# Chapter 2: Is Matter Around Us Pure?

## ● Introduction to Pure Substances and Mixtures

- **Pure Substance**: A material with a constant composition and distinct chemical properties.
  - **Examples**: Water ($H_2O$), oxygen ($O_2$), gold (Au).
- **Mixture**: A combination of two or more substances that retain their individual properties.
  - **Examples**: Air, seawater, alloys.

**Practice Questions:**

1. What is a pure substance? Explain with an example.
2. How is a mixture different from a compound?
3. Can all mixtures be separated by physical methods? Justify your answer.

**Revision Points:**

- Pure substances have a fixed composition and properties.
- Mixtures can be separated by physical means and have variable composition.

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## ● Types of Mixtures

### ○ Homogeneous Mixtures

- **Definition**: Mixtures that have a uniform composition throughout.
  - **Examples**: Salt dissolved in water, sugar dissolved in tea.
- **Properties**:
  - The composition is consistent.
  - Particles are not visible to the naked eye.
  - Cannot be separated by simple physical means.

### ○ Heterogeneous Mixtures

- **Definition**: Mixtures that do not have a uniform composition.
  - **Examples**: Sand and water, oil and water.
- **Properties**:

- Composition is non-uniform.
- The components can be seen separately.
- Can be separated by physical methods like filtration or sedimentation.

**Practice Questions:**

1. Classify the following mixtures as homogeneous or heterogeneous:
   - (a) Smoke
   - (b) Brass
   - (c) Ice cream with nuts
2. What are the key differences between homogeneous and heterogeneous mixtures?
3. Can homogeneous mixtures be separated by filtration? Why or why not?

**Revision Points:**

- Homogeneous mixtures have uniform composition, while heterogeneous mixtures do not.
- Heterogeneous mixtures can often be separated by physical methods.

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● **Solutions**

○ **Definition of Solution**

- **Solution**: A homogeneous mixture of two or more substances. It consists of:
  - **Solute**: The substance that is dissolved (e.g., salt in saltwater).
  - **Solvent**: The substance that dissolves the solute (e.g., water in saltwater).

○ **Types of Solutions**

- **Solid in Liquid**: Salt in water.
- **Gas in Liquid**: Oxygen dissolved in water.
- **Liquid in Liquid**: Alcohol in water.

○ **Concentration of a Solution**

- The amount of solute dissolved in a given quantity of solvent.
  - **Dilute Solution**: Contains a small amount of solute.
  - **Concentrated Solution**: Contains a large amount of solute.

○ **Solubility**

- **Solubility**: The maximum amount of solute that can dissolve in a solvent at a particular temperature.

- **Saturated Solution**: No more solute can dissolve at the given temperature.
- **Unsaturated Solution**: More solute can dissolve in the solvent.

**Practice Questions:**

1. Define a solution and its components with examples.
2. What factors affect the solubility of a substance in a solvent?
3. Explain the difference between a saturated and unsaturated solution. Give examples of each.

**Revision Points:**

- Solutions are homogeneous mixtures of solute and solvent.
- Solubility is the maximum amount of solute that can dissolve in a given solvent at a specific temperature.

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## ● Suspension

- **Definition**: A heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.
  - **Examples**: Muddy water, flour in water.
- **Properties**:
  - Particles are large and visible.
  - They settle down when left undisturbed.
  - Can be separated by filtration.

**Practice Questions:**

1. What is a suspension? Provide two examples.
2. How do the properties of suspensions differ from those of solutions?
3. Why do suspended particles settle down over time?

**Revision Points:**

- Suspensions are heterogeneous and have visible particles.
- Suspended particles can be separated by filtration and tend to settle over time.

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## ● Colloids

- **Definition**: A heterogeneous mixture where particles are dispersed but not dissolved. The particles are too small to settle but large enough to scatter light.
  - **Examples**: Milk, fog, blood.

- **Properties**:
  - The particles are not visible to the naked eye.
  - It exhibits the **Tyndall Effect** (scattering of light).
  - Cannot be separated by filtration, but can be separated by techniques like centrifugation.

○ **Tyndall Effect**

- When light passes through a colloid, the dispersed particles scatter the light, making the path of the light visible.

**Practice Questions:**

1. Explain the Tyndall Effect with an example.
2. How is a colloid different from a solution and a suspension?
3. Why can't colloids be separated by filtration?

**Revision Points:**

- Colloids have dispersed particles that scatter light (Tyndall Effect).
- Colloids cannot be separated by filtration but exhibit properties between suspensions and solutions.

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● **Separation of Mixtures**

○ **Filtration**

- Used to separate insoluble solids from liquids.
  - **Example**: Sand from water.

○ **Evaporation**

- Used to separate a dissolved solid from a liquid.
  - **Example**: Salt from seawater.

○ **Centrifugation**

- Used to separate solids from liquids in which the solid particles are very small (colloids).
  - **Example**: Separating cream from milk.

○ **Distillation**

- Used to separate liquids with different boiling points.

- **Example**: Water and alcohol.

○ **Chromatography**

- Used to separate different dissolved substances that have different solubilities in the same solvent.
  - **Example**: Separation of dyes.

**Practice Questions:**

1. Which method would you use to separate the following mixtures?
   - (a) Oil and water
   - (b) Salt from seawater
   - (c) Cream from milk
2. Explain the principle of centrifugation and its applications.
3. How does distillation work? Give an example of a mixture that can be separated using this technique.

**Revision Points:**

- Filtration, evaporation, distillation, and centrifugation are techniques to separate different mixtures.
- The separation method depends on the nature of the substances in the mixture.

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● **Physical and Chemical Changes**

○ **Physical Change**

- A change in which no new substance is formed, and the chemical composition remains unchanged.
  - **Examples**: Melting of ice, boiling of water.

○ **Chemical Change**

- A change in which new substances with different chemical compositions are formed.
  - **Examples**: Burning of paper, rusting of iron.

**Practice Questions:**

1. What is the key difference between a physical and a chemical change? Provide an example of each.
2. Explain why melting of ice is considered a physical change.
3. Is rusting of iron a chemical change? Explain your reasoning.

**Revision Points:**

- Physical changes involve changes in state or form without creating new substances.
- Chemical changes result in the formation of new substances with different properties.

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## ● Elements, Compounds, and Mixtures

### ○ Elements

- **Definition**: A pure substance that consists of only one type of atom.
  - **Examples**: Hydrogen, Oxygen, Gold.
- **Types**:
  - **Metals**: Good conductors of heat and electricity.
    - **Examples**: Iron, Copper.
  - **Non-metals**: Poor conductors of heat and electricity.
    - **Examples**: Carbon, Sulfur.
  - **Metalloids**: Have properties intermediate between metals and non-metals.
    - **Examples**: Silicon, Arsenic.

### ○ Compounds

- **Definition**: A pure substance made up of two or more elements chemically combined in a fixed proportion.
  - **Examples**: Water ($H_2O$), Carbon Dioxide ($CO_2$).

### ○ Mixtures

- **Definition**: A combination of two or more substances that are not chemically combined.
  - Can be separated by physical methods.

**Practice Questions:**

1. Classify the following as elements, compounds, or mixtures:
   - (a) Saltwater
   - (b) Oxygen
   - (c) Carbon Dioxide
   - (d) Brass.
2. What are the characteristics of metals and non-metals? Provide two examples of each.
3. Why can't compounds be separated by physical methods?

**Revision Points:**

- Elements consist of only one type of atom.
- Compounds are formed by the chemical combination of elements in fixed proportions.
- Mixtures are combinations of substances that can be separated by physical methods.

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