CHAPTER

1 Nature of Matter

1. **Substance (or chemical substance) :** A **"substance"** is a kind of matter that can not be separated into other kinds of matter by any physical process. e.g. gold, silver, iron, sodium chloride, calcium carbonate etc.
2. **Pure substance:** is one that is a *single substance* and has a *uniform composition*. Such a substance always have the *same texture* and *taste*. e.g. water, salt, sugar etc.
3. **Testing the purity of a substance :** The purity of substance can easily be checked by checking its melting points in case of a solid substance or by checking its boiling points in case of a liquid substance.
4. **Types of pure substances :** Two different types of pure substances are
   - **(i) Element:** An element is a substance which can not be split up into two or more simpler substances by usual chemical methods of applying heat, light or electric energy. e. g. hydrogen, oxygen, sodium, chlorine etc.
   - **(ii) Compound:** A compound is a substance made up of two or more elements chemically combined in a fixed ratio by weight e.g. H_2O (water), NaCl (sodium chloride) etc.
5. **Mixture :** A mixture is a substance which consists of two or more elements or compounds not chemically combined together. e.g. Air is a mixture of nitrogen, oxygen, inert gases, water vapour, carbon dioxide etc.
6. **Types of mixtures :** Mixtures are *impure substances*. They are of two types:
   - (i) **Homogeneous mixture:** It has a uniform composition throughout and its components can not be distinguished visually. e.g. a well mixed sample of vinegar.
   - (ii) **Heterogeneous mixture:** It is one that is not uniform throughout. Different samples of a heterogeneous mixture may have different composition. e.g. a mixture of salt and pepper.
7. **Solution :** It is a homogeneous mixture of two or more substances whose composition can be varied. e.g. solution of common salt in water, solution of ammonia in water. Some other examples are lemonade, coke, pepsi etc.
8. **Separating the components of a mixture :** Various methods are used for separating the constituents of a mixture. Depending upon the type of mixture (i.e. whether it is a homogeneous mixture or heterogeneous mixture) different methods used are given below :

	Mixture	Separation Method
1.	Insoluble solid in solvent	*Sedimentation* followed by *filtration*. In case of a fine solid *centrifugation* is used instead of filtration
2.	Solution of solid in liquid	Evaporation, crystallization, distillation
3.	Miscible mixture of liquids.	Fractional distillation
4.	Immiscible mixture of liquids.	Separating funnel
5.	Mixture of two solids one of which is sublime	Sublimation
6.	Mixture of substances in solution.	Chromatography

9. **Solute :** The component of solution that is dissolved and present in smaller quantities in a solution is known as solute. e.g. **common salt** in case of solution of common salt in water and **ammonia** in case of solution of ammonia in water.
10. **Solvent :** The component of solution in which solute is dissolved is known as solvent. It is always present in larger amount in a solution. e.g. water in case of the solution of common salt or ammonia in water.
11. **Saturated Solution :** A solution in which no more solute can be dissolved at the same temperature is called *Saturated solution*.
12. **Unsaturated Solution :** It is a solution in which more solute can be dissolved at the same temperature.
13. **Super-saturated Solution :** It is a solution which contains more mass of the dissolved solute than the saturated solution at the same temperature and pressure.
14. **Alloys :** Alloys are homogeneous mixtures of metal and can not separated into their components by physical methods.

    e.g. **Brass** is a mixture of copper (Cu) and zinc (Zn).

15. **Concentration of a solution :** *Concentration of a solution* is the amount of solute present in a given amount (mass or volume) of a solution or the amount of solute dissolved in a given mass or volume of a solvent.

$$\text{Concentration} = \frac{\text{Amount of solute}}{\text{Amount of solvent}}$$

16. **Solubility :** It is defined as the amount of solute dissolved in 100g of solvent to form a saturated solution.

17. **Suspension :** It is a non-homogeneous mixture in which *solids are dispersed in liquids.* In it the solute particles do not dissolve but remains suspended through out the bulk of the medium.

18. **Colloids or colloidal solution : Colloid** is a *heterogeneous mixture.* The size of particles of a colloid is intermediate between *true solutions* and *suspensions* (i.e between 1nm and 100 nm). The particles of a colloid can not be seen with naked eye.

19. **Types of colloidal solution :** Since colloidal solution is heterogeneous mixture it consists of two *phases*. These are

    (i) *dispersed phase* (colloidal particles)

    (ii) *dispersion medium* (The medium in which colloidal particles are dispersed.)

20. **Emulsion :** Emulsions are liquid-liquid colloids.

21. **Types of Emulsion :** Emulsions are of two types :

    (i) water in oil (ii) oil in water

22. **Emulsifiers** are those substances that help in forming stable emulsions of oil and water, e.g. milk, cod-liver oil, cold creams, vanishing creams, moisturising cream, paints, etc.

23. **Physical change :** During such a change no new substances is formed and there is no change in the chemical properties of the substances.

24. **Chemical change :** Such a change is accompanied by change in chemical properties and formation of new substances.

25. **Elements** are a type of pure substances. An element is a substance that can **not** be split into two or more simpler substances by usual chemical methods of applying heat, light or electric energy.

