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SOLUTIONS BOOK

CLASS 8

Science · Curiosity

CHAPTER 9

The Amazing World of Solutes, Solvents, and Solutions

Complete In-text Questions, Exercises and Projects Solutions

In-text Questions | Exercises | Discover, Design and Debate

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9.1

CLASS 8 SCIENCE · CHAPTER 9

In-text Questions

Solutions · 25 questions

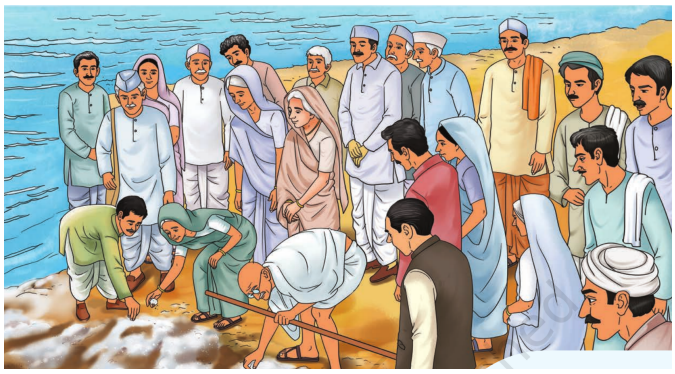
Directions (Questions 1–25): These are the questions, activities and discussion points that appear inside the chapter (Probe and ponder, Activities, Think like a scientist, Be a scientist and the questions asked in the text and in speech bubbles), numbered in the order in which they appear. Many are open-ended; model answers based on the chapter are given, and you may add examples from your own surroundings.

QUESTION 1 *Probe and ponder · p. 134*

What do you think is happening in the picture above?

ANSWER

The picture on the opening page of the chapter shows a crowd on a seashore. Some people are bending down to pick up white crystals from the shore.



Picture on the opening page of the chapter (p. 134)

a What the picture shows

- A group of people is standing on the **seashore**, with the sea behind them.
- A few of them are **bending down** and collecting white crystals (salt) from the ground; the scene looks like the famous salt-making scene at Dandi.

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b The science behind it

- Sea water is a **solution** of salts in water.
- When the water of the sea evaporates in the sun and wind, the dissolved **salt is left behind as crystals**, which can be collected.

Therefore, the picture shows people collecting salt crystals that remain on the seashore after sea water evaporates.

QUESTION 2 *Probe and ponder · p. 134*

What happens when you add too much sugar to your tea and it stops dissolving? How can you solve this problem?

ANSWER

Water (or tea) can dissolve only a limited amount of sugar at a given temperature.

a What happens

- The tea has become a **saturated solution** of sugar at that temperature; it cannot dissolve any more sugar.
- The extra sugar stays **undissolved** and settles at the bottom of the cup.

b How the problem can be solved

- **Warm the tea:** for most solids, solubility increases with an increase in temperature, so more sugar dissolves in hot tea.
- **Add more tea (solvent):** a larger quantity of solvent can dissolve more sugar.
- Stirring helps the sugar dissolve faster, but it does not change the limit; the next time, add less sugar.

Therefore, undissolved sugar means the tea is saturated; heating it or adding more tea (solvent) lets more sugar dissolve.

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QUESTION 3 *Probe and ponder · p. 134*

Why do sugar and salt dissolve in water but not in oil? Why is water considered a good solvent?

ANSWER

Whether a solid dissolves depends on the solvent. Water dissolves a very large number of substances; oil dissolves very few of them.

a Dissolving in water and in oil

Solute	In water	In oil
Sugar	Dissolves; uniform mixture (solution)	Does not dissolve; stays as grains
Salt	Dissolves; uniform mixture (solution)	Does not dissolve; stays as grains

In water, the particles of sugar and salt spread evenly among the water particles. Oil is a different kind of liquid: sugar and salt do not spread through it, so they remain separate.

b Why water is a good solvent

- It dissolves many **solids** (salt, sugar, baking soda), and also **gases** such as oxygen, which keeps aquatic life alive.
- It is used in ORS, and has primarily been used as the solvent for medicines in Ayurveda, Siddha and other Indian systems of medicine.
- It is easily available, safe and colourless.

Therefore, sugar and salt dissolve in water but not in oil, and water is called a good solvent because it dissolves a large variety of substances.

QUESTION 4 *Probe and ponder · p. 134*

Why are water bottles usually tall and cylindrical in shape instead of spherical?

