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SOLUTIONS BOOK

# CLASS 8

## Science · Curiosity

CHAPTER 8

## Nature of Matter: Elements, Compounds, and Mixtures

Complete In-text Questions, Exercises and Projects Solutions

In-text Questions | Keep the Curiosity Alive | Projects

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Every question is followed by its answer. Question numbers above are clickable and the PDF bookmarks panel lets you jump to any exercise set or question. Figures are reproduced from the NCERT textbook (© NCERT) for educational use.

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8.1

CLASS 8 SCIENCE · CHAPTER 8

# In-text Questions

Solutions · 17 questions

**Directions (Questions 1–17):** These are the questions, activities and tables given inside the chapter (Probe and ponder, Activities 8.1 to 8.5, Tables 8.1 and 8.2, the questions in the text, in "A step further" and in the speech bubbles), numbered in the order in which they appear. Many are open-ended or observation-based; model answers based on the chapter are given, and you may add examples from your own surroundings.

QUESTION 1 *Probe and ponder · p. 116*

**Which of the entities in the picture above consist of matter, and which of them do not?**

ANSWER

Matter is everything that has mass and takes up space. Light, heat, electricity, and even thoughts and emotions are not made of matter.

### a Entities in the picture

| Made of matter | Not made of matter |
|---|---|
| Students, football, trees, bushes and flowers, grass | The light that fills the picture (sunlight) |
| Steel water bottle, backpack, books, lunch boxes | The warmth of the Sun (heat) |
| Staircase, ramp, school building, walking stick | The thoughts and feelings of the students |
| The air all around | |

**Therefore, all objects and the air in the picture are matter, while light, heat, thoughts and emotions do not consist of matter.**

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QUESTION 2 *Probe and ponder · p. 116*

## How can elements be combined to form a compound?

ANSWER

A compound is formed when different elements combine chemically in a fixed ratio. Merely mixing elements does not form a compound.

### a Examples from the chapter

| Compound | Elements combined | Ratio |
|---|---|---|
| Water ($H_2O$) | Hydrogen and oxygen | 2 : 1 (atoms) |
| Sodium chloride | Sodium and chlorine | 1 : 1 |
| Iron sulfide | Iron and sulfur (heated together) | Fixed ratio (5.6 g iron : 3.2 g sulfur in Activity 8.5) |

- The new compound has **properties entirely different** from those of its elements, and its elements cannot be separated by physical methods.

**Therefore, elements combine chemically (for example, by heating iron and sulfur) in a fixed ratio to form a compound with new properties.**

QUESTION 3 *Probe and ponder · p. 116*

## How could the discovery of a compound that absorbs carbon dioxide from the air contribute to solving environmental challenges?

ANSWER

Carbon dioxide in the atmosphere is increasing because of the burning of fuels. A compound that absorbs it could help to reduce this.

### a Possible contributions

- It could **remove carbon dioxide** from the air, and so help to reduce the harmful effects of its increasing amount in the atmosphere.

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- It could be used in places where much carbon dioxide is released, such as factories and vehicles, to capture the gas before it enters the air.
- We already know a small example: lime water (calcium hydroxide) absorbs carbon dioxide and forms calcium carbonate, which is why it turns milky (Activity 8.1).

### b Share your questions

- Some model questions: Can the absorbed carbon dioxide be reused? How long can such a compound keep absorbing the gas? Is it safe for living beings?

**Therefore, such a compound could lower the carbon dioxide in the air and help to solve environmental problems like the rise in carbon dioxide caused by burning fuels.**

QUESTION 4 *Question in the text · p. 117*

**Can you identify a few more examples of non-uniform mixtures around you?**

ANSWER

In a non-uniform mixture the components are generally visible with the naked eye or with a magnifying device.

### a Examples

- Sprout salad and *poha* (the examples in the chapter).
- Sand and water; muddy water; oil and water.
- Soil; rocks (a mixture of minerals); a bowl of fruit salad.

**Therefore, sprout salad, poha, sand and water, muddy water, oil and water and soil are non-uniform mixtures because their components can be seen.**

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QUESTION 5 *Question in the text · p. 117*

**Can you list a few uniform mixtures?**

ANSWER

In a uniform mixture the components are evenly distributed and cannot be distinguished, even with a microscope.

### a Examples

- Sugar dissolved in water; lemonade; soda water; vinegar; seawater.
- Air.
- Alloys such as stainless steel, brass and bronze.

**Therefore, sugar in water, lemonade, vinegar, seawater, air and alloys are uniform mixtures.**

QUESTION 6 *Question in the text · p. 118*

**8.1.1 Is air a mixture?**
**In *Curiosity*, Grade 6, you learnt about air and its composition in the chapter 'Nature's Treasures'. Is air a mixture? What kind of mixture is it?**

ANSWER

Yes, air is a mixture. It is a uniform mixture of gases.

### a Why air is a mixture

- Air is made of mainly **nitrogen** (about 78%), **oxygen**, **argon**, **carbon dioxide** and **water vapour**.
- Its components do not react chemically with each other and keep their own properties: oxygen supports combustion, nitrogen does not take part in combustion, and water vapour condenses into droplets on a cool surface.

