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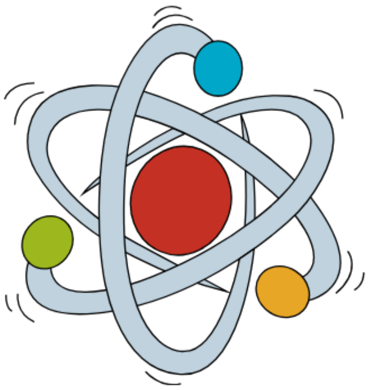
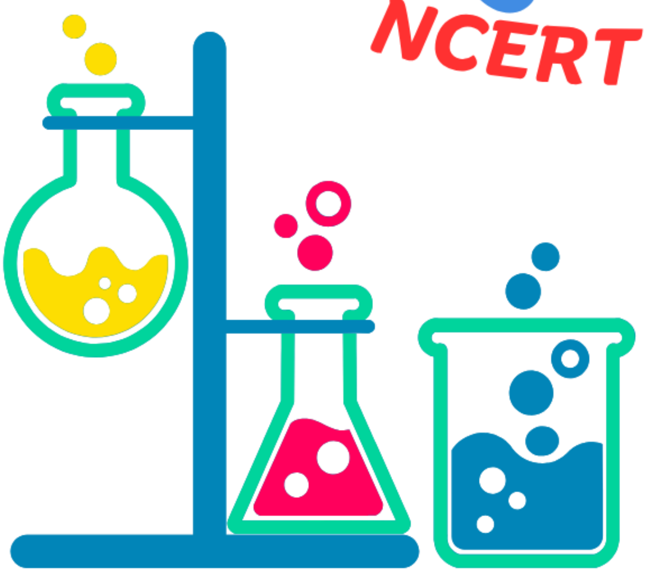


Class 9 Science

C2 : Is Matter Around Us Pure

FREE

NCERT SOLUTIONS



📄 Page 15 – 📗 In-Text Questions

Q1. What is meant by a substance?

In science, a substance (or pure substance) means a form of matter that has uniform composition and chemical properties throughout. All particles in a pure substance are identical in chemical nature.

In other words, a pure substance consists of a single type of particle – for example, distilled water (H_2O molecules only), pure oxygen (O_2 molecules only), or crystalline sodium chloride (NaCl).

Unlike mixtures, a pure substance cannot be separated into other substances by physical means, because it already has only one constituent type

Q2. List the points of differences between homogeneous and heterogeneous mixtures.

Properties	Homogeneous Mixtures	Heterogeneous Mixtures
Uniformity of Composition	Homogeneous mixtures have the same composition throughout.	Heterogeneous mixtures do not have the same composition throughout.
Phases and Appearance	Homogeneous mixtures appear as a single phase (no visible boundaries between components).	Heterogeneous mixtures contain Two or more visible phases or regions.
Particle Size and Visibility	In homogeneous mixtures (solutions), particle size is extremely small (usually <1 nm) and cannot be seen.	Heterogeneous mixtures contain larger particles or chunks that can often be seen with the naked eye.
Tyndall Effect	Homogeneous mixtures generally do not scatter light (no Tyndall effect).	Heterogeneous mixtures or colloids do scatter light.

Properties	Homogeneous Mixtures	Heterogeneous Mixtures
Separation	Components of a homogeneous mixture cannot be separated by simple filtration.	Components of a heterogeneous mixture (like sand and water) can often be separated physically (e.g. by filtration).
Example	In a sugar-water solution the dissolved sugar is evenly distributed (homogeneous).	a mixture of iron filings and sand has visible distinct parts.

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Q1. How are sol, solution and suspension different from each other?

1. **Solution:** A solution is a homogeneous mixture in which the solute (substance dissolved) is evenly distributed in the solvent (liquid, solid, or gas).

   Solution particles are extremely small (< nm) and cannot be seen by eye or separated by filtration.

   Solutions do not show the Tyndall effect (light beam passes through without scattering).

   Example: Salt water or sugar water, where salt/sugar is the solute and water is the solvent.

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2. **Sol (Colloid):** A sol is a type of colloid where tiny solid particles are dispersed in a liquid (solid-in-liquid colloid).

   It is a heterogeneous mixture at the microscopic level.

   The dispersed particles are small enough (larger than in a true solution but smaller than in a suspension) to remain suspended and can scatter light (Tyndall effect).

