisturbed for sometime in a beaker, the particles of earth (clay and sand) settle at the bottom. This process is called sedimentation. The clear liquid at the top can be gently transferred into another beaker. This process is known as decantation.

Concept of change in state : (a) Melting Point : The temperature at which solid and the liquid forms of the substance exist at equilibrium or both forms have same vapour pressure is called melting point.

(b Boiling point : The temperature at which the vapour pressure of the liquid is equal to atmospheric pressure is called boiling point.

(c) Freezing Point : The temperature at which the vapour pressure of its liquid is equal to the vapour pressure of the corresponding solid is called freezing point.

(d) Evaporation : The process of conversion of a liquid into its vapours at room temperature is called evaporation. Evaporation causes cooling. Actually, during evaporation, the molecules having higher kinetic energy escape from the surface of the liquid. Therefore, average kinetic energy of the rest of the molecules decreases. Therefore cooling takes place during evaporation because of temperature of liquid is directly proportional to average kinetic Energy. Evaporation is affected by following factors,

(i) Nature of liquid (ii) Temperature (iii) Surface area.

(e) Vapour pressure : The pressure exerted by the vapours of liquid in equilibrium with liquid at a given temperature is called vapour pressure. Vapour pressure depends upon—(i) its nature and (ii) temperature.

Higher the vapour pressure of a particular liquid lesser will be the magnitude of intermolecular forces present in molecules. Vapour pressure of a liquid increases with increase in temperature.