


2 Is Matter Around us Pure?

Fastrack Revision

- ▶ **Pure Substance:** A pure substance consists of single type of particles, *i.e.*, it contains only one kind of pure matter and its composition is the same throughout. It cannot be separated by physical process into its chemical constituents, *e.g.*, sodium chloride, sugar, etc.
- ▶ **Mixtures:** Mixtures are constituted by more than one kind of pure form of matter, *i.e.*, they contain more than one pure substance, *e.g.*, soft drink, soil, etc.
- ▶ **Types of Mixtures:** Mixtures are of two types:
 - ▶ **Homogeneous Mixtures:** Mixtures which have a uniform composition throughout are called homogeneous mixtures. However, they can have a variable composition, *e.g.*, salt dissolved in water, sugar dissolved in water, etc.
 - ▶ **Heterogeneous Mixtures:** Mixtures which contain physically distinct parts and have non-uniform compositions are called heterogeneous mixtures, *e.g.*, oil and water, salt and sulphur, etc.
- ▶ **Solution:** A solution is a homogeneous mixture of two or more substances, *e.g.*, lemonade, soda water, etc. In a solution, there is homogeneity at the particle level, *i.e.*, particles of dissolved substances are evenly distributed in the solution.

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 Only homogeneous mixtures can be regarded as solutions. The heterogeneous mixtures are not solutions.

- ▶ **Components of Solution:** Components of a solution are:
 - ▶ **Solvent:** The component of the solution that dissolves the other component in it (usually the component present in larger amount) is called the solvent.
 - ▶ **Solute:** The component of the solution that is dissolved in the solvent (usually present in lesser quantity) is called the solute.
- ▶ **Examples of a Solution**
 - ▶ A solution of sugar in water is a solid in liquid solution. In this solution, sugar is the solute and water is the solvent.
 - ▶ A solution of iodine in alcohol known as 'tincture of iodine', has iodine (solid) as the solute and alcohol (liquid) as the solvent.
 - ▶ Aerated drinks like soda water etc., are gas in liquid solutions. These contain carbon dioxide (gas) as solute and water (liquid) as solvent.
 - ▶ Air (gaseous solutions) is a mixture of gas in gas. Air is a homogeneous mixture of a number of gases.
- ▶ Alloys (solid solutions) are mixtures of two or more metals or a metal and a non-metal and cannot be separated into their components by physical method, *e.g.*, brass is a mixture of 30% zinc and 70% copper.
- ▶ **Properties of a Solution**
 - ▶ A solution is a homogeneous mixture.
 - ▶ The particles of a solution are smaller than 1 nm (10^{-9} metre) in diameter. So, they cannot be seen by naked eyes.
 - ▶ Because of very small particle size, they do not scatter a beam of light passing through the solution. So, the path of light is not visible in a solution.
 - ▶ The solute particles cannot be separated from the mixture by the process of filtration. The solute particles do not settle down when left undisturbed, that is, a solution is stable.
- ▶ **Saturated Solution:** A solution in which no more solute can be dissolved at a given temperature, is called a saturated solution.

The amount of solute present in the saturated solution at this temperature is called solubility.
- ▶ **Unsaturated Solution:** If the amount of solute contained in a solution is less than the saturation level, it is called an unsaturated solution.
- ▶ **Concentration of Solution:** The concentration of a solution is the amount (mass or volume) of solute present in a given amount (mass or volume) of solution.
- ▶ **Expressing the Concentration of a Solution**
 - ▶ Mass by mass percentage of a solution
$$\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$
 - ▶ Mass by volume percentage of a solution
$$\frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$
 - ▶ Volume by volume percentage of a solution
$$\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$
- ▶ **Suspension:** A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.

► Properties of a Suspension

- Suspension is a heterogeneous mixture.
- The particles of a suspension can be seen by the naked eye.
- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable. They can be separated from the mixture by the process of filtration. When the particles settle down, the suspension breaks and it does not scatter light any more.

► **Colloidal Solution or Colloid:** A mixture that is actually heterogeneous but appears to be homogeneous as the particles are uniformly spread throughout the solution, e.g., milk, cheese, etc.

► Properties of a Colloid

- A colloid is a heterogeneous mixture.
- The size of particles of a colloid is too small to be individually seen by naked eyes.
- Colloids are big enough to scatter a beam of light passing through it and make its path visible.
- They do not settle down when left undisturbed, that is, a colloid is quite stable.
- They cannot be separated from the mixture by the process of filtration. But, a special technique of separation known as centrifugation can be used to separate the colloidal particles.

The components of a colloidal solution are the dispersed phase and the dispersion medium. The solute-like component or the dispersed particles in a colloid form the dispersed phase and the component in which the dispersed phase is suspended is known as the dispersing medium.

► Common Examples of Colloids

| Dispersed Phase | Dispersing Medium | Type | Example |
|-----------------|-------------------|-----------|--------------------------------|
| Liquid | Gas | Aerosol | Fog, clouds, mist |
| Solid | Gas | Aerosol | Smoke, automobile exhaust |
| Gas | Liquid | Foam | Shaving cream |
| Liquid | Liquid | Emulsion | Milk, face cream |
| Solid | Liquid | Sol | Milk of magnesia, mud |
| Gas | Solid | Foam | Foam, rubber, sponge, pumice |
| Liquid | Solid | Gel | Jelly, cheese, butter |
| Solid | Solid | Solid Sol | Coloured gemstone, milky glass |

► **Tyndall Effect:** The scattering of light by colloidal particles is known as Tyndall effect. It can also 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.
- When sunlight passes through the canopy of a dense forest.

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Tyndall effect is quite helpful in distinguishing a colloidal solution from a true solution. If the path of light becomes visible while passing through a particular solution, it is a colloidal solution. In case, it remains invisible, the solution is regarded as a true solution.