   Example: Muddy water or paint; solid clay particles dispersed in water. Sols appear uniform to the naked eye but are actually heterogeneous mixtures.

3. **Suspension:** A suspension is a heterogeneous mixture in which relatively large solid particles are suspended in a liquid.

   The particles do not dissolve and are visible to the naked eye.

   Suspensions scatter light and are unstable: over time, particles settle down (e.g., muddy water settles to form a solid layer).

   Example: A mixture of chalk powder in water or flour in water. Because the particles are large, they can be separated by filtration.

Thus, solutions are homogeneous with dissolved particles; sols are colloidal (solid particles dispersed in liquid) showing the Tyndall effect; suspensions have large particles that settle out.

Q2. 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.

Mass of solution = mass of solute + mass of solvent = 36 g + 100 g = 136 g.
Using the mass-by-mass percentage formula:

Concentration (mass %) = mass of solute
mass of solution × 100 = 36
136 × 100 ≈ 26.5%

So the concentration is about **26.5% (w/w)**. (This uses the formula mass of solute
mass of solution × 100.)

📄 Page 19 – 📗 In-Text Questions

Q1. Classify the following as chemical or physical changes:
- **cutting of trees,**
- **melting of butter in a pan,**
- **rusting of almirah,**
- **boiling of water to form steam,**
- **passing of electric current through water and the water breaking down into hydrogen and oxygen gases,**
- **dissolving common salt in water,**

- **making a fruit salad with raw fruits,**
- **burning of paper and wood.**

Physical Changes

Example	Description
Cutting trees	Only shape changes, no new substance formed
Melting butter in a pan	Change of state from solid to liquid
Boiling water to form steam	Liquid turns into gas, reversible change
Dissolving common salt in water	Salt is still salt, no chemical change
Making fruit salad with raw fruits	Just mixing pieces, no new substance formed

Chemical Changes

Example	Description
Rusting of an almirah	Iron reacts with oxygen to form rust (new substance)
Passing Of Electric Current Through Water and The Water Breaking Down into Hydrogen and Oxygen Gases	Water breaks into hydrogen and oxygen gases
Burning paper and wood	Combustion produces ash, CO_2, and other substances

We note that **physical changes** can be reversed by physical means and the original substances remain (Group I in the iron–sulfur example involved physical mixing), whereas **chemical changes** produce different products (Group II's heating reaction produced a compound).

Q2. Try segregating the things around you as pure substances or mixtures.

Around us, many items are either pure substances (elements or compounds) or mixtures. For example:

Pure Substances

Substance	Type	Description
Oxygen gas (O_2)	Element	Contains only oxygen molecules
Distilled water (H_2O)	Compound	Pure form of water, no impurities
Common salt (NaCl)	Compound	Has only sodium chloride particles
Sugar ($C_{12}H_{22}O_{11}$)	Compound	Single chemical compound
Pure copper metal	Element	Contains only copper atoms

Each of these has only one type of chemical particle.

Mixtures

Mixture	Type	Description
Air	Homogeneous	Mixture of nitrogen, oxygen, etc.
Sea water	Homogeneous	Water + various salts
Milk	Colloidal mixture	Water, fat, and proteins
Stainless steel	Alloy	Iron mixed with carbon and chromium
Soil	Heterogeneous	Rock particles and organic matter
Soft drinks	Homogeneous	Soda + sugar + flavorings

These mixtures contain two or more substances physically combined.

According to NCERT, most naturally occurring materials (like minerals, soft drinks, soil) are mixtures of pure components, whereas pure substances have a fixed composition.

📄 Page 22 – 📘 Exercise Questions

Q1. Which separation techniques will you apply for the following mixtures?

Mixture	Separation Technique	Reason / Explanation
(a) Sodium chloride from its solution in water	Evaporation / Distillation	Water evaporates, leaving NaCl behind; or use distillation to collect water separately.
(b) Ammonium chloride from a mixture of NaCl and NH_4Cl	Sublimation	NH_4Cl sublimes (directly turns to gas) and can be separated from NaCl.
(c) Small pieces of metal in engine oil	Filtration / Magnetic Separation	Filter out metal pieces or use a magnet if the metal is magnetic like iron.
(d) Different pigments from an extract of flower petals	Paper Chromatography	Pigments travel different distances on chromatography paper and separate.
(e) Butter from curd	Churning / Centrifugation	Butter separates out due to density difference during churning.
(f) Oil from water	Separation Funnel	Oil and water form separate layers due to difference in density; can be drained separately.
(g) Tea leaves from tea	Filtration	Tea leaves are retained on filter while tea passes through.