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- The components are evenly distributed, so air is a **uniform** mixture (a mixture of gas and gas).

**Therefore, air is a uniform mixture of gases such as nitrogen, oxygen, argon, carbon dioxide and water vapour.**

QUESTION 7 *Activity 8.1 · pp. 118–119*

**Activity 8.1: Let us experiment**
**• Take a glass tumbler and fill it half with water.**
**• Add a small amount of calcium oxide (quick lime) slowly to it.**
**• What do you observe?**
**• Calcium oxide reacts vigorously with water to form calcium hydroxide and releases heat.**
**• Stir continuously to make a solution of calcium hydroxide. This solution is called lime water.**
**• Filter it and observe its colour.**
**• Leave this colourless solution in a petri dish for a few hours (Fig. 8.5a).**
**• Keep stirring the solution at regular intervals.**
**• What do you observe (Fig. 8.5b)? Does it turn milky?**
**Can you explain why the solution has turned milky?**

ANSWER

Lime water is made from calcium oxide, and it is then left open to the air. We note what happens at each stage.

### a Observations

| Stage | Observation |
|---|---|
| Calcium oxide added to water | It reacts vigorously with water, forming calcium hydroxide, and heat is released (the tumbler becomes warm). |
| Stirred, then filtered | A colourless solution of calcium hydroxide (lime water) is obtained. |
| Left in a petri dish for a few hours, stirred at intervals | The lime water turns **milky** (Fig. 8.5b). |

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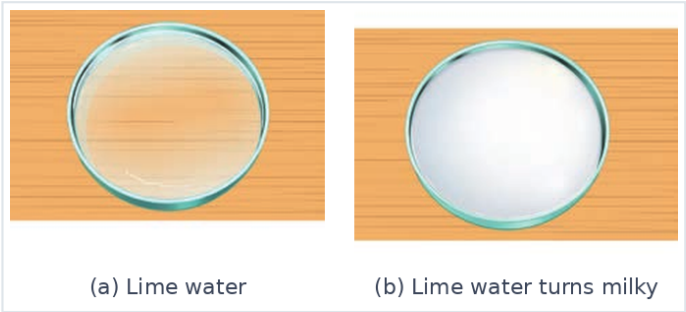


*Fig. 8.5: Lime water turns milky in the presence of carbon dioxide*

### b Why does it turn milky?

- Carbon dioxide from the air reacts with calcium hydroxide to form **calcium carbonate** (insoluble tiny white particles) and water.
- Since lime water turns milky on being exposed to air, the activity shows that carbon dioxide is present in the air.

Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water

**Therefore, the lime water turns milky because carbon dioxide of the air forms insoluble calcium carbonate, which shows that air contains carbon dioxide.**

**QUESTION 8** *Activity 8.2 · p. 119*

**Activity 8.2: Let us explore**
**• Take a black sheet of paper. Ensure that it is free from any visible dust particles.**
**• Place the black sheet of paper undisturbed near an open window (Fig. 8.6a), or in the garden, for a few hours.**
**• What do you observe?**

**ANSWER**

A clean black sheet is kept open to the air so that anything present in the air can settle on it.

### a Observation

- After a few hours, **tiny particles are seen settled on the surface** of the sheet. They can be examined more closely with a magnifying glass (Fig. 8.6b).

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### b Inference

- Dust particles are **suspended in the air**. They are not an integral part of air and are considered **pollutants**.
- The nature and the number of dust particles vary from time to time and from place to place.
- Other major pollutants are soot, carbon monoxide, ozone, nitrogen dioxide and sulfur dioxide. The air quality index (AQI) is a tool used to describe the air quality.

**Therefore, the black sheet collects dust, which shows that dust particles are present in the air as pollutants and are not a part of air.**

**QUESTION 9** *Table 8.1 · p. 120*

**Some mixtures with their examples are shown in Table 8.1. Complete the third column—**
**(Table 8.1: Different types of mixtures; the last column "Uniform or non-uniform" is to be completed.)**

**ANSWER**

A mixture is uniform if its components cannot be seen separately and non-uniform if they can be seen. In science, all components of a mixture must be pure substances.

### a Table 8.1: Different types of mixtures

| S.No. | Mixture-type | Examples | Uniform or non-uniform |
|---|---|---|---|
| 1. | Gas and gas | Air | Uniform |
| 2. | Gas and liquid | Aerated water (soda water)<br>Oxygen dissolved in water | **Uniform**<br>**Uniform** |
| 3. | Solid and gas | Carbon particles in air | **Non-uniform** |
| 4. | Liquid and liquid | Acetic acid in water (vinegar)<br>Oil and water | **Uniform**<br>**Non-uniform** |
| 5. | Solid and liquid | Sand and water<br>Seawater | **Non-uniform**<br>**Uniform** |
| 6. | Solid and solid | Baking powder (baking soda and tartaric acid)<br>Alloys | **Uniform**<br>**Uniform** |

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- Acetic acid dissolves in water and oxygen dissolves in water, so they cannot be seen separately; oil and sand do not dissolve, so they remain visible.
- Baking powder is a fine powder in which the two components are mixed so well that they look the same throughout.