- **Physical Change:** Change in which only physical properties of the substances change but no new substances are formed, e.g., melting of ice to form water, etc.
- **Chemical Change:** Change in which new substances are formed and chemical properties of a substance gets changed, e.g., rusting of iron, etc.

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During burning of a candle, both physical and chemical changes take place.



- **Elements:** An element is defined as a basic form of matter that cannot be broken down into simpler substances by chemical reactions. Elements are divided into metals, non-metals and metalloids.

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Around 118 elements exist in nature where around 92 are natural and rest are man-made elements.



- **Metals:** Metals are one category of elements that have lustre. They have silvery-grey or golden-yellow colour. They conduct heat and electricity. They are sonorous. They are malleable and ductile, e.g., gold, silver, etc.

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Mercury is the only metal which is liquid at room temperature.



- **Non-metals:** They do not have lustre, are not sonorous and are poor conductors of heat and electricity. They are brittle, e.g., hydrogen, oxygen, etc.

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Bromine is the only non-metal that exists in liquid state at normal conditions of temperature and pressure.



- **Metalloids:** These are elements having properties intermediate between those of metals and non-metals, e.g., germanium, silicon, etc.
- **Compounds:** Pure substances composed of two or more elements, chemically combined with one another in a fixed proportion, e.g., water (H_2O), methane (CH_4), etc. Properties of a compound are different from its constituent elements.



Practice Exercise



Multiple Choice Questions

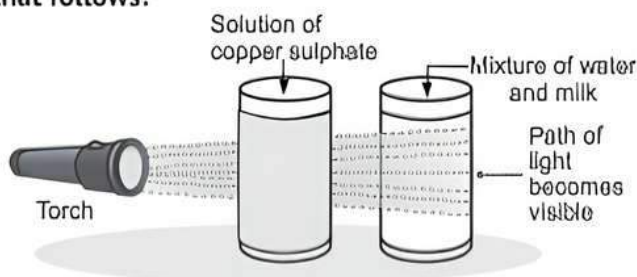
Q 1. Which of the following statements are true for pure substances? (NCERT EXEMPLAR)

- (i) Pure substances contain only one kind of particles.
 - (ii) Pure substances may be compounds or mixtures.
 - (iii) Pure substances have the same composition throughout.
 - (iv) Pure substances can be exemplified by all elements other than nickel.
- a. (i) and (ii) b. (i) and (iii)
c. (iii) and (iv) d. (ii) and (iii)

Q 2. Which of the following are homogeneous in nature? (NCERT EXEMPLAR)

- (i) Ice (ii) Wood
 - (iii) Soil (iv) Air
- a. (i) and (iii) b. (ii) and (iv)
c. (i) and (iv) d. (iii) and (iv)

Q 3. Observe the given diagram and answer the question that follows:



Identify the correct statement(s).

- (i) Solution of copper sulphate shows Tyndall effect.
 - (ii) Tyndall effect can be observed when a fine beam of light enters a room through a small hole due to scattering of light by the particles of dust and smoke in the air.
 - (iii) Tyndall effect can be observed when sunlight passes through the canopy of a dense forest.
 - (iv) Mixture of water and milk shows Tyndall effect.
- a. Only (i) b. (ii) and (iii)
c. (ii), (iii) and (iv) d. All of these

Q 4. A mixture of sulphur and carbon disulphide is: (NCERT EXEMPLAR)

- a. heterogeneous and shows Tyndall effect
- b. homogeneous and shows Tyndall effect
- c. heterogeneous and does not show Tyndall effect
- d. homogeneous and does not show Tyndall effect

Q 5. Tincture of iodine has antiseptic properties. This solution is made by dissolving: (NCERT EXEMPLAR)

- a. Iodine in potassium iodide
- b. Iodine in vaseline
- c. Iodine in water
- d. Iodine in alcohol

Q 6. A solution contains 38 g of common salt in 362 g of water. The concentration of this solution is:

- a. 9.5 % b. 10.49 %
- c. 11.7 % d. 10.85 %

Q 7. Size of colloidal particles in a solution is:

- a. more than 100 nm b. less than 1 nm
- c. between 1 to 100 nm d. between 100 to 1000 nm

Q 8. Which of the following statements are correct about properties of colloids?

- (i) A colloid is a homogeneous mixture.
- (ii) The size of particles of a colloid is too small to be individually seen by naked eye.
- (iii) Colloids are big enough to scatter a beam of light passing through it and make its path visible.

- a. (i), (ii) and (iii) b. (ii) and (iii)
- c. (i) and (ii) d. (i) and (iii)

Q 9. Which of the following is correctly matched?

- a. Emulsion-mud b. Aerosol-jelly
- c. Sol-milk of magnesla d. Gel-face cream

Q 10. Match Column I with Column II.

| Column I | Column II |
|------------------|---------------------|
| A. Fog | (i) Solid in gas |
| B. Smoke | (ii) Gas in solid |
| C. Sponge | (iii) Gas in liquid |
| D. Shaving cream | (iv) Liquid in gas |

- a. A-(iii), B-(i), C-(iv), D-(ii) b. A-(iv), B-(i), C-(ii), D-(iii)
- c. A-(iii), B-(ii), C-(i), D-(iv) d. A-(iv), B-(ii), C-(i), D-(iii)

Q 11. Rusting of an article made up of iron is called: (NCERT EXEMPLAR)

- a. corrosion and it is a physical as well as chemical change
- b. dissolution and it is a physical change
- c. corrosion and it is a chemical change
- d. dissolution and it is a chemical change

Q 12. Which of the following are physical changes? (NCERT EXEMPLAR)

- (i) Melting of iron metal
- (ii) Rusting of iron
- (iii) Bending of an iron rod
- (iv) Drawing a wire of iron metal

- a. (i), (ii) and (iii) b. (i), (ii) and (iv)
- c. (i), (iii) and (iv) d. (ii), (iii) and (iv)

Q 13. Which of the following are chemical changes?

