# SHORT NOTES: CLASS 9

# CHAPTER 2: IS MATTER AROUND US PURE?

**Pure substance:** A pure substance means a single substance (matter) which cannot be separated into other kinds of matter by any physical process.

**Effect of impurities on the freezing point and boiling point of a pure substance:** Impurities increase the boiling point of a liquid and decrease the freezing point.

**Types of Pure Substance:** i. Elements and ii. Compounds

**Elements:**

- An element is the simplest or basic form of a pure substance which cannot be broken down into anything simpler than it by physical or chemical methods.
- The pure substances which are made up of one kind of atoms only are called elements.

**Types of Elements:** i. Metals ii. Non-metals iii. Metalloids

**i. Metals:**

(a) Metals are lustrous.
(b) Metals are usually in silvery grey or golden yellow colour.
(c) Metals are sonorous i.e.; they make a ringing sound when hit.
(d) Metals are generally hard. *Exception: Sodium (Na) and Potassium(K).*
(e) Metals are solids at room temperature. *Exception: Mercury (Hg)(liquid).*
(f) Metals are good conductors of heat and electricity. *Exception-Lead (Pb) and Mercury (Hg).*
(g) Metals have high melting and boiling points. *Exception- Sodium (Na), Potassium(K), Gallium (Ga) and Caesium (Cs) have very low m.p.*
(h) Metals have high density. *Exception: Lithium (Li), Sodium (Na) and Potassium(K) have low densities*
(i) Metals are malleable i.e.; They can be hammered into thin sheets. Gold (Au) and Silver (Ag)-most malleable metals.
(j) Metals are ductile i.e.; They can be drawn into wires. Gold (Au)- most ductile.
(k) Metals generally form alloys.
(l) Metals donate electrons to form positive ions. (Cations)
(m) Examples of metals: Gold, Silver, Copper, Iron, Sodium, Aluminium etc.

**ii. Non-metals:**

(a) Non-metals are non-lustrous. *Exception: Graphite(C) and Iodine(I)*
(b) Non-metals display a variety of colours.
(c) Non-metals are non-sonorous.
(d) Non-metals are generally soft. *Exception: Diamond(C).*
(e) Non-metals are either solids or gaseous at room temperature. *Exception: Bromine (Br)(liquid).*
(f) Non-metals are poor conductors of heat and electricity. *Exception-Graphite(C)*
(g) Non-metals have low melting and boiling points. *Exception: Diamond(C), Graphite(C), Boron(B), Silicon (Si).*
(h) Non-metals have low density.
(i) Non-metals are non-malleable.
(j) Non-metals are non-ductile.
(k) Non-metals do not form alloys. *Exception- carbon(C) is alloyed with iron(Fe) to form steel*
(l) Non-metals gain electrons to form negative ions. (Anions)
(m) Examples of Non-metals: hydrogen, oxygen, iodine, carbon etc.

**iii. Metalloids:**

Elements which have properties, intermediate between those of metals and non-metals are called

metalloids. Metalloids often form amphoteric oxides and they often behave as semiconductors. Examples: Boron(B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb), Tellurium (Te), Polonium (Po) etc.

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

e.g., Water ($H_2O$) is a compound made up of two elements, Hydrogen and Oxygen chemically combined in a fixed proportion of 2:16(or 1:8) by mass.

Molecule is the smallest unit of the compound.

**Characteristics of Compounds:**

i. A pure compound is homogeneous in nature.
ii. A Compound is formed as a result of chemical reaction between the constituent elements. E.g., $C + O_2 \longrightarrow CO_2$.
iii. The composition of a compound is fixed, the constituents are present in fixed proportion by weight. Each compound has a definite formula.
iv. Properties of the compound are altogether different from the elements from which it is formed.
v. Constituents of the chemical compound cannot be separated mechanically.
vi. Formation of chemical compound involves energy changes. Energy is usually either given out or absorbed during the formation of a compound.

**Difference between Elements and Compounds:**

| | Elements | | Compounds |
|---|---|---|---|
| i. | An element is a substance which cannot be split into two or more different substances. | i. | A compound can be split into two or more different substances. |
| ii. | An element consists of same kind of atoms. | ii. | A compound is formed from atoms of different kinds. |

**Mixtures:** The combination of two or more substances (Elements or Compounds) which are not chemically combined with each other and may also be present in any proportion. The components of a mixture can be separated by mechanical means.

**Characteristics of Mixtures:**

i. A mixture shows the properties of all the constituents present in it.
ii. Energy change may or may not take place during the formation of a mixture.
iii. A mixture does not have a definite melting and boiling point.
iv. The composition of a mixture may vary, the constituents can be present in any proportion.
v. A mixture can be separated into its constituents by physical processes (like filtration, evaporation, sublimation, distillation etc.).
vi. In the formation of a mixture, no chemical reaction occurs.