ANSWER

The shape of a container is chosen so that it is easy to use, store and carry.

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a Reasons

- A cylindrical bottle has a **flat base**, so it stands upright; a spherical bottle would roll away.
- It is easy to **hold, grip and pour** from, and easy to fill through the narrow neck.
- Cylindrical bottles **pack closely** in bags, boxes and refrigerators with little wasted space; spheres leave gaps.
- A tall, narrow shape also makes the level of water easy to see and read, as in a measuring cylinder (see Question 19).

Therefore, water bottles are tall and cylindrical because this shape stands steadily, is easy to hold and pour, and packs neatly.

QUESTION 5 *Chapter text · p. 135*

You may have wondered why every sip of your homemade ORS tastes the same, no matter how much you drink. Why does it not taste salty in one sip and sweet in another?

ANSWER

ORS is a mixture of sugar, salt and water. The answer depends on how the components are spread in the mixture.

a Explanation

- When sugar and salt are added to water, they dissolve and form a mixture in which the components are **evenly distributed throughout**.
- Such a mixture is **uniform** (a **solution**), so every part of it has the same composition.
- Therefore every sip has the same amounts of sugar and salt, and tastes the same.

Therefore, ORS tastes the same in every sip because sugar and salt are evenly distributed in water, forming a uniform mixture (a solution).

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QUESTION 6 *Chapter text · p. 135*

Can you predict whether this mixture is uniform or not (Fig. 9.1)? What happens when chalk powder is mixed with water—does it form a uniform mixture?

ANSWER

A mixture is uniform if its components are evenly distributed. Compare Fig. 9.1 with Fig. 9.2.



Fig. 9.1: Mixture of sugar, salt, and water



Fig. 9.2: Mixture of (a) Sand and water; (b) Sawdust and water

a The mixture in Fig. 9.1

It is **uniform**. Sugar and salt are evenly distributed in water, so it looks the same everywhere and the components cannot be seen separately.

b Chalk powder and water

Chalk powder does **not** form a uniform mixture with water. Its particles are not evenly distributed (like sand or sawdust in Fig. 9.2); it forms a **non-uniform mixture**.

Mixture	Type	Reason
Sugar + salt + water	Uniform (solution)	Components evenly distributed
Chalk powder + water	Non-uniform	Chalk is not evenly distributed
Sand + water	Non-uniform	Sand sinks to the bottom
Sawdust + water	Non-uniform	Sawdust floats on the water

Therefore, the mixture in Fig. 9.1 is uniform, whereas chalk powder and water form a non-uniform mixture.

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QUESTION 7 *Chapter text · p. 135*

We know air is a mixture. Would a mixture of gases also be considered a solution?

ANSWER

A solution is defined in the chapter as a uniform mixture.

a **Answer with reason**

- Gases mix evenly with one another, so a mixture of gases (such as air) is **uniform**: its components are not visible separately.
- A uniform mixture is called a solution, so a mixture of gases is also a **solution** (a gaseous solution).

Therefore, yes: a mixture of gases is a uniform mixture and can be considered a solution.

QUESTION 8 *Activity 9.1 · p. 136*

Activity 9.1: Let us investigate

What will happen if we keep on adding more salt in a given amount of water?

• Take a clean glass tumbler and fill it half with water.

• Add one spoon of salt into it and stir well till it dissolves completely (Fig. 9.5).

• Gradually add a spoonful of salt into the glass tumbler and stir. Observe how many spoons of salt you can add before it stops dissolving completely.

• Record your observations in Table 9.1.

Some discussion points: How many spoons of salt were you able to dissolve before some of it remained undissolved? What does this indicate about the capacity of water to dissolve salt?

ANSWER

Model observations are given below. The exact number of spoons depends on the size of the tumbler and the spoon, and on the temperature of the water.

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a Table 9.1: Dissolution of salt in water (model observations)

Amount of salt taken (teaspoon)	Observation (salt dissolves / salt does not dissolve)
One	Salt dissolves
Two	Salt dissolves
Three	Salt dissolves
Four	Salt dissolves
Five	Salt dissolves
Six	Salt dissolves
Seven	Salt does not dissolve; some settles at the bottom

b Discussion points

- About six spoons dissolved in this model before some salt remained undissolved.
- This shows that a fixed amount of water can dissolve only a **limited amount** of salt; the water has reached its limit.
- Up to that stage the solution is **unsaturated**; when the salt stops dissolving and settles at the bottom, it is **saturated** at that temperature.