- (i) Decaying of wood
- (ii) Burning of wood
- (iii) Sawing of wood
- (iv) Hammering of a nail into a piece of wood

(NCERT EXEMPLAR)

- a. (i) and (ii) b. (ii) and (iii)
- c. (iii) and (iv) d. (i) and (iv)

Q 14. Who was the first scientist to use the term element?

- a. Robert Boyle b. Lavoisier
- c. Dalton d. Charles

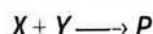
Q 15. Which of the following is a metalloid?

- a. Germanium b. Gallium
- c. Carbon d. Sodium

Q 16. Which of the following is not a compound?

- a. Marble b. Washing soda
- c. Quicklime d. Brass

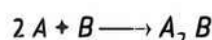
Q 17. Two chemical species X and Y combine together to form a product P which contains both X and Y .



X and Y cannot be broken down into simpler substances by simple chemical reactions. Which of the following concerning the species X , Y and P are correct? (NCERT EXEMPLAR)

- (i) P is a compound
 - (ii) X and Y are compounds
 - (iii) X and Y are elements
 - (iv) P has a fixed composition
- a. (i), (ii) and (iii) b. (i), (ii) and (iv)
 - c. (ii), (iii) and (iv) d. (i), (iii) and (iv)

Q 18. Two substances, A and B were made to react to form a third substance, A_2B according to the following reaction:



Which of the following statements concerning this reaction are incorrect? (NCERT EXEMPLAR)

- (i) The product A_2B shows the properties of substances A and B .
 - (ii) The product will always have a fixed composition.
 - (iii) The product so formed cannot be classified as a compound.
 - (iv) The product so formed is an element.
- a. (i), (ii) and (iii) b. (i), (ii) and (iv)
 - c. (i), (iii) and (iv) d. (ii), (iii) and (iv)



Assertion & Reason Type Questions

Directions (Q. Nos. 19-27): Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

- c. Assertion (A) is true but Reason (R) is false.
- d. Assertion (A) is false but Reason (R) is true.

Q 19. Assertion (A): A solution of sugar in a glass of water is homogeneous.

Reason (R): A solution having non-uniform composition is homogeneous.

Q 20. Assertion (A): True solution do not exhibit Tyndall effect.

Reason (R): Particles of true solution are very small in size.

Q 21. Assertion (A): Solute particles can be separated from the solution by the process of filtration.

Reason (R): A solution is a homogeneous mixture.

Q 22. Assertion (A): On dissolving chalk powder in water, a suspension is obtained.

Reason (R): The particles of a suspension can be seen by the naked eye.

Q 23. Assertion (A): Tyndall effect can be observed in the canopy of a dense forest.

Reason (R): When a beam of light passes through the canopy of a dense forest, it gets scattered by the tiny droplets of water that act as particles of colloid dispersed in air.

Q 24. Assertion (A): When a beam of light is passed through a colloidal solution placed in a dark place the path of the beam becomes visible.

Reason (R): Light gets scattered by the colloidal particles.

Q 25. Assertion (A): Colloidal solutions are stable and the colloidal particles do not settle down.

Reason (R): Colloidal particles can be separated from a colloidal solution by centrifugation.

Q 26. Assertion (A): If the dispersed phase is liquid and the dispersion medium is solid, the colloid formed is known as sol.

Reason (R): Mud is an example of a sol.

Q 27. Assertion (A): Interconversion of states of matter is considered a physical change.

Reason (R): Interconversion of states of matter takes place without change in composition.

Answers

1. (b) (i) and (iii)
Pure substances may be elements or compounds.
2. (c) (i) and (iv)
3. (c) (ii), (iii) and (iv)
Solution of copper sulphate does not show Tyndall effect.

4. (a) heterogeneous and shows Tyndall effect
Adding sulphur to carbon disulphide forms a heterogeneous colloid exhibiting Tyndall effect.
5. (d) Iodine in alcohol

6. (a) 9.5 %

$$\begin{aligned}\text{Concentration of solution} &= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100 \\ &= \frac{38}{(38+362)} \times 100 \\ &= \frac{3800}{400} = 9.5\%\end{aligned}$$

7. (c) between 1 to 100 nm

8. (b) (ii) and (iii)

Colloidal solutions are heterogeneous in nature.

9. (c) Sol-milk of magnesia

10. (b) A-(iv), B-(i), C-(ii), D-(iii)

11. (c) corrosion and it is a chemical change

It is a chemical change because a new substance (rust) is formed.

12. (c) (i), (iii) and (iv)

Melting of iron metal bending of iron rod and drawing a wire of iron metal are physical changes because no new substances are formed during these changes.

13. (a) (i) and (ii)

14. (a) Robert Boyle

15. (a) Germanium

16. (d) Brass

Brass (alloy) is a mixture and not a compound.

17. (d) (i), (iii) and (iv)

X and Y are elements hence, cannot be broken down into simpler substances. P is a compound hence, it has a fixed composition.

18. (c) (i), (iii) and (iv)

The product A_2B is a new compound formed. Hence, it does not show properties of A and B. The product formed is a compound and not an element.

19. (c) Assertion (A) is true but Reason (R) is false.

A solution having non-uniform composition is heterogeneous.

20. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

21. (d) Assertion (A) is false because solute particles cannot be separated from the solution by the process of filtration.

22. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

23. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

24. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

25. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

26. (c) Reason (R) is false because in sol dispersed phase is solid and dispersion medium is liquid.

27. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).