**Therefore, the third column reads: Uniform; Uniform, Uniform; Non-uniform; Uniform, Non-uniform; Non-uniform, Uniform; Uniform, Uniform.**

QUESTION 10 *A step further · p. 121*

**According to science, how would you classify milk, packed fruit juice, baking soda, sugar, and soil—as mixtures or pure substances?**

ANSWER

A pure substance consists of the same type of particles, while a mixture is made of more than one substance.

### a Classification

| Item | Classification | Reason |
|---|---|---|
| Milk | Mixture | Contains water, fat, proteins and other substances. |
| Packed fruit juice | Mixture | Contains water, fruit pulp, sugar and other substances. |
| Baking soda | Pure substance | Made of only one substance, sodium hydrogen carbonate (a compound). |
| Sugar | Pure substance | Made of only one substance; it is a compound of carbon, hydrogen and oxygen. |
| Soil | Mixture | Made of sand, minerals and other substances. |

**Therefore, milk, packed fruit juice and soil are mixtures; baking soda and sugar are pure substances.**

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QUESTION 11 *Activity 8.3 · pp. 121–122*

**Activity 8.3: Let us experiment (Demonstration activity)**
**• Collect two small test tubes, a beaker or a glass tumbler, and a 9 V battery.**
**• Fill 2/3rd of the beaker with water and add a few drops of dilute sulfuric acid to it.**
**• Fill both the small test tubes completely with water taken from the beaker (Fig. 8.8a).**
**• Place a 9 V battery inside the beaker (Fig. 8.8b).**
**• Without spilling the water, carefully place the water-filled test tubes on each of the terminals of the battery (Fig. 8.8c).**
**• Wait for a few minutes. Do you observe the formation of any gas bubbles at both the terminals inside the test tubes?**
**• Let it continue for 10–15 minutes. Observe the volume of gas collected in each test tube (Fig. 8.8d). Is the volume of the gas collected the same in both the test tubes?**
**• Remove these test tubes one-by-one carefully. Test these gases one-by-one by bringing a burning candle close to the mouth of the test tubes. What happens in each case? Which gas is present in each test tube?**
**Can these collected gases be water vapour?**

ANSWER

Electricity is passed through water (made conducting by a few drops of dilute sulfuric acid), and the gases formed at the two terminals are collected and tested.

### a Observations

| Question | Observation |
|---|---|
| Gas bubbles at both terminals? | Yes, gas bubbles form at both terminals and collect in the test tubes. |
| Same volume in both test tubes? | No. The two test tubes collect different volumes of gas; the hydrogen tube has the larger volume (Fig. 8.8d). |
| Burning candle at the first tube | A **pop sound** is heard: the gas is **hydrogen**. |
| Burning candle at the second tube | The flame glows **brighter**: the gas is **oxygen**. |

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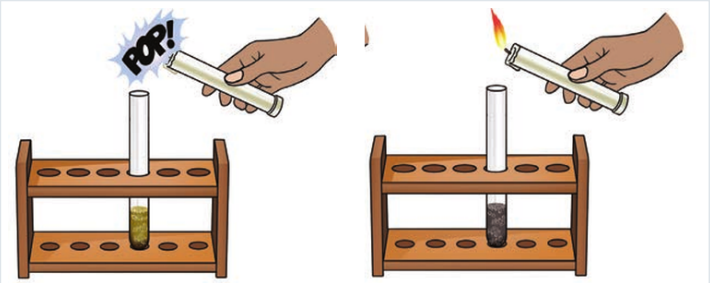


(a) Hydrogen: pop sound (b) Oxygen: flame glows brighter

*Fig. 8.9: Testing the nature of gas (a) hydrogen; (b) oxygen*

### b Can the gases be water vapour?

- **No.** If they were water vapour, they would have condensed back to form water.

### c Inference

- Water is composed of two different constituents, hydrogen and oxygen.

Water → Hydrogen + Oxygen

**Therefore, passing electricity through water gives hydrogen (pop sound) and oxygen (brighter flame), so water is composed of hydrogen and oxygen.**

**QUESTION 12** *Ever heard of … · p. 123*

**When electric current is passed through water, it breaks down into hydrogen and oxygen. Is this a chemical change or a physical change? Recall *Curiosity*, Grade 7, chapter 'Changes Around Us: Physical and Chemical'.**

**ANSWER**

In a chemical change one or more new substances are formed; in a physical change no new substance is formed.

### a Deciding the change

- Water breaks down into two new substances, hydrogen and oxygen, which have properties different from water.

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- Hydrogen burns with a pop sound and oxygen supports combustion, but water does not.

**Therefore, the breaking down of water by electric current is a chemical change.**

QUESTION 13 *Question in the text · p. 124*

**Why cannot we separate hydrogen and oxygen present in water by physical means?**

ANSWER

The answer lies in the way hydrogen and oxygen are joined in water.

a **Reason**

- In water, the particles of hydrogen and oxygen are **so tightly attached** to each other that it is generally impossible to separate them using physical methods.
- They are combined chemically in a **fixed ratio**; the ratio of the number of atoms of hydrogen to oxygen is 2 : 1.
- That is why water is a **compound**, and the properties of a compound are different from those of its elements.