Therefore, a given amount of water can dissolve only a limited amount of salt; beyond that limit the solution is saturated and the extra salt settles.

QUESTION 9 *Chapter text · p. 137*

Can you now reflect — which solution is more concentrated; 2 spoons of salt in 100 mL of water or 4 spoons of salt in 50 mL of water?

ANSWER

Concentration is the amount of solute present in a fixed quantity of solution (or solvent). To compare, take the same quantity of water in both.

a Comparison for the same volume of water

Solution	Salt in 50 mL	Salt in 100 mL
2 spoons in 100 mL	1 spoon	2 spoons
4 spoons in 50 mL	4 spoons	8 spoons

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2 spoons in 100 mL = 1 spoon in 50 mL

4 spoons in 50 mL = 4 spoons in 50 mL (more salt in the same water)

Therefore, 4 spoons of salt in 50 mL of water is the more concentrated solution; 2 spoons in 100 mL is the dilute one (dilute and concentrated are relative terms).

QUESTION 10 *Activity 9.2 · pp. 137–138*

Activity 9.2: Let us experiment (Demonstration activity)

• Take about 50 mL of water in a glass beaker and measure its temperature using a laboratory thermometer, say 20 °C.

• Add a spoonful of baking soda (sodium hydrogen carbonate) to the water and stir until it dissolves. Continue adding small amounts of baking soda while stirring, till some solid baking soda is left undissolved at the bottom of the beaker.

• Now, heat the contents to 50 °C while stirring (Fig. 9.7). **What happens to the undissolved baking soda?**

• Continue adding more baking soda while stirring at this temperature until some solid baking soda remains undissolved.

• Again, heat the contents further to 70 °C while continuing to stir. **What do you observe?**

• **What do you infer from this experiment?** *(Safety first: be careful while using the heating device.)*

ANSWER

Heating increases the amount of baking soda that the same 50 mL of water can dissolve.

a **Observations**

Temperature	Observation
20 °C	Some baking soda remains undissolved (saturated solution at 20 °C); the least amount is dissolved.
50 °C	The undissolved baking soda **dissolves**. More can be added until some solid remains again.
70 °C	The undissolved baking soda **dissolves** again; water at 70 °C dissolves more than at 50 °C.

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b Inference

- The amount of baking soda that dissolves is: **20 °C < 50 °C < 70 °C**.
- For most substances, **solubility increases with an increase in temperature**.
- A saturated solution at a particular temperature behaves as an **unsaturated solution** if the temperature is increased.

Therefore, the undissolved baking soda dissolves on heating; the solubility of baking soda in water increases with temperature.

QUESTION 11 *Be a scientist · p. 138*

What inspired Asima Chatterjee to work on medicinal plants?

ANSWER

The chapter does not state her personal inspiration, so the answer is based on what it tells us about her work.

a What the chapter tells us

- She is renowned for developing **anti-epileptic** and **anti-malarial** drugs.
- She used **solvents and solutions** extensively to extract and isolate important compounds from medicinal plants.
- She earned a Doctorate of Science (the second Indian woman to do so after Janaki Ammal), was the first woman to receive the Shanti Swarup Bhatnagar Award in chemical science, and received the Padma Bhushan.

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b What this suggests

Her work was driven by the idea that medicinal plants contain useful compounds that can be extracted with solvents and turned into medicines for illnesses such as epilepsy and malaria. To know her own words, read a biography of her.

Therefore, her work shows how solvents and solutions help to obtain medicines from medicinal plants.

QUESTION 12 *Chapter text · p. 139*

Do gases also dissolve in water? Is the mixture of gases in water a uniform or non-uniform mixture? Does temperature affect the solubility of gases in liquids also? If so, how?

ANSWER

Many gases, including oxygen, dissolve in water, though only to a small extent.

Question	Answer
Do gases dissolve in water?	Yes. Many gases, including oxygen, dissolve in water.
Uniform or non-uniform?	Uniform, because the gases dissolve evenly in water.
Does temperature affect the solubility of gases?	Yes. The solubility of gases generally **decreases** as the temperature increases.

a Why it matters

- More oxygen dissolves in **cold** water, ensuring sufficient oxygen for aquatic life.
- When water warms up, the solubility of oxygen **decreases**, so less oxygen is available.
- This is opposite to most solids, whose solubility increases with temperature.

Therefore, gases dissolve in water to form a uniform mixture, and their solubility generally decreases as the temperature rises.