Case Study Based Questions

Case Study 1

A homogeneous mixture of two or more substances is called a true solution. A solution has a solute and a solvent as its component. The particles of a true solution are smaller than 1 nm in diameter. A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. A colloid is a mixture that is actually heterogeneous but appears to be homogeneous as the particles are uniformly spread throughout the solution.

Read the given passage carefully and give the answer of the following questions:

Q1. The correct sequence which describe the true solution, suspension and colloidal solution in order of their increasing stability is:

- colloidal solution < true solution < suspension
- suspension < colloidal solution < true solution
- colloidal solution < suspension < true solution
- true solution < colloidal solution < suspension

Q2. Which type of mixture can be separated by filtration?

- Colloid
- True solution
- Suspension
- All of these

Q3. Colloids are classified on the basis of:

- nature of dispersed phase and dispersion medium
- phase of solution
- temperature of solution
- None of the above

Q4. Component present in larger amount in solution is known as:

- Dispersed phase
- Solvent
- Solute
- None of these

Q5. The teacher instructed three students Ali, Aisha and Arvind respectively to prepare a 50% (volume by volume) solution of NaOH. Ali dissolves 50 mL of NaOH in 100 mL of water, Aisha dissolves 100 mL of NaOH in 500 g of water while Arvind dissolves 50 mL of NaOH in water to make 100 mL of solution. Which one of them has made the desired solution?

- Ali
- Aisha
- Arvind
- All of these

Answers

- (b) suspension < colloidal solution < true solution
- (c) Suspension
- (a) nature of dispersed phase and dispersion medium
- (b) Solvent

5. (c) Arvind

Volume by volume percentage of a solution

$$= \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

For Ali,

$$\text{Volume by volume \%} = \frac{50}{150} \times 100 = 33.33\%$$

For Alsha,

$$\text{Volume by volume \%} = \frac{100}{500} \times 100 = 20\%$$

(\because 500 g = 500 mL)

For Arvind,

$$\text{Volume by volume \%} = \frac{50}{100} \times 100 = 50\%$$

Hence, Arvind has made the desired solution.

Case Study 2

A suspension is a heterogeneous mixture in which the small particles of solid are spread throughout a liquid without dissolving in it. If a beam of light is passed through a suspension, it scatters the beam of light and renders its path visible inside it.

On the other hand, colloidal solution appears to be homogeneous to us but actually, it is a heterogeneous mixture. The particles of a colloid are uniformly spread throughout the solution and its particles are big enough to scatter a beam of light passing through it.

Read the given passage carefully and give the answer of the following questions:

Q 1. Which one of the following couldn't be classified as a colloid?

- a. Blood b. Soap solution
c. Chalk powder in water d. Milk

Q 2. Which of the following solutions shows Tyndall effect?

- a. A solution of common salt
b. Sugar solution
c. Lemonade
d. Starch solution

Q 3. The size of particles in suspension, true solution and colloidal solution varies in the order of:

- a. suspension > colloidal > true solution
b. true solution > suspension > colloidal
c. suspension > colloidal = true solution
d. None of the above

Q 4. Consider the following table:

| Dispersed Phase | Dispersing Medium | Type |
|-----------------|-------------------|----------|
| Liquid | Gas | Aerosol |
| Gas | Solid | Foam |
| Solid | Solid | Gel |
| Liquid | Liquid | Emulsion |

Which are correct options?

- a. 1, 2 and 3 only b. 1, 3 and 4 only
c. 1, 2 and 4 only d. All are correct

Q 5. Automobile exhaust is an example of:

- a. Liquid dispersed in gas b. solid dispersed in liquid
c. Liquid dispersed in solid d. solid dispersed in gas

Answers

- (c) Chalk powder in water
It is an example of suspension.
- (d) Starch solution
Starch solution is a colloidal solution, so it will show Tyndall effect.
Sugar solution, common salt solution and lemonade are all true solutions.
- (a) suspension > colloidal > true solution
- (c) 1, 2 and 4 only
In gel dispersed phase is liquid.
- (d) solid dispersed in gas

Case Study 3

Pragya tested the solubility of three different substances at different temperatures and collected the data as given below (results are given in the following table, as grams of substance dissolved in 100 grams of water to form a saturated solution).

| Substance Dissolved | Temperature in K | | | | |
|---------------------|------------------|-----|-----|-----|-----|
| | 283 | 293 | 313 | 333 | 353 |
| | Solubility | | | | |
| Potassium nitrate | 21 | 32 | 62 | 106 | 167 |
| Sodium chloride | 36 | 36 | 36 | 37 | 37 |
| Potassium chloride | 35 | 35 | 40 | 46 | 54 |
| Ammonium chloride | 24 | 37 | 41 | 55 | 66 |

Read the given passage carefully and give the answer of the following questions:

- What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 grams of water at 313 K?
- Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the solution to cool at room temperature. What would she observe as the solution cools? Explain.
- Find the solubility of each salt at 293 K. Which salt has the highest solubility at this temperature?
- What is the effect of change of temperature on the solubility of a salt?

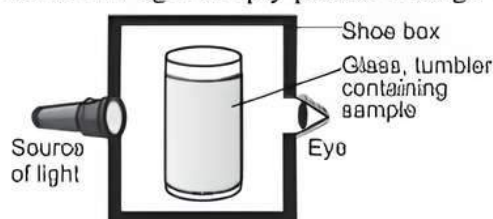
Answers

- Mass of KNO_3 needed to produce a saturated solution KNO_3 in 100 grams of water at 313 K = 62 g
 \therefore Mass of KNO_3 needed in 50 grams of water at 313 K
$$= \frac{62.0 \times 50}{100} = 31.0 \text{ g}$$
- Crystals of potassium chloride will be obtained on cooling the saturated solution.
- Solubility of each salt at 293 K is
(i) Potassium nitrate \rightarrow 32 g
(ii) Sodium chloride \rightarrow 36 g

- (iii) Potassium chloride → 35 g
 (iv) Ammonium chloride → 37 g
 Ammonium chloride has the highest solubility at this temperature.
4. The given data shows that the solubility of a salt increases on increasing the temperature.