**Therefore, hydrogen and oxygen cannot be separated from water by physical means because they are chemically combined in a fixed ratio to form the compound water.**

QUESTION 14 *Question in the text · p. 124*

**Are common salt and sugar elements or compounds? Let us find out. ... Is it possible to separate sodium chloride into its elements by physical processes?**

ANSWER

Common salt is sodium chloride. We check what physical processes can and cannot do.

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### a Sodium chloride

- Sodium (a soft metal) and chlorine (a hazardous gas) combine in a 1 : 1 ratio to form sodium chloride, a harmless substance essential for life.
- Dissolved sodium chloride can be separated from **water** by evaporation, because salt solution is a mixture.
- But sodium chloride **cannot be separated into sodium and chlorine** by physical processes.

### b Salt and sugar

- Common salt (sodium chloride) is a **compound** of sodium and chlorine. Sugar is also a **compound**, as shown in Activity 8.4.

**Therefore, it is not possible to separate sodium chloride into its elements by physical processes. Common salt and sugar are compounds.**

QUESTION 15 *Activity 8.4 · pp. 124–125*

**Activity 8.4: Let us experiment**
**• Put a teaspoon of sugar in a boiling tube.**
**• Heat it gently as shown in Fig. 8.12a.**
**• What do you observe?**
**Where did this water come from? Was it in the dry sugar, or did it come by the condensation of water vapour in the air? Can you predict what is left behind?**

ANSWER

Sugar is heated gently in a boiling tube over a spirit lamp. (Perform only in the presence of a teacher.)

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### a Observations




*Fig. 8.12: Heating sugar in a boiling tube (a) heating (b) colour changes (c) charcoal*

- The sugar turns **brown** and later begins to **char** (turns blackish).
- **Small droplets of water** are seen inside the boiling tube near its open end.

### b Where did the water come from?

- Since the tube is being heated, the water must have come from the **dry sugar** and not by condensation of water vapour in the air.

### c What is left behind?

- **Charcoal (carbon)** is left behind in the boiling tube. It can be scooped out on a watch glass and it burns like coal.

Sugar → Carbon + Water

Water = hydrogen + oxygen, so sugar contains carbon, hydrogen and oxygen

**Therefore, sugar decomposes on heating into carbon and water, so it is not an element. It is a compound of carbon, hydrogen and oxygen.**

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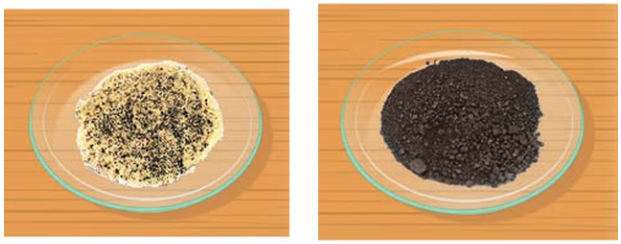
QUESTION 16 *Activity 8.5 · pp. 125–128*

**Activity 8.5: Let us experiment (Demonstration activity)**
**• Take 5.6 grams of iron filings (Fig. 8.13a) and 3.2 grams of sulfur powder (Fig. 8.13b) on a watch glass. Observe them carefully.**
**• Mix them thoroughly in a watch glass. Label this mixture as Sample A (Fig. 8.14). Observe it carefully.**
**• Is this a uniform or a non-uniform mixture? Can you still observe both iron and sulfur as separate substances?**
**• Take half of Sample A in a china dish and gently heat it (Fig. 8.15a) with continuous stirring until a black mass is formed. Let the content cool. Place this black mass in a mortar and grind it with the help of a pestle. Now, put it on another watch glass and label it as Sample B (Fig. 8.15b).**
**• Compare Samples A and B step by step (Step 1 — Appearance; Step 2 — Magnet test; Step 3 — Gas test with dilute hydrochloric acid) and record your observations in Table 8.2.**
**Some discussion points: Do the Samples, A and B look the same? Which sample exhibits magnetic properties? Can we separate the components of Samples A and B? On adding dilute hydrochloric acid, do gases evolve in both Samples A and B? In both the cases, do the gases smell the same or different? Also, categorise the substances used in this activity into mixtures, compounds, and elements.**

ANSWER

Iron and sulfur are mixed to get Sample A. Half of Sample A is heated to get Sample B. The two samples are then compared.

### a Samples A and B



(a) Sample A (b) Sample B

*Fig. 8.16: (a) Sample A (iron and sulfur mixed); (b) Sample B (black mass, iron sulfide)*

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- Sample A is a **non-uniform mixture**: the black iron filings and yellow sulfur can still be seen as separate substances.