    Types of elements : Elements have been divided into **metals** and **non-metals**. All metals (except mercury) are solids. mercury is a liquid, e.g. sodium, potassuim, gold, silver etc.

    All non-metals are solids or gases (Bromine is an exception as it is a *liquid* non-metal) e.g. hydrogen, oxygen, carbon, bromine, chlorine, iodine etc.

26. **Compound :** A compound is a substance made up of two or more elements chemically combined in a fixed ratio by weight. e.g. water (H_2O) is a compound made up of two elements *Hydrogen* and *Oxygen* chemically combined in a fixed proportion of 1: 8 by weight.

EXERCISE

1. Air is regarded as a mixture because
   (a) its pressure may very
   (b) its temperature may change
   (c) its volume changes under different conditions
   (d) its composition may vary
2. Which of the following is a compound ?
   (a) Stainless steel (b) Bronze
   (c) Graphite (d) Hydrogen sulphide
3. The process used to separate oil and water is
   (a) distillation (b) sublimation
   (c) separating funnel (d) chromatography
4. In which of the following the constituents are present in any ratio?
   (a) Mixture (b) Compound
   (c) Solution (d) Colloid
5. A mixture of common salt, sulphur, sand and iron filings is shaken with carbon disulphide and filtered through a filter paper. The filtrate is evaporated to dryness in a china dish. What will be left in the dish after evaporation?
   (a) Sand (b) Sulphur
   (c) Iron filings (d) Common salt
6. Two substances A and B when brought together form a substance C with the evolution of heat. The properties of C are entirely different from those of A and B. The substance C is
   (a) a compound (b) an element
   (c) a mixture (d) none of these.
7. Camphor can be purified by
   (a) distillation (b) filtration
   (c) sedimentation (d) sublimation
8. Which one of the following will result in the formation of a mixture?
   (a) Crushing of a marble tile into small particles
   (b) Breaking of ice cubes into small pieces
   (c) Adding sodium metal to water
   (d) Adding milk in water
9. Purity of a solid substance can be checked by its
   (a) boiling point (b) melting point
   (c) solubility in water (d) solubility in alcohol
10. A mixture of ethanol and water can be separated by
    (a) filtration (b) decantation
    (c) fractional distillation (d) sublimation
11. Salt can be obtained from sea water by
    (a) filtration (b) decantation
    (c) evaporation (d) sublimation
12. A sample contains two substances and has uniform properties. The sample is
    (a) a compound (b) a heterogeneous mixture
    (c) an element (d) a homogeneous mixture
13. Which of the following is considered to be a pure substance?
    (a) Granite (b) Sodium chloride
    (c) Muddy water (d) Milk of magnesia
14. Physical properties of a mixture
    (a) vary with the amount of substance.
    (b) depend on the volume of the substance
    (c) depend on the organization of the substance
    (d) vary depending upon its components
15. Compounds
    (a) are the same as mixtures
    (b) can be separated by their physical properties
    (c) contain only one type of element
    (d) are different kinds of atoms chemically combined with each other.
16. White gold is used in jewelry and contains two elements, gold and palladium. A jeweler has two different samples that are both identical in appearance and have a uniform composition throughout. What can be said about the samples?
    (a) They are homogeneous mixtures and be classified as metallic alloys.
    (b) The materials are heterogeneous mixtures and can be classified by their components
    (c) The samples have variable compositions and are classified as metallic solutions.
    (d) The samples are heterogeneous mixtures that can be separated using magnetic properties.
17. Which of the following is an example of a heterogeneous substance?
    (a) Bottled water (b) Table salt
    (c) Pieces of copper (d) Candle
18. Which of the following is an example of a homogeneous substance?
    (a) Granite (b) Copper sulphate
    (c) Oil-water solution (d) Muddy water
19. Filtration can be used to separate
    (a) solids from solids (b) liquids from solids
    (c) liquids from liquids (d) liquids from gases
20. Melting points can separate materials because
    (a) substances melt at different temperatures
    (b) molecules vibrate rapidly when heated
    (c) heat causes molecules to disintegrate
    (d) many substances fuse at the melting point
21. Distillation is a good separation technique for
    (a) solids (b) liquids
    (c) solid alloys (d) gases
22. Solubility is a good separation technique for
    (a) pure metals (b) noble gases
    (c) different salts (d) metallic alloys
23. Magnetism is most beneficial for separating
    (a) gases and non-metallic liquids
    (b) magnetic solids and solids such as sulfur
    (c) non-metallic solids and solids such as sulfur
    (d) non-magnetic solids from non-magnetic liquids
24. Select the one that is a chemical change.
    (a) Melting of wax (b) Freezing of water
    (c) Cooking of food (d) None of these

25. Select the one that is a physical change.
(a) Digestion of food (b) Growth of plant
(c) Rusting of iron (d) None of these

26. On passing through a colloidal solution, the beam of light gets .....
(a) reflected (b) refracted
(c) scattered (d) absorbed

27. The size of colloidal particles usually lies in the range
(a) 10^{-5} - 10^{-7} cm (b) 10^{-7} - 10^{-9} cm
(c) 10^{-3} - 10^{-5} cm (d) 10^{-2} - 10^{-6} cm

28. Brass is an example of
(a) compound (b) element
(c) homogeneous mixture (d) heterogeneous mixture

29. Select the one that is not a chemical change ?
(a) Dissolution of ammonia in water.
(b) Dissolution of carbon dioxide in water.
(c) Dissolution of oxygen in water.
(d) None of these is a chemical change.