Case Study 4

A group of students took an old shoe box and covered it with a black paper from all sides. They fixed a source of light (a torch) at one end of the box by making a hole in it and made another hole on the other side to view the light. They placed a milk sample contained in a tumbler in the box as shown in the figure below. They were amazed to see that milk taken in the tumbler was illuminated. They tried the same activity by taking a salt solution but found that light simply passed through it.



Read the given passage carefully and give the answer of the following questions:

- Q 1. Explain why the milk sample was illuminated? Name the phenomenon involved.
 Q 2. Same results were not observed with a salt solution. Explain.
 Q 3. Can you suggest two more solutions which would show the same effect as shown by the milk solution?
 Q 4. Give one example of above phenomenon observed in our surroundings.

Answers

1. Because milk is a colloidal solution and would show Tyndall effect.
2. Salt solution is a true solution and would not scatter light.
3. Soap solution and Ink solution.
4. Tyndall effect is observed when sunlight passes through the canopy of a dense forest.



Very Short Answer Type Questions

- Q 1. State any one difference between pure and impure substances.
Ans. Pure substances are homogeneous in nature, i.e., their composition is uniform throughout the bulk whereas impure substances may be homogeneous or heterogeneous in nature, i.e., their composition is not uniform throughout the bulk.
- Q 2. What type of mixtures are represented by the soap bubbles formed by blowing air into soap solution?
Ans. Heterogeneous mixtures.
- Q 3. Identify homogeneous mixtures from the following: soda water, soil, vinegar, unfiltered tea.
Ans. Soda water and vinegar.

- Q 4. Identify the solutions among the following mixtures: (i) soil, (ii) sea water, (iii) air, (iv) coal, (v) soda water. (NCERT EXERCISE)

Ans. Solutions are: (ii) sea water, (iii) air and (v) soda water.

- Q 5. What are alloys?

Ans. Alloys are homogeneous mixtures of two or more metals or a metal and a non-metal. For example, brass.

- Q 6. Define the term solubility.

Ans. The amount of solute present in the saturated solution at a given temperature is called its solubility.

- Q 7. What is saturated solution?

Ans. When no more solute can be dissolved in a solution at a given temperature, it is called a saturated solution.

- Q 8. What is unsaturated solution?

Ans. If the amount of solute contained in a solution is less than the saturation level, it is called an unsaturated solution.

- Q 9. How can you convert a saturated solution into an unsaturated solution?

Ans. On heating a saturated solution, it converts into an unsaturated solution.

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A saturated solution can also be converted to an unsaturated solution by adding solvent to it.

- Q 10. What is meant by concentration of a solution?

Ans. The concentration of a solution is the amount of solute present per unit volume or per unit mass of the solution.

- Q 11. To make a saturated solution, 36 g of sodium chloride is dissolved in 100 g of water at 293 K. Find its concentration at this temperature. (NCERT TEXT)

Ans.

$$\text{Concentration} = \frac{\text{Mass of solute (sodium chloride)}}{\text{Mass of solution (sodium chloride + water)}} \times 100$$

$$= \frac{36}{36 + 100} \times 100$$

$$= \frac{36}{136} \times 100 = 26.47\%$$

- Q 12. Define the term suspension.

Ans. A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.

- Q 13. Define the term colloidal solution.

Ans. Colloids are heterogeneous mixtures in which the particle size is too small to be seen with naked eye, but is big enough to scatter light.

- Q 14. Smoke and clouds both are aerosols. In what way are they different?

| Aerosols | Dispersed Phase | Dispersing Medium |
|----------|-----------------|-------------------|
| Smoke | Solid | Gas |
| Clouds | Liquid | Gas |

Q 15. Choose the chemical change out of the following:
Digestion of food, freezing of water, glowing of electric lamp, mixing of iron filings with sulphur.

Ans. Digestion of food is a chemical change.

Q 16. Why are silicon and germanium metalloids?

Ans. They have intermediate properties between those of metals and non-metals, therefore, called metalloids.

Q 17. Name a metal which exist as liquid at room temperature.

Ans. Mercury

Short Answer Type-I Questions

Q 1. List the points of differences between homogeneous and heterogeneous mixtures. (NCERT INTExT)

Ans. The main points of differences between the homogeneous and heterogeneous mixtures are as follows:

| Basis of Difference | Homogeneous Mixture | Heterogeneous Mixture |
|----------------------------|---|--|
| Definition | Its constituents are uniformly distributed all over the mixture. | Its constituents are not distributed uniformly. |
| Separation of constituents | Its constituents cannot be easily separated. Special methods are required for this purpose. | Its constituents can be easily separated by simple methods. |
| Example | Alloys, air, soft drinks, vinegar, etc. | Mixture of sand and sugar, mixture of chalk powder and water, etc. |

Q 2. Tabulate the differences between true solution and colloid. Give two points of difference.

| Basis of Difference | True Solution | Colloid |
|---------------------|---|---|
| Type | It is a homogeneous mixture. | It is a heterogeneous mixture. |
| Particle size | The particles of solution are smaller than 1nm in diameter. | The particles are between 1 to 100nm in diameter. |
| Tyndall effect | It does not show Tyndall effect. | It shows Tyndall effect. |

(Any two)

Q 3. Define a solution. Give an example of (i) gas in liquid solution, (ii) gas in gas solution.

Ans. Solution is homogeneous mixture of two or more substances. In a solution, there is homogeneity at the particle level, for example, lemonade, alloys, etc.

(i) Aerated drinks (soda water) contain carbon dioxide (gas) dissolved in water (liquid).

(ii) Air is a mixture of gas in gas.