Mass of iron : mass of sulfur = 5.6 g : 3.2 g
= (0.8 × 7) g : (0.8 × 4) g = 7 : 4

## b Table 8.2: Comparison of Samples A and B

| S.No. | Experiment | Sample A | Sample B |
|---|---|---|---|
| 1. | Appearance<br>(i) Colour<br>(ii) Texture | Black and yellow particles seen separately<br>Gritty mixture of two powders | Black throughout<br>Same throughout (a dull black powder after grinding) |
| 2. | Magnet test | Iron filings are attracted to the magnet | Not attracted by the magnet |
| 3. | Gas test<br>(i) Odour<br>(ii) Burning | Colourless gas with no smell<br>Burns with a 'pop' sound (hydrogen); sulfur is left as a yellow solid | Colourless gas with a rotten egg-like odour<br>Gas (hydrogen sulfide) burns with a flame, with no 'pop' |

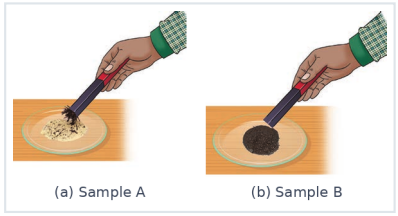


*Fig. 8.17: Responses of Samples A and B to a magnet*

## c Discussion points

| Question | Answer |
|---|---|
| Do A and B look the same? | No. A shows black and yellow particles; B is uniformly black. |
| Which sample is magnetic? | Sample A (because of the iron filings). |
| Can the components be separated? | In A, yes (iron by a magnet). In B, no. |
| Do gases evolve in both on adding dilute hydrochloric acid? | Yes: hydrogen from A and hydrogen sulfide from B. |
| Do the gases smell the same? | No. Hydrogen has no smell; hydrogen sulfide smells like rotten eggs. |
| Categorise the substances | **Elements:** iron, sulfur (and hydrogen). **Mixture:** Sample A. **Compounds:** iron sulfide (Sample B), iron chloride, hydrogen sulfide. |

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### d Reactions with dilute hydrochloric acid

Iron + Dilute hydrochloric acid → Iron chloride + Hydrogen gas

Iron sulfide + Dilute hydrochloric acid → Iron chloride + Hydrogen sulfide

**Therefore, Sample A is a mixture of the elements iron and sulfur, which keep their properties. Sample B (iron sulfide) is a compound with entirely different properties.**

QUESTION 17 *Question in the text · p. 128*

## Can you explain now why the magnet has no effect on Sample B?

ANSWER

The magnet attracts iron, so we find out whether iron is still present as iron in Sample B.

### a Explanation

- On heating, iron and sulfur combined chemically to form a new substance, **iron sulfide**, with completely different properties.
- There is no free iron in Sample B, so there is nothing for the magnet to attract. Iron and sulfur can no longer be separated.

**Therefore, the magnet has no effect on Sample B because the iron has chemically combined with sulfur to form iron sulfide, which is not magnetic.**

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8.2

CLASS 8 SCIENCE · CHAPTER 8

# Keep the Curiosity Alive

Solutions · 14 questions

**Directions (Questions 1–14):** These are the questions given at the end of the chapter under “Keep the curiosity alive”, numbered as in the textbook. Questions 13 and 14 are the two open-ended boxes (“Prepare some questions…” and “Reflect on the questions framed by your friends…”), for which model answers are given.

QUESTION 1 *Keep the curiosity alive · p. 131*

**Consider the following reaction where two substances, A and B, combine to form a product C:**
**A + B → C**
**Assume that A and B cannot be broken down into simpler substances by chemical reactions. Based on this information, which of the following statements is correct?**
**(i) A, B, and C are all compounds and only C has a fixed composition.**
**(ii) C is a compound, and A and B have a fixed composition.**
**(iii) A and B are compounds, and C has a fixed composition.**
**(iv) A and B are elements, C is a compound, and has a fixed composition.**

ANSWER

Substances that cannot be broken down into simpler substances are elements. Two elements that combine chemically form a compound.

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### a Checking the statements

| Statement | Correct? | Reason |
|---|---|---|
| (i) | No | A and B cannot be broken down, so they are elements, not compounds. |
| (ii) | No | It does not say that A and B are elements, so it is incomplete. |
| (iii) | No | A and B are elements, not compounds. |
| (iv) | **Yes** | A and B are elements; their chemical combination gives a compound C with a fixed composition. |

**Therefore, the correct statement is (iv): A and B are elements, C is a compound, and has a fixed composition.**

**QUESTION 2** *Keep the curiosity alive · p. 131*

**Assertion: Air is a mixture.**
**Reason: A mixture is formed when two or more substances are mixed, without undergoing any chemical change.**
**(i) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.**
**(ii) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.**
**(iii) Assertion is true, but Reason is false.**
**(iv) Assertion is false, but Reason is true.**

**ANSWER**

We check whether the assertion and the reason are true, and whether the reason explains the assertion.

### a Checking

- **Assertion is true:** air is a uniform mixture of nitrogen, oxygen, argon, carbon dioxide and water vapour.
- **Reason is true:** a mixture is formed when two or more substances are mixed without any chemical change, and each keeps its properties.
- The reason **explains** the assertion: the gases in air are only mixed, they do not react chemically.

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**Therefore, the correct option is (i): both Assertion and Reason are true and Reason is the correct explanation for Assertion.**

QUESTION 3 *Keep the curiosity alive · p. 131*

**Water, a compound, has different properties compared to those of the elements oxygen and hydrogen from which it is formed. Justify this statement.**

ANSWER

A compound is something entirely new, and its properties differ from those of its elements.

### a Comparing the properties

| Substance | Properties |
|---|---|
| Hydrogen (element) | A gas; a fuel; burns with a pop sound. |
| Oxygen (element) | A gas; supports combustion; makes a flame glow brighter. |
| Water (compound) | A liquid at room temperature; extinguishes fire; neither burns nor supports burning. |

- Hydrogen and oxygen combine chemically in a fixed ratio of atoms (2 : 1) to form water, and they cannot be separated from water by physical methods.