30. A change is said to be a chemical change when
(a) it is accompanied by energy change
(b) it is accompanied by formation of new substances
(c) it is accompanied by change in physical properties
(d) All the above are correct

31. Solutions with low concentrations of solutes are
(a) concentrated (b) dilute
(c) solvents (d) None of these

32. Which of the following statements is true about a colloidal system?
(a) It carries a net electric charge
(b) It consists of one phase only
(c) It can be made out of two gases
(d) It is electrically neutral as a whole

33. Cloud or fog is an example of colloidal system of
(a) liquid dispersed in gas (b) gas dispersed in gas
(c) solid dispersed in gas (d) solid dispersed in liquid

34. Normal solution is :
(a) inert solution
(b) acidic solution
(c) one litre containing one equivalent
(d) basic solution

35. Which of the following is a colloid ?
(a) Sugar solution (b) Urea solution
(c) Silicic acid (d) NaCl solution

36. When dispersed phase is liquid and dispersion medium is gas then the colloidal system is called
(a) smoke (b) clouds
(c) jellies (d) emulsions

ANSWER KEY

1	(d)	**7**	(d)	**13**	(b)	**19**	(b)	**25**	(d)	**31**	(b)
2	(d)	**8**	(d)	**14**	(d)	**20**	(a)	**26**	(c)	**32**	(d)
3	(c)	**9**	(b)	**15**	(d)	**21**	(b)	**27**	(a)	**33**	(a)
4	(a)	**10**	(c)	**16**	(a)	**22**	(c)	**28**	(c)	**34**	(c)
5	(b)	**11**	(c)	**17**	(d)	**23**	(b)	**29**	(c)	**35**	(c)
6	(a)	**12**	(d)	**18**	(b)	**24**	(c)	**30**	(d)	**36**	(b)

HINTS AND SOLUTIONS

1. (d) Air is a mixture of different gases like N_2, O_2, CO_2 etc. Its general composition is N_2 = 78%, O_2 = 21% and traces of few other gases but there may be variation in its composition from place to place and at different height.
2. (d) Hydrogen sulphide (H_2S) is a compound of hydrogen and sulphur. Stainless steel and bronze are alloys whereas graphite is allotropic form of element carbon.
3. (c) As oil being less denser than water it forms upper layer. Thus mixture of oil and water can be separated by using separating funnel.
5. (b) Sulphur will left behind. As in given mixture only sulphur gets dissolved in carbon disulphide.
6. (a) C is a compund which is formed as a result of reaction between A and B.
7. (d) Camphor being a sublime substance can be purified by sublimation.
9. (b) Every pure solid has a fixed melting point.
10. (c) Mixture of ethanol and water can be separated by fractional distillation as they have different boiling points.
11. (c) Sea water is a solution of salt and water.During evaporation water gets evaporated off and salt left as a residue.
12. (d) Homogeneous mixture is a solution having uniform composition and properties throughout.
13. (b) Sodium chloride being compound is a pure substance. Granite, muddy water and milk of magnesia all are mixtures.
14. (d) Physical properties of mixtures are same as of its components.
15. (d) In a compund the elements are present in a fixed ratio by weight.
16. (a) As they have uniform composition throughout they are considered as homogeneous mixture. Both samples are mixture of two metals (gold and palladium) thus are alloys.
17. (d) Candle is a heterogeneous mixture of wax and thread. Copper is element while bottled water and table salt are compounds.
18. (b) It is a compound.
20. (a) Different pure solid substances melts at a different temperatures.
21. (b) Distillation is a separation technique used for separation of miscible liquids having different boiling point.
22. (c) Different salts have different solubility in a particular solvent. Thus on this basis mixture of different salts can be separated.
23. (b) Magnetism is useful for separation of magnetic and non-magnetic substances.
24. (c) Chemical changes are irrerversible in nature.
25. (d) Each of the process given in options are irreversible and involve change in chemical properties hence all are chemical changes.
26. (c) This is due to Tyndall effect.
27. (a) The size of colloidal particles usually lie in range of one nm to 100 nm. i.e., 10^{-5} to 10^{-7} cm
or $1nm = 10^{-7}$ $\therefore$ $100\ nm = 10^{-5}cm$
28. (c) Brass is an alloy which is a homogeneous substance.
29. (c) Oxygen is insoluble in water.
31. (b) dilute solutions have low concentration of solid.
33. (a) Fog is a colloidal system consisting water droplets dispersed in air.
34. (c) The solution which has one gram equivalent in one litre is called normal solution.
35. (c) Those substances which can not pass through membrane are termed as colloids e.g., silicic acid. Whereas sugar solution, urea and NaCl can pass through the membrane.
36. (b) Clouds consists of fine droplets of water suspended in air.