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QUESTION 13 *Chapter text · pp. 139–140*

I observed that in some non-uniform mixtures, such as sawdust in water, the sawdust floats, whereas in the mixture of sand and water, the sand sinks. I wonder why that happens?
(Also asked on p. 140: while washing rice, husk particles float while rice sinks. Why does this happen?)

ANSWER

Whether an object floats or sinks is explained by a property called density, which describes the heaviness of an object.

Material	Compared with water	Result
Sawdust	Less dense	Floats
Sand	More dense	Sinks
Rice husk	Less dense	Floats
Rice	More dense	Sinks
Oil	Less dense	Floats on water

a Explanation

- Objects that float in a liquid are generally lighter (**less dense**) than the liquid; those that sink are **denser**.
- An iron rod feels much heavier than a wooden stick of the same size because iron is denser than wood.
- Note: the density of a substance is not the only factor that decides whether it floats or sinks.

Therefore, sawdust floats because it is less dense than water, and sand sinks because it is denser than water.

QUESTION 14 *Chapter text · p. 140*

How do scientists define density?

ANSWER

Density tells us how much matter is packed into a given space.

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Density = Mass ÷ Volume

Density is the mass present in a unit volume of a substance.

a Important points

- SI unit of density is **kg/m³**; other units are g/mL and g/cm³.
- Density of a substance is **independent of its shape or size**.
- It depends on **temperature and pressure**; pressure mainly affects the density of gases.

Therefore, density is defined as the mass present in a unit volume of a substance: Density = Mass/Volume.

QUESTION 15 *Think like a scientist · p. 141*

Have you noticed that some packets of ghee or oil are labelled with a volume of 1 litre but a weight of only say 910 grams (Fig. 9.11)? What does this tell us about the density of the oil, and is it less or more than that of water?

ANSWER

Use density = mass ÷ volume, and compare with the density of water (1 g/cm³).



Fig. 9.11: Packed oil

a Calculation

Volume = 1 litre = 1000 mL = 1000 cm³; Mass = 910 g

Density = 910 g ÷ 1000 cm³ = 0.91 g/cm³ (= 910 kg/m³)

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b Comparison with water

- Density of water is about 1 g/cm³; the density of oil is 0.91 g/cm³, which is **less**.
- Relative density of the oil = 0.91 ÷ 1 = 0.91.
- That is why oil floats on water.

Therefore, the density of the oil is 0.91 g/cm³, which is less than the density of water.

QUESTION 16 *Activity 9.3 · p. 142*

Activity 9.3: Let us measure (mass of a solid using a digital weighing balance)

• Switch ON the digital weighing balance. Observe the initial reading on the display. It should show a zero reading. If not, then bring it to zero by pressing the tare or reset button (Fig. 9.12a).

• Place a dry and clean watch glass or butter paper on the pan. Note the reading. Reset the reading to zero by pressing the tare or reset button (Fig. 9.12b).

• Now, carefully place the solid object, such as stone, on the watch glass (Fig. 9.12c). Note the reading displayed on the balance, which gives the mass of the stone, say 16.400 g.

ANSWER

The balance is first made to read zero so that the reading shows only the mass of the object.

a Steps and their purpose

Step	Purpose
Switch ON; check that the display shows zero	Starting reading must be zero (use the tare button if it is not)
Place the watch glass; press tare	Removes the mass of the watch glass from the reading
Place the stone on the watch glass	Reading shows only the mass of the stone

b Result and note

- Mass of the stone = **16.400 g** (as in the chapter).
- For a **liquid**, replace the watch glass with a beaker, tare, and pour in the liquid.

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- Most balances actually measure weight, but their scales are marked in mass units (g or kg).

Therefore, the mass of the stone read from the balance is 16.400 g.

QUESTION 17 *Chapter text · p. 143*

A tetra pack says it contains 200 mL buttermilk (chach) (Fig. 9.14). What does that mean?

ANSWER

The 200 mL on the pack tells us how much space the buttermilk occupies, that is, its **volume**.

Quantity	Meaning
Volume	Space occupied by an object or a substance
1 mL	= 1 cm^3
1 L	= 1 dm^3 = 1000 mL
200 mL	= 200 cm^3 = 0.2 L

Therefore, the pack contains buttermilk that occupies a volume of 200 mL (200 cm^3 or 0.2 litre).