**Therefore, water has properties completely different from those of hydrogen and oxygen, as is true for all compounds.**

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QUESTION 4 *Keep the curiosity alive · p. 131*

**In which of the following cases are all the examples correctly matched? Give reasons in support of your answers.**
**(i) Elements — water, nitrogen, iron, air.**
**(ii) Uniform mixtures— minerals, seawater, bronze, air.**
**(iii) Pure substances— carbon dioxide, iron, oxygen, sugar.**
**(iv) Non-uniform mixtures — air, sand, brass, muddy water.**

ANSWER

We classify each example and check every option.

### a Checking the options

| Option | Correct? | Reason |
|---|---|---|
| (i) Elements — water, nitrogen, iron, air | No | Water is a compound and air is a mixture. |
| (ii) Uniform mixtures — minerals, seawater, bronze, air | No | Minerals are pure substances (mostly compounds), not mixtures. |
| (iii) Pure substances — carbon dioxide, iron, oxygen, sugar | **Yes** | Carbon dioxide and sugar are compounds; iron and oxygen are elements; all are pure substances. |
| (iv) Non-uniform mixtures — air, sand, brass, muddy water | No | Air and brass (an alloy) are uniform mixtures. |

**Therefore, only option (iii) has all the examples correctly matched.**

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QUESTION 5 *Keep the curiosity alive · p. 131*

**Iron reacts with moist air to form iron oxide, and magnesium burns in oxygen to form magnesium oxide. Classify all the substances involved in the above reactions as elements, compounds or mixtures, with justification.**

ANSWER

The two reactions are: iron + moist air → iron oxide (rust), and magnesium + oxygen → magnesium oxide.

### a Classification

| Substance | Class | Justification |
|---|---|---|
| Iron | Element | Made of one kind of atom; cannot be broken down. |
| Moist air | Mixture | Mixture of nitrogen, oxygen, water vapour and other gases; components are not chemically combined. |
| Oxygen | Element | Made of one kind of atom (molecules of two oxygen atoms). |
| Water vapour (moisture) | Compound | Hydrogen and oxygen combined chemically in a fixed ratio (2 : 1). |
| Iron oxide (rust) | Compound | Iron and oxygen combined chemically; it has properties different from both. |
| Magnesium | Element | Made of one kind of atom. |
| Magnesium oxide | Compound | Magnesium and oxygen combined chemically in a fixed ratio. |

**Therefore, iron, oxygen and magnesium are elements; water vapour, iron oxide and magnesium oxide are compounds; and moist air is a mixture.**

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QUESTION 6 *Keep the curiosity alive · p. 132*

**Classify the following as elements, compounds, or mixtures in Table 8.3.**
**Carbon dioxide, sand, seawater, magnesium oxide, muddy water, aluminium, gold, oxygen, rust, iron sulfide, glucose, air, water, fruit juice, nitrogen, sodium chloride, sulfur, hydrogen, baking soda.**
**Identify pure substances amongst these and list them below.**

ANSWER

Elements are made of one kind of atom, compounds are chemical combinations of elements, and mixtures contain more than one substance.

### a Table 8.3

| Elements | Compounds | Mixtures |
|---|---|---|
| Aluminium | Carbon dioxide | Sand |
| Gold | Magnesium oxide | Seawater |
| Oxygen | Rust (iron oxide) | Muddy water |
| Nitrogen | Iron sulfide | Air |
| Sulfur | Glucose | Fruit juice |
| Hydrogen | Water | |
| | Sodium chloride | |
| | Baking soda | |

### b Pure substances

All the elements and compounds are pure substances: aluminium, gold, oxygen, nitrogen, sulfur, hydrogen, carbon dioxide, magnesium oxide, rust, iron sulfide, glucose, water, sodium chloride and baking soda.

**Therefore, there are 6 elements, 8 compounds and 5 mixtures; the 14 elements and compounds are the pure substances.**

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QUESTION 7 *Keep the curiosity alive · p. 132*

**What new substance is formed when a mixture of iron filings and sulfur powder is heated, and how is it different from the original mixture? Also, write the word equation for the reaction.**

ANSWER

On heating, iron and sulfur react chemically and form a new substance.

### a The new substance

- The new substance is **iron sulfide**, a black mass.

### b Difference from the original mixture

| Property | Mixture of iron and sulfur | Iron sulfide |
|---|---|---|
| Appearance | Black and yellow particles seen separately | Same black colour and texture throughout |
| Magnet | Iron is attracted | Not attracted |
| Separation | Components can be separated | Iron and sulfur cannot be separated |
| With dilute HCl | Hydrogen gas (no smell); sulfur left | Hydrogen sulfide gas (rotten egg odour) |
| Type | Mixture | Compound |

Iron + Sulfur → Iron sulfide

**Therefore, heating forms the compound iron sulfide, which has properties different from the mixture. Word equation: Iron + Sulfur → Iron sulfide.**

NCERT ARCHIVE

QUESTION 8 *Keep the curiosity alive · p. 132*

**Is it possible for a substance to be classified as both an element and a compound? Explain why or why not.**

ANSWER

The definitions of an element and a compound are different, so a substance cannot be both.