Q 4. (i) Identify the heterogeneous mixture from the following:

Air, soda water, soap solution, brass.

(ii) Write two components of a colloidal solution. Give an example.

Ans. (i) Soap solution is a heterogeneous mixture while the rest are homogeneous mixtures.

(ii) The two components of a colloidal solution are dispersed phase and dispersion medium. The solute-like component in a colloid form the dispersed phase and the component in which the dispersed phase is suspended is known as the dispersing medium.

In milk of magnesia, solid is dispersed phase and liquid is dispersing medium.

Q 5. (i) Identify colloids from the following:

Copper sulphate solution, milk, smoke, muddy water, butter, sugar solution, face cream, lemonade.

(ii) Identify the dispersed phase and dispersing medium in the following examples of colloids: (a) Fog, (b) Cheese, (c) Coloured gemstone.

Ans. (i) Milk, smoke, muddy water, butter and face cream are colloids.

| Example | Dispersed Phase | Dispersing Medium |
|-----------------------|-----------------|-------------------|
| (a) Fog | Liquid | Gas |
| (b) Cheese | Liquid | Solid |
| (c) Coloured gemstone | Solid | Solid |

Q 6. Classify the following as physical or chemical property:

(i) The composition of a sample of steel is: 98% iron, 1.5% carbon and 0.5% other elements.

(ii) Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas. Zinc reacts with HCl to form ZnCl_2 which is soluble in water.

(iii) Metallic sodium is soft enough to be cut with a knife.

(iv) Most metal oxides form bases on interacting with water. (NCERT EXEMPLAR)

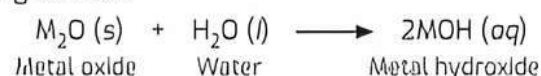
Ans. (i) It is physical property because steel is an alloy and alloy is a homogeneous mixture of two or more metals or a metal and a non-metal. Also, no new compound is formed.

(ii) It is chemical property because chemical reaction takes place.



(iii) It is physical property as cutting with knife does not form new substance.

(iv) It is chemical property as new compound is being formed.



Q 7. State one instance where water undergoes a physical change and one in which it undergoes a chemical change.

Ans. Physical Change: Evaporation of water or freezing of water.

Chemical Change: Electrolysis of water or when any chemical or acid is poured in it.

Q 8. On heating calcium carbonate gets converted into calcium oxide and carbon dioxide.

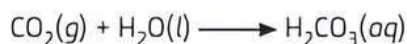
- (i) Is this a physical or a chemical change?
 (ii) Can you prepare one acidic and one basic solution by using the products formed in the above process? If so, write the chemical equation involved. (NCERT EXEMPLAR)

Ans. (i) It is a chemical change.

- (ii) Yes. CaO dissolves in water forming calcium hydroxide which is a basic solution.



CO₂(g) dissolves in water forming carbonic acid which is an acidic solution.



Q 9. Write any two physical properties each of metals and non-metals.

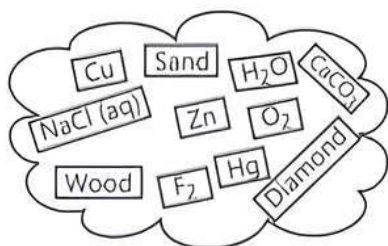
Ans. **Physical properties of metals:**

- (i) They have a lustre (shlne).
 (ii) They are malleable and ductile.

Physical properties of non-metals:

- (i) They are not lustrous.
 (ii) They are not malleable and ductile.

Q 10. Classify the substances given in figure into elements and compounds. (NCERT EXEMPLAR)



Ans. **Elements:** Cu, Zn, O₂, F₂, and Hg, diamond (carbon)

Compounds: H₂O, CaCO₃

Q 11. Which of the following are not compounds?

(NCERT EXEMPLAR)

- (i) Chlorine gas (ii) Potassium chloride
 (iii) Iron (iv) Iron sulphide
 (v) Aluminium (vi) Iodine
 (vii) Carbon (viii) Carbon monoxide
 (ix) Sulphur powder

Ans. (i) Chlorine gas, (iii) iron,
 (v) aluminium, (vi) iodine,
 (vii) carbon,
 (ix) sulphur powder are elements and not compounds.

Q 12. Tabulate the differences between compound and mixture.

| Ans. | Basis of Difference | Mixtures | Compounds |
|------|---------------------------|--|--|
| | Formation of new compound | Elements or compounds just mix together to form a mixture and no new compound is formed. | Elements react to form new compounds. |
| | Composition | A mixture has a variable composition. | The composition of each new substance is always fixed. |
| | Properties | A mixture shows the properties of the constituent substances. | The new substance has totally different properties. |
| | Method of separation | The constituents can be separated fairly easily by physical methods. | The constituents can be separated only by chemical or electrochemical reactions. |

(Any two)



Short Answer Type-II Questions

Q 1. Differentiate between true solution, suspension and colloidal solution.

| Ans. | Basis of Difference | True Solution | Suspension | Colloidal Solution |
|------|---------------------|---|---|--|
| | Nature | It is a <u>homogeneous mixture</u> . | It is a <u>heterogeneous mixture</u> . | It appears to be homogeneous but actually it is a <u>heterogeneous mixture</u> . |
| | Particle size | The particles are <u>smaller than 1 nm</u> in diameter. | The particles are <u>larger than 100nm</u> in diameter. | The particles are <u>between 1 to 100nm</u> in diameter. |
| | Visibility | Particles cannot be seen by <u>naked eyes</u> . | Particles can be seen by <u>the naked eyes</u> . | Particles cannot be seen by <u>naked eyes</u> . |
| | Tyndall effect | It <u>does not show Tyndall effect</u> . | It <u>shows Tyndall effect</u> . | It <u>shows Tyndall effect</u> . |
| | Stability | <u>Stable</u> | <u>Unstable</u> | <u>Quite stable</u> |

Q 2. (i) Write one point of difference between concentration and solubility.