Mixture	Separation Technique	Reason / Explanation
(h) Iron pins from sand	Magnetic Separation	Magnet attracts and removes iron pins from the mixture.
(i) Wheat grains from husk	Winnowing	Husk being lighter is blown away by air; heavier wheat grains fall straight.
(j) Fine mud particles suspended in water	Sedimentation & Decantation / Filtration	Mud settles at the bottom; water is poured off or filtered.

Note: In general, mixtures can be separated into pure substances using appropriate physical methods.

📄 Page 23 – 📘 Exercise Questions

Q2. Write the steps you would use for making tea. Use the words: *solution, solvent, solute, dissolve, soluble, insoluble, filtrate, residue*.

Answer: Making a cup of tea involves dissolving and filtering steps:

1. **Boil Water:** Take water in a cup or pot and heat it. **Water acts as the solvent.**
2. **Add Sugar (Solute):** Add some sugar. Stir and let it **dissolve** completely. Now you have a **sugar-water solution**, where **sugar is the solute** and is **soluble** in water. (Sugar becomes invisible as it dissolves.)
3. **Add Tea Leaves (Insoluble):** Add tea leaves. Stir and boil briefly. The tea leaves do not dissolve (they are **insoluble**), but the colored compounds and flavor **dissolve**, coloring the water.
4. **Add Milk (Soluble):** Add milk (optional). Milk mixes with the tea **solution**. Milk proteins and salts are **soluble** in water, making the tea lighter-colored.
5. **Filter:** Pour the tea mixture through a strainer or filter into another cup. The liquid collected is the **filtrate** (the tea drink), and the tea leaves remaining on the strainer are the **residue**.

Q3 : 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).

a. **What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 g of water at 313 K?**

b. **Pragya makes a saturated solution of potassium chloride in water at 353 K and cools it to room temperature. What would she observe? Explain.**

c. **Find the solubility of each salt at 293 K and identify the highest. (The solubility data from the table is: KNO_3: 32 g, NaCl: 36 g, KCl: 35 g, NH_4Cl: 37 g per 100 g water.)**

d. **What is the effect of temperature change on the solubility of a salt?**

Answer:

- **(a)** From the solubility data at 313 K, 100 g water dissolves 62 g KNO_3 to become saturated. For 50 g water, proportional scaling gives:

  62 × (50 / 100) = 31 g
  So **31 g of KNO_3** will saturate 50 g of water at 313 K.

- **(b)** On cooling the saturated KCl solution from 353 K to room temperature, KCl becomes less soluble. Excess KCl will precipitate out as solid crystals. Pragya would observe salt crystals forming (the solution becomes unsaturated on cooling) – this happens because **solubility decreases with temperature**.

- **(c)** At 293 K the solubilities (from the table) are:
  - KNO_3 = 32 g
  - NaCl = 36 g
  - KCl = 35 g
  - NH_4Cl = 37 g

per 100 g water. The highest solubility at 293 K is **37 g (NH_4Cl)**.

- **(d) Effect of temperature:** Generally, the solubility of most solid salts in water increases with temperature. As temperature goes up, more solute can dissolve. (This explains why KNO_3's solubility jumps from 32 g at 293 K to 62 g at 313 K.) Conversely, cooling a saturated solution often causes some solute to come out of solution.

Q4. Explain the following giving examples:

- **a. Saturated solution**
- **b. Pure substance**
- **c. Colloid**
- **d. Suspension**

Answer -

a. **Saturated solution:** A solution in which no more solute can dissolve at a given temperature. Beyond this point, any extra solute added remains undissolved.
Example: A solution with 36 g salt in 100 g water at room temperature – you cannot dissolve any more salt unless you heat or add more water.

b. **Pure substance:** A substance made of only one kind of particle. It can be an element or a compound, but has uniform properties throughout.
Examples: Table salt (NaCl), distilled water (H_2O), oxygen gas (O_2). These contain only one type of chemical molecule or atom.

c. **Colloid:** A colloid is a heterogeneous mixture in which the particle size of the dispersed phase is intermediate between that of a solution and a suspension, and it shows the Tyndall effect. The particles (1–1000 nm) do not settle and cannot be filtered easily.
Examples: Milk (liquid fat droplets dispersed in water), blood, paint. These look uniform but scatter light due to suspended particles.

d. **Suspension:** A suspension is a heterogeneous mixture in which relatively large particles of a solid are dispersed in a liquid. The particles do not dissolve and are visible with the naked eye; the mixture will scatter light and eventually settle.
Examples: Mud in water, chalk dust in water, or flour in water. If left undisturbed, the solid particles settle at the bottom.