### a Explanation

| | Element | Compound |
|---|---|---|
| Particles | Identical atoms of one kind | Two or more different elements combined chemically |
| Breaking down | Cannot be broken into simpler substances | Can be broken down into elements by chemical methods |
| Examples | Hydrogen, oxygen, gold | Water, sugar, sodium chloride |

**Therefore, no. A substance is either an element (one kind of atom, cannot be broken down) or a compound (two or more elements combined chemically), never both.**

QUESTION 9 *Keep the curiosity alive · p. 132*

**How would our daily lives be changed if water were not a compound but a mixture of hydrogen and oxygen?**

ANSWER

If water were just a mixture, hydrogen and oxygen would keep their own properties instead of the properties of water.

### a What would change

- Water would not be a liquid to drink, cook, wash or irrigate with; the components could be separated by physical means and would exist as gases.

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- Hydrogen is a fuel and oxygen supports combustion, so the mixture would catch fire easily instead of putting fire out. Fires could not be extinguished with water.
- The oceans, rivers and rain would not exist, and living beings could not survive.

**Therefore, our daily life would be completely different, because water would lose the properties that make it essential for life and for putting out fires.**

**QUESTION 10** *Keep the curiosity alive · p. 132*

**Analyse Fig. 8.24. Identify Gas A. Also, write the word equation of the chemical reaction.**
**(Fig. 8.24: iron filings and dilute hydrochloric acid in a test tube, with the gas collected in another tube above.)**

**ANSWER**

Iron filings react with dilute hydrochloric acid, and the gas formed is collected in the upper tube.

### a Analysing the figure

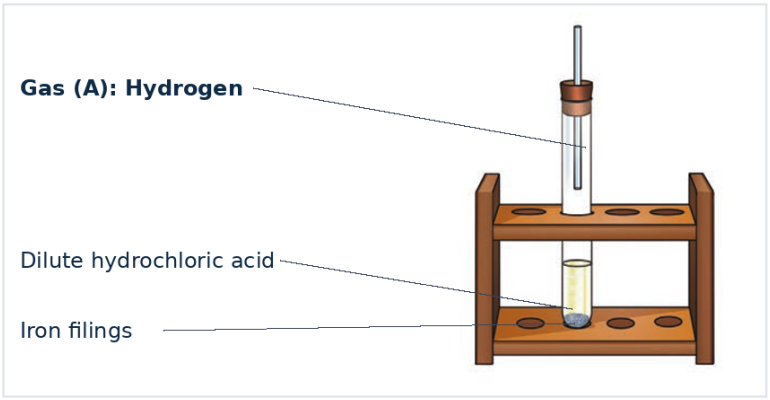


*Fig. 8.24 with Gas A identified*

- Iron reacts with dilute hydrochloric acid to form iron chloride and a colourless, odourless gas which burns with a ‘pop’ sound. This gas (Gas A) is **hydrogen**.

Iron + Dilute hydrochloric acid → Iron chloride + Hydrogen gas

**Therefore, Gas A is hydrogen. Word equation: Iron + Dilute hydrochloric acid → Iron chloride + Hydrogen gas.**

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QUESTION 11 *Keep the curiosity alive · p. 132*

**Write the names of any two compounds made only from non-metals, and also mention two uses of each of them.**

ANSWER

Compounds made only from non-metals include water (hydrogen and oxygen) and carbon dioxide (carbon and oxygen).

### a Two compounds and their uses

| Compound | Elements (all non-metals) | Two uses |
|---|---|---|
| Water ($H_2O$) | Hydrogen and oxygen | 1. Drinking, cooking and washing.<br>2. Extinguishing fire. |
| Carbon dioxide ($CO_2$) | Carbon and oxygen | 1. Making aerated (soda) water and cold drinks.<br>2. Used in fire extinguishers. |

**Therefore, two such compounds are water (drinking and extinguishing fire) and carbon dioxide (aerated drinks and fire extinguishers).**

QUESTION 12 *Keep the curiosity alive · p. 132*

**How can gold be classified as both a mineral and a metal?**

ANSWER

Gold is an element, and it is found in nature as the pure element.

### a Why gold is both

- **As a metal:** gold is an element, and gold, silver, iron and aluminium are metals.
- **As a mineral:** minerals are natural, solid substances found on the Earth with a fixed chemical composition. Some minerals, called **native minerals**, are pure elements; gold, silver and copper are examples.

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**Therefore, gold is a metal because it is a metallic element, and a mineral because it occurs naturally as a solid pure element (a native mineral).**

QUESTION 13 *Prepare some questions · p. 131*

**Prepare some questions based on your learnings so far …**
**(Why? When? How long? Where? Why not?)**

ANSWER

This is an open-ended task. Model questions, one for each question word, are given below.