(ii) What is the effect of temperature on the rate of solubility?

Ans. (i) Concentration of solution is the amount (mass or volume) of solute present in a given amount (mass or volume) of solution.

On the other hand, solubility is the maximum amount of solute that can be dissolved in a given solution at a given temperature.

(ii) The rate of solubility increases with increase in temperature.

Q 3. Calculate the mass of sodium sulphate required to prepare its 20% (mass per cent) solution in 100 g of water.

Sol. Let the mass of sodium sulphate required be x g.
The mass of solution would be $(x + 100)$ g.
 x g of solute is dissolved in $(x + 100)$ g of solution.
Given, concentration in mass percentage = 20%
 \therefore Concentration in mass percentage

$$= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$\therefore 20 = \frac{x}{x + 100} \times 100$$

$$\Rightarrow 20x + 2000 = 100x \Rightarrow 80x = 2000$$

$$\Rightarrow x = \frac{2000}{80} = 25\text{g}$$

\therefore Required mass of sodium sulphate = 25 g

Q 4. A teacher told three students A, B and C to prepare 25% solution (mass by volume) of KOH. Student A dissolved 25g of KOH in 100 g of water. Student B dissolved 25 g of KOH in 100 ml of water and student C dissolved 25 g KOH in water and made the volume 100 ml. Which one of them has made required 25% solution?

Ans. Student C has made the required 25% solution.
Given, mass of solute = 25 g of KOH in water

Volume of solution = 100 ml

\therefore Mass by volume percentage of solution

$$= \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100 = \frac{25}{100} \times 100 = 25\%$$

Q 5. During an experiment, the students were asked to prepare a 10% (Mass/Mass) solution of sugar in water. Ramesh dissolved 10 g of sugar in 100 g of water while Sarika prepared it by dissolving 10 g of sugar in water to make 100 g of the solution.

- Are the two solutions of the same concentration?
- Compare the mass % of the two solutions.

(NCERT EXEMPLAR)

Ans. (i) No, two solutions do not have the same concentration.

(ii) Mass by mass percentage of solution prepared by Ramesh

$$= \frac{\text{Mass of solute}}{\text{Mass of solute} + \text{Mass of solvent}}$$

$$= \frac{10\text{g}}{10 + 100} \times 100 = \frac{100}{11} = 9.09\%$$

Mass by mass percentage of solution prepared by Sarika

$$= \frac{10}{100} \times 100 = 10\%$$

The solution prepared by Sarika has more mass by mass percentage than that of Ramesh.

Q 6. Distinguish between physical change and chemical change.


| Basis of Difference | Physical Change | Chemical Change |
|---------------------|--|--|
| Product | No. new substance is formed. | New substance is formed. |
| Nature | It is a reversible change. | It is an irreversible change. |
| Type | It is a temporary change. | It is a permanent change. |
| Effect | No change in mass or composition of the substance. | Change occurs in composition of the substance. |

Q 7. Why is the inter-conversion of states of matter considered as a physical change?

Ans. Inter-conversion of states of matter takes place without change in composition. So, it is considered as a physical change. The substances differ in physical properties but chemically they are the same.

For example, water changes into ice below 0°C . Ice changes into liquid above 0°C . Liquid water changes into steam at 100°C . So, the physical states of water are different due to different forces of attraction and intermolecular spaces but their composition is same, i.e., all of them contain the same water molecules. Also, no new substance having new properties will be formed.

Knowledge BOOSTER

 Matter can change from one state to another when specific physical conditions change, i.e., temperature and pressure of the substance.

Q 8. Differentiate between an element and a compound (any two points). Write one example of each.

| Basis of Difference | Element | Compound |
|---------------------|--|--|
| Composition | It is made up of only one kind of atom. | It is made up of two or more types of atoms. |
| Nature | These are simplest substances and cannot be further broken into more simpler substances. | They can be further broken down into simpler substances. |
| Example | Oxygen, hydrogen, etc. | Sodium chloride, water, etc. |



Long Answer Type Questions

- Q 1. (i) What is the effect of change of temperature on the solubility of a salt?
 (ii) How many litres of 15% (mass/volume) sugar solution would it take to get 75 g of sugar?
 (iii) Identify colloid from the following mixtures: Muddy water, sugar in water, ink, blood, soda water, foam
 (iv) Why copper sulphate solution in water does not show Tyndall effect but mixture of water and milk shows?

Ans. (i) Solubility of a salt (solid) increases with rise in temperature and vice-versa.

- (ii) Mass by volume percentage of a solution

$$= \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

Given, mass by volume percentage = 15

Mass of solute (sugar) = 75 g

Let volume of solution = x

$$\Rightarrow 15 = \frac{75}{x} \times 100$$

$$\Rightarrow x = 500 \text{ mL}$$

$$\text{or } x = 0.5 \text{ L}$$

- (iii) Ink, blood and foam are examples of colloids.

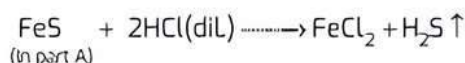
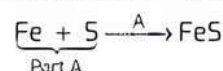
- (iv) Copper sulphate solution in water is a true solution.

The particles are very small and do not scatter light. Hence, it does not show Tyndall effect.

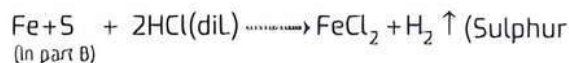
Mixture of water and milk is a colloidal solution, the particles are big enough to scatter light. Hence, it shows Tyndall effect.