**Types of Mixtures:** i. Homogeneous Mixtures ii. Heterogeneous Mixtures

i. **Homogeneous Mixtures:** A mixture is said to be homogeneous, if the different constituents or substances present in it exist in single phase without any visible boundaries of separation between them. A homogeneous mixture has a uniform composition throughout.
e.g., sugar in water, air etc.
All homogeneous mixtures are regarded as solutions.

ii. **Heterogeneous Mixtures:** A mixture is said to be heterogeneous, if it does not have a uniform composition and also has visible boundaries of separation between the constituents.
e.g., oil in water

Suspensions and Colloidal solutions are regarded as Heterogeneous mixtures.

**Difference between Compounds and Mixtures:**

| | Compounds | | Mixtures |
|---|---|---|---|
| i. | In a compound, two or more elements are combined chemically. | i. | In the mixture, two or more elements are simply mixed, not combined chemically. |
| ii. | In a compound, the elements are present in a fixed ratio by mass. | ii. | In a mixture, the constituents are not present in fixed ratio. It can vary. |
| iii. | Compounds are always homogeneous. they have the same composition throughout. | iii. | Mixtures may be either homogeneous or heterogeneous in nature. |
| iv. | Compounds do not show the characteristics of the constituting elements. | iv. | Mixtures show the characteristics of all its constituents. |
| v. | In the compound formation, energy (heat, light, electricity) is either absorbed or evolved. | v. | No energy change is noticed in the formation of a mixture. |
| vi. | In a compound, the constituents cannot be separated by physical means. | vi. | The constituents from a mixture can be easily separated by physical means. |
| vii. | A compound has a fixed melting point, boiling point etc. due to its composition. | vii. | A mixture does not have a fixed melting point. |

**Solution:** A solution is a homogeneous mixture of two or more substances.

**Components of a solution:** i. Solute ii. Solvent

**Solute + Solvent = Solution**

**Solute:** The component present in small amount is called solute.

**Solvent:** The component present in greater amount or proportion is called solvent.

e.g., Salt Solution: Solute- Salt, Solvent- Water

Copper Sulphate Solution: Solute- Copper Sulphate, Solvent-Water.

**Types of Solutions:**

| Based on the nature of solvent | | On the basis of amount of dissolved solute | |
|---|---|---|---|
| i. Aqueous Solution<br>ii. Non-aqueous Solution | i. Solid Solution<br>ii. Liquid Solution<br>iii. Gaseous Solution | i. Unsaturated Solution<br>ii. Saturated Solution<br>iii. Super-saturated Solution | i. Dilute solution<br>ii. Concentrated solution. |

**Aqueous Solution:** Solvent-water

**Non-aqueous Solution:** Solvent-other than water, e.g.; Alcohol, Carbon disulphide ($CS_2$), Carbon tetrachloride ($CCl_4$), acetone, benzene etc. e.g.; Iodine in alcohol (tincture of iodine), Bromine dissolved in chloroform.

**Solid Solution:** Solvent- Solid

**Liquid Solution:** Solvent-Liquid

**Gaseous Solution:** Solvent-Gas

| Solution | Solute | Solvent | Examples |
|---|---|---|---|
| ***Solid Solution*** | Gas | Solid | Gases present on metal surface under pressure. |
| | Liquid | Solid | Hydrated salts, e.g.; hydrated copper sulphate, $CuSO_4.5H_2O$ |
| | Solid | Solid | Alloys |
| ***Liquid Solution*** | Gas | Liquid | Aerated drinks |
| | Liquid | Liquid | Mixture of two miscible liquids. i.e., water and alcohol. |
| | Solid | Liquid | Sugar, common salt and other salts dissolved in water. |

| | | | |
|---|---|---|---|
| ***Gaseous Solution*** | Gas | Gas | Air |
| | Liquid | Gas | Clouds and fog |
| | Solid | Gas | In sublimation, the vapours of solid substance present in air. |

**Unsaturated solution:** A solution in which more solute can be dissolved at any particular temperature.
**Saturated solution:** A solution in which no more can be dissolved at a particular given temperature.
**Super-saturated solution:** If a solution has more than the maximum amount of solute present. Such a solution is said to be super saturated. More solute can be dissolved by heating the solution but on cooling, the extra amount of solute precipitate out.
**Dilute solution:** A dilute solution is the one that has relatively small amount of dissolved solute.
**Concentrated solution:** A concentrated solution is the one that has relatively large amount of dissolved solute.

**Properties of a solution:**

i. A solution is a homogeneous mixture, it has the same composition throughout.
ii. All the components in a solution are present in the same phase.
iii. The size of solute particles in a solution is very small.
iv. Particles of a solution cannot be seen by naked eye.
v. Due to the very small size, the solute particles in a solution do not scatter a beam of light.
vi. The solute particles cannot be separated from the mixture by the process of filtration.
vii. The solute particles do not settle down when left undisturbed. i.e., a solution is stable.

**Concentration of a solution:** The concentration of a solution is measured as the amount of solute present in a given amount of solvent or solution. It is expressed as mass percent or as volume percent.