**a** **Model questions**

| Word | Question |
|---|---|
| Why? | Why is iron sulfide a compound while a mixture of iron and sulfur is not? |
| When? | When does a mixture of elements become a compound? |
| How long? | How long does lime water take to turn milky when kept open in the air? |
| Where? | Where do we find native minerals such as gold and sulfur? |
| Why not? | Why not separate sodium and chlorine from salt by filtering or evaporation? |

**Therefore, questions can be framed with words like why, when, how long, where and why not, using the ideas of this chapter.**

QUESTION 14 *Reflect · p. 132*

**Reflect on the questions framed by your friends and try to answer …**

ANSWER

Answers to the model questions framed above.

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## a Reflections

| Question | Answer |
|---|---|
| Why is iron sulfide a compound while a mixture of iron and sulfur is not? | In iron sulfide the iron and sulfur are chemically combined and have new properties; in the mixture they keep their own properties. |
| When does a mixture of elements become a compound? | When the elements react chemically, for example when iron and sulfur are heated together. |
| How long does lime water take to turn milky in air? | A few hours, if it is left in a petri dish and stirred at regular intervals (Activity 8.1). |
| Where do we find native minerals? | In rocks and the Earth’s crust; gold, silver, copper, sulfur and carbon occur as pure elements. |
| Why not separate sodium and chlorine from salt by evaporation? | Evaporation only separates salt from water; the elements in the compound are chemically combined and cannot be separated by physical processes. |

**Therefore, the questions can be answered with the ideas of mixtures, compounds, elements and minerals studied in this chapter.**

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8.3

CLASS 8 SCIENCE · CHAPTER 8

# Discover, Design, and Debate

Solutions · 4 questions

**Directions (Questions 1–4):** These are the activities given under “Discover, design, and debate” at the end of the chapter. Model answers and plans are given; you may use your own ideas and findings.

QUESTION 1 *Discover, design, and debate · p. 133*

**Design and create comic strips from real-life examples to differentiate between elements, compounds, and mixtures with diagrams and illustrate their properties and uses.**

ANSWER

A comic strip tells a short story in a few panels. A model four-panel plan is given below.

## a A model comic strip

| Panel | Scene and diagram | Idea shown |
|---|---|---|
| 1 | Students make a sprout salad. | **Mixture:** components keep their properties and can be separated. |
| 2 | Water is broken into hydrogen and oxygen by electricity. | **Compound:** elements combined chemically; properties differ from the elements. |
| 3 | A student picks up gold or iron. | **Element:** one kind of atom; cannot be broken down; building block of matter. |
| 4 | Uses: bridges (iron), drinking water, stainless steel utensils. | **Uses** of elements, compounds and mixtures in daily life. |

**Therefore, a comic strip with diagrams can show that mixtures keep properties, compounds have new properties, and elements are the simplest substances.**

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QUESTION 2 *Discover, design, and debate · p. 133*

**Search for discoveries of some elements (such as phosphorus, sodium), compounds (such as penicillin) and mixtures (such as brass, bronze, stainless steel). Present your findings in the class.**

ANSWER

A model table of findings is given below (the discoverers and dates are from general science sources).

### a Findings

| Substance | Type | Finding |
|---|---|---|
| Phosphorus | Element | Discovered in 1669 by Hennig Brand, a German alchemist. |
| Sodium | Element | Isolated in 1807 by Humphry Davy, using electricity. |
| Penicillin | Compound | Discovered in 1928 by Alexander Fleming, from the *Penicillium* mould; the first antibiotic. |
| Brass | Mixture (alloy) | Copper and zinc. |
| Bronze | Mixture (alloy) | Copper and tin; in ancient India called *Kamsya* (4 parts *Tamra* and 1 part *Vanga*), used for digestion and immunity. |
| Stainless steel | Mixture (alloy) | Iron, nickel, chromium and a small amount of carbon; stronger and more durable than pure iron. |

**Therefore, phosphorus and sodium are elements, penicillin is a compound, and brass, bronze and stainless steel are alloys, which are mixtures.**

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QUESTION 3 *Discover, design, and debate · p. 133*

**Let us search: Read labels on items like detergents or snacks, and try to list the mixtures and compounds they contain.**

ANSWER

Labels list the ingredients. A model list for a packet of salted snacks is given below; read the label of your own packet.

### a Model ingredients of a snack

| Ingredient | Type |
|---|---|
| Potato, gram flour, spices | Mixtures |
| Edible vegetable oil | Mixture |
| Salt (sodium chloride) | Compound |
| Sugar | Compound |
| Water | Compound |

- In the same way, a detergent label lists compounds (such as washing soda) and mixtures (such as perfume and colour).

**Therefore, most packaged products are mixtures that contain several compounds as ingredients.**

QUESTION 4 *Discover, design, and debate · p. 133*

**Work in groups: Each group will pretend to be in the role of either an element, a compound, or a mixture. Debate which category among them is the most important.**

ANSWER

Each group argues for its own category. Some model arguments are given below.

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### a Model arguments

| Group | Argument |
|---|---|
| Elements | We are the simplest substances and the building blocks of all matter; metals build bridges and vehicles. |
| Compounds | We form when elements combine in fixed ratios and have entirely new properties; water, medicines and fertilisers are compounds. |
| Mixtures | Most things around us, such as air, food, alloys, wood and concrete, are mixtures; materials with unique properties are designed from us. |

**Therefore, all three are important. Compounds are made from elements and mixtures contain elements and compounds, so none can do without the others.**

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