- Q 2. Iron filings and sulphur were mixed together and divided into two parts, A and B. Part A was heated strongly while part B was not heated. Dilute hydrochloric acid was added to both the parts and evolution of gas was seen in both the cases. How will you identify the gases evolved? (NCERT EXEMPLAR)

Ans. Part A is heated strongly, so the reaction will be:



Part B is not heated, so Fe and S will not react and the reaction will be:



In part A, H₂S gas is produced, which is identified by its characteristic smell of rotten eggs. In part B, H₂ gas is produced. Hydrogen gas is tested by bringing a burning matchstick near the mouth of the test tube which burns with a pop sound.

- Q 3. Classify each of the following, as a physical or a chemical change. Give reasons.

- Drying of a shirt in the sun.
- Rising of hot air over a radiator.
- Burning of kerosene in a lantern.
- Change in the colour of black tea on adding lemon juice to it.
- Churning of milk cream to get butter.

(NCERT EXEMPLAR)

- Ans. (i) Physical change because water evaporates with composition of substance remaining the same.
 (ii) Physical change involving only movement of air but composition of air remains the same.
 (iii) Both physical and chemical change where initially kerosene vaporises showing the physical change, then it burns to convert into CO₂ and water (new compounds) showing the chemical change.
 (iv) Chemical change as the acid of lemon juice reacts with the caffeine of black tea.
 (v) Physical change because the components separate by centrifugation but there is no change in composition.



Chapter Test

Multiple Choice Questions

- Q 1. Which of the following is not true for a compound?

- A compound is heterogeneous in nature.
- A compound contains different elements in a fixed ratio.
- Properties of a compound are entirely different from those of the elements present in it.
- Constituents of a compound cannot be separated by simple physical methods.

- Q 2. Water, ice and steam are all:

- elements
- mixtures
- compounds
- None of the above

- Q 3. A solution contains 50 g of common salt in 420 g of water. Calculate the concentration in terms of mass by mass percentage of the solution.

- 9.80%
- 10.64%
- 11.52%
- 15.64%

- Q 4. Match the Columns:

| Column I | Column II |
|---------------------|-----------------------|
| A. Alloys | (i) Gas in liquid |
| B. Alcohol in water | (ii) Solid in solid |
| C. Aerated drinks | (iii) Gas in gas |
| D. Air | (iv) Liquid in liquid |

- A-(ii), B-(iv), C-(iii), D-(i)
- A-(iv), B-(ii), C-(i), D-(iii)
- A-(iv), B-(ii), C-(iii), D-(i)
- A-(ii), B-(iv), C-(i), D-(iii)

Assertion and Reason Type Questions

Directions (Q. Nos. 5-6): Each of the following questions consists of two statements, one is **Assertion (A)** and the other is **Reason (R)**. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
- Assertion (A) is true but Reason (R) is false.
- Assertion (A) is false but Reason (R) is true.

Q 5. Assertion (A): Particles of colloidal solution do not settle down when left undisturbed while in case of suspension, they do.

Reason (R): Particle size in suspension is larger than those in a colloidal solution.

Q 6. Assertion (A): All homogeneous mixtures are pure substances.

Reason (R): Alloys are homogeneous mixtures of solids.

Case Study Based Question

Q 7. A pure substance is the one which is made up of only one kind of atoms or molecules. All the elements and compounds are pure substances. An element is a substance which cannot be split up into two (or more) simpler substances by the usual chemical methods whereas a compound is a substance made up of two or more elements chemically combined in a fixed proportion by mass.

Read the given passage carefully and give the answer of the following questions:

- A pure substance which is made up of only one kind of atom and cannot be broken into two or more simpler substances by physical or chemical means is:
 - a compound
 - a mixture
 - an element
 - None of these
- According to the definition of pure substance, which of the following is a pure substance?
 - Ice
 - Iron
 - Mercury
 - All of these
- Which of the following property does not describe a compound?
 - It is composed of two or more elements.
 - It is a pure substance.
 - It cannot be separated into constituents by physical methods.
 - It is mixed in any proportion by mass.
- On the basis of following features, identify the correct option.
 - It is a homogeneous substance.
 - Their properties are different from their constituents.
 - Element
 - Mixture
 - Compound
 - Both a. and b.

Very Short Answer Type Questions

- Q 8.** Identify the solute and solvent in:
(i) tincture of iodine, (ii) brass.
- Q 9.** An element is sonorous and highly ductile. Under which category would you classify this element? What other characteristics do you expect the element to possess?

Short Answer Type-I Questions

- Q 10. (a)** Under which category of mixtures will you classify alloys and why?
(b) A solution is always a liquid. Comment.
- Q 11.** Define concentration of a solution. Give two ways of expressing the concentration of a solution.
- Q 12.** Explain the following:
(i) Saturated solution (ii) Pure substance
(iii) Colloid (iv) Suspension

Short Answer Type-II Questions

- Q 13.** State the properties of a suspension.
- Q 14. (i)** Calculate the mass of water and mass of glucose required to make 250 g of 40% solution of glucose.
(ii) Calculate the mass of sodium sulphate required to prepare its 40% (mass percent) solution in 100 g of water.
- Q 15.** Melting of wax is a physical change but burning of wax is a chemical change. Explain.

Long Answer Type Questions

- Q 16. (i)** Distinguish among true solution, suspension and colloid in a tabular form under the following heads:
(a) Stability (b) Particle size
(c) Type of mixture
- (ii)** In what way sol and gel are different from each other? Give one example for each.
- Q 17. (i)** Classify the following as chemical or physical changes:
(a) Cutting of trees.
(b) Melting of butter in a pan.
(c) Rusting of Almirah.
(d) Boiling of water to form steam.
(e) Passing of electric current, through water and the water breaking down into hydrogen and oxygen gases.
(f) Dissolving common salt in water.
(g) Making a fruit salad with raw fruits.
(h) Burning of paper and wood.
- (ii)** List three differences between metals and non-metals.