QUESTION 18 *Activity 9.4 · pp. 143–144*

Activity 9.4: Let us observe and calculate

Take a measuring cylinder and observe it carefully. Note down the following:

• What is the maximum volume it can measure?

• What is the smallest volume it can measure? Look at the measuring cylinder again.

• How much is the volume difference indicated between the two bigger marks (for example, between 10 mL and 20 mL)?

• How many smaller divisions are there between the two bigger marks?

• How much volume does one small division indicate?

The smallest volume that the measuring cylinder can read is _____.

ANSWER

The answers below are for the 100 mL measuring cylinder shown in Fig. 9.16.

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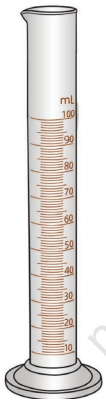

Fig. 9.16: Measuring cylinder of 100 mL

Observation	Fig. 9.16 cylinder
Maximum volume it can measure	100 mL
Volume difference between two bigger marks (10 mL and 20 mL, or 40 mL and 50 mL)	10 mL
Number of smaller divisions between the two bigger marks	10
Volume indicated by one small division	1 mL

One small division = 10 mL ÷ 10 = 1 mL

a Smallest volume for different cylinders

Capacity of the cylinder	Smallest volume it can measure
10 mL or 25 mL	0.1 mL
100 mL	1 mL
250 mL	2 mL
500 mL	5 mL

To take 70 mL of water, a 50 mL cylinder would need two steps, while a 250 mL or 500 mL cylinder has a larger smallest reading (less accurate). A **100 mL** cylinder is the best choice.

Therefore, the smallest volume that this measuring cylinder can read is 1 mL.

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QUESTION 19 *Chapter text · p. 144*

Why are measuring cylinders always designed narrow and tall instead of wider and short like a beaker?

ANSWER

Volume = area of cross-section × height of the liquid, so the width of the container decides how much the level changes for a small change in volume.

a **Example: 1 mL (1 cm³) of liquid**

Container	Cross-section	Rise in level
Narrow measuring cylinder	1 cm²	1 cm ÷ 1 = 1 cm
Wide beaker (for comparison)	25 cm²	1 ÷ 25 = 0.04 cm (0.4 mm)

- In a narrow, tall cylinder even a small volume makes the level rise noticeably, so the marks can be spaced out and read **accurately**.
- In a wide, short beaker the level hardly changes, so small volumes cannot be read accurately.

Therefore, measuring cylinders are narrow and tall so that small volumes can be read accurately.

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QUESTION 20 *Activity 9.5 · pp. 144–145*

Activity 9.5: Let us measure 50 mL of water

• Place a clean, dry measuring cylinder on a flat surface.

• Pour water slowly into the measuring cylinder up to the required mark, as shown in Fig. 9.17.

• If required, adjust the level of water in the measuring cylinder by adding or removing a small amount of water using a dropper.

• On careful observation, you will notice that the water inside the measuring cylinder forms a curved surface. This curved surface is called the meniscus (Fig. 9.18).

• Read the mark on the measuring cylinder that coincides with the bottom of the meniscus for water or other colourless liquids.

• Make sure that the eyes are at level with the bottom of the meniscus while noting the readings as shown in Fig. 9.18.

• Once it reaches the required level—that is, 50 mL—transfer this water to the required container.

ANSWER

Follow the steps carefully; the main idea is to read the meniscus correctly.

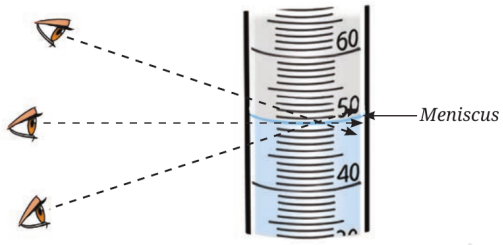

Fig. 9.18: Measuring the reading

a **Procedure for measuring 50 mL**

- Keep the cylinder upright on a **flat surface**.
- Pour water slowly up to just below the 50 mL mark and adjust with a **dropper**.
- The curved surface of the water is the **meniscus**.
- Keep your **eyes level** with the bottom of the meniscus and read the mark that coincides with it (50 mL).
- Transfer the 50 mL of water to the required container.

Therefore, 50 mL of water is measured by filling the cylinder until the bottom of the meniscus coincides with the 50 mL mark, with the eyes at the same level.

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QUESTION 21 *Chapter text · p. 145*

I wonder how the level of a coloured liquid is measured?