Q5: Classify each of the following as a homogeneous or heterogeneous mixture:
Soda water, wood, air, soil, vinegar, filtered tea.

Substance	Type of Mixture	Explanation
Soda water	Homogeneous	Solution of CO_2 gas uniformly dissolved in water; appears as a single phase.
Wood	Heterogeneous	Contains cellulose, fibers, and resins; components are visible and non-uniform.
Air	Homogeneous	Uniform mixture of gases like nitrogen, oxygen, etc.; appears as a single phase.
Soil	Heterogeneous	Mixture of minerals, organic matter, air, and water; visibly non-uniform.
Vinegar	Homogeneous	Solution of acetic acid in water; completely uniform with one visible phase.
Filtered tea	Homogeneous	Tea extract without leaves is uniform and appears as a single phase liquid.

Note: Homogeneous mixtures appear uniform and contain only one visible phase. For example, soda water (aerated drink) has gas dissolved uniformly in liquid, and air is a uniform gas mixture. On the other hand, heterogeneous mixtures like wood or soil have visible different components and are non-uniform in composition.

Q6: How would you confirm that a colourless liquid given to you is pure water?

Answer: To test if a colourless liquid is pure water, one can check its physical properties which are well-defined for pure H_2O. For example:

- **Boiling/Freezing Point:** Pure water boils at 100 °C (373 K) and freezes at 0 °C (273 K) under normal pressure. Measure the liquid's boiling or freezing point – if it matches these values precisely, it is likely pure water.
  Note: Any dissolved impurities usually raise or lower these points (boiling point elevation or freezing point depression).
- **Electrical Conductivity:** Pure water is a very poor conductor of electricity (contains no free ions). If the liquid conducts electricity strongly, it indicates the presence of dissolved ions (impurities).

- **Chemical Test:** Add a small amount of anhydrous copper sulfate (white powder). If it turns blue, the liquid is water, as it forms $CuSO_4 \cdot 5H_2O$. Non-water liquids usually do not cause this change.
- **Tyndall Effect:** Shine a narrow beam of light through the liquid. Pure water does not scatter light and shows no beam. If light scatters visibly, it may be a colloid or impure.

By comparing these observations to the known properties of pure water, one can confirm its purity.

Note: Pure substances like water have fixed and characteristic physical and chemical properties.

Q7. Which of the following materials fall in the category of a "pure substance"?

Material	Type
Ice	Pure Substance
Milk	Mixture
Iron	Pure Substance
Hydrochloric acid	Pure Substance
Calcium oxide	Pure Substance
Mercury	Pure Substance
Brick	Mixture
Wood	Mixture
Air	Mixture

Q8. Identify the solutions among the following mixtures.

Mixture	Type
Soil	Not a Solution
Sea water	Solution
Air	Solution
Coal	Not a Solution
Soda water	Solution

Q9. Which of the following will show “Tyndall effect”?

Substance	Tyndall Effect
Salt solution	No
Milk	Yes
Copper sulphate solution	No
Starch solution	Yes

Q10. Classify the following into elements, compounds and mixtures.

Substance	Classification
Sodium	Element
Soil	Mixture
Sugar solution	Mixture
Silver	Element
Calcium carbonate	Compound
Tin	Element
Silicon	Element
Coal	Mixture
Air	Mixture
Soap	Compound
Methane	Compound
Carbon dioxide	Compound
Blood	Mixture

Q11. Which of the following are chemical changes?

Process	**Type of Change**
Growth of a plant	Chemical Change
Rusting of iron	Chemical Change
Mixing of iron filings and sand	Physical Change
Cooking of food	Chemical Change
Digestion of food	Chemical Change
Freezing of water	Physical Change
Burning of a candle	Chemical Change