(i) Mass by mass percentage of a solution = $\frac{\text{mass of solute}}{\text{mass of solution}} \times 100$

(ii) Mass by volume percentage of a solution = $\frac{\text{mass of solute}}{\text{volume of solution}} \times 100$

(iii) Volume by volume percentage of a solution = $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$

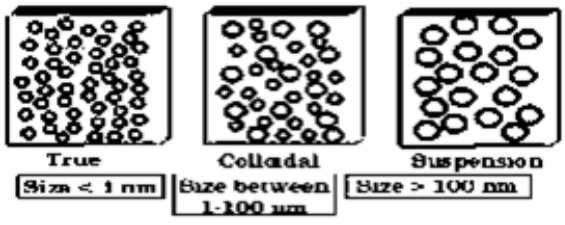
**Solubility and effect of temperature on solubility:** Amount of solute present in the saturated solution at a particular temperature is called its solubility. Solubility increases with rise in temperature. This means that sodium chloride becomes more soluble in water upon heating.

**Heterogeneous Mixtures:** **i. Suspension** **ii. Colloids**

**Suspensions:** Suspensions may be defined as a heterogeneous mixtures in which the solid particles are spread throughout the liquid without dissolving in it. They settle as precipitate if the suspension is left undisturbed.

**Properties of a suspension:**

i. A suspension is a heterogeneous mixture.
ii. Particles of a suspension can be seen by the naked eye.
iii. The solute particles settle down when a suspension is left undisturbed. i.e., a suspension is unstable.




iv. The particles of a suspension scatter a beam of light passing through it and make its path visible, but when the particles settle down, the suspension breaks and it does not scatter light anymore.

v. A suspension can be separated from the mixture by the process of filtration.
vi. The size of solute particles in a suspension is greater than 100nm.

**Examples of suspension:** chalk-water mixture, muddy-water, sand particles suspended in water, some paints.

**Colloidal solutions:** Colloidal solutions are also heterogeneous in nature like suspensions, but they have smaller size of particles which are distributed. Because of smaller size of particles, most of the colloidal solution appears to be homogeneous like true solutions.

**Examples of colloids:** smoke coming out of chimneys, toothpaste, ink, blood, soap solution, starch solution.

**Two phases of colloids: i. Dispersed phase** (component present in smaller proportion)
**ii. dispersion medium** (component present in greater proportion)

**Types of colloidal solution:**

| S.No. | Dispersed Phase | Dispersing Medium | Type | Examples |
|---|---|---|---|---|
| i. | Liquid | Gas | Aerosol | Mist, Fog, Cloud |
| ii. | Solid | Gas | Aerosol | Smoke, Automobile exhaust, Volcanic dust |
| iii. | Gas | Liquid | Foam | Shaving cream, Soap leather, Soda water |
| iv. | Liquid | Liquid | Emulsion | Milk, Face cream |
| v | Solid | Liquid | Sol | Mud, Paints |
| vi | Gas | Solid | Foam | Foam, Rubber, Sponge, Bread |
| vii | Liquid | Solid | Gel | Jelly, Cheese, Butter, Boot polish, Curd |
| viii | Solid | Solid | Solid sol | Alloys, Coloured glass |

### Properties of Colloidal Solution:

i. A colloid is a heterogeneous mixture.
ii. Colloidal particles pass through the filter paper. They cannot be separated from the mixture by the process of filtration. Centrifugation can be used to separate the colloid particles.
iii. Particles in colloidal solutions follow zig-zag path.
iv. The size of colloid particles is bigger than those in a true solution but smaller than those in a suspension. It is between 1nm and 100nm in diameter.
v. Particles of colloid do not settle down when left undisturbed, i.e., a colloid is quite stable.
vi. Colloidal solutions scatter the beam of light passing through it. The particles present in colloidal solutions have size big enough to scatter or disperse the light rays present in the beam as they fall on them. As a result, these rays as well as colloidal particles become visible. This scattering of light by colloidal particles is known as **Tyndall effect.**

**Example of Tyndall effect:** When sunlight passes through canopy of forest shows Tyndall effect as tiny droplets of water in mist acts as particles of colloid dispersed in air.

**Physical and Chemical Changes:**

| Physical Change | | Chemical Change | |
|---|---|---|---|
| i. | A physical change involves a change in the physical state of a substance by changing either the interparticle spaces or interparticle forces. | i. | As a result of chemical change, the physical state of a substance may or may not change. |
| ii. | There is no change in the composition of substances during physical changes. | ii. | There is always a change in chemical composition. |
| iii. | No new substance is formed during a | iii. | New substances are always formed during a |

| | | | |
|---|---|---|---|
| | physical change. | | chemical change. |
| iv. | Change is temporary and can be reversed by reversing the conditions which bring about the change. | iv. | The chemical change is of permanent nature. |
| v. | Energy changes may or may not occur. | v. | Energy changes always occur. |
| vi. | Examples: melting, freezing, evaporation, condensation, vaporization, sublimation etc. | vi. | Examples: burning of coal, souring of milk, digestion of food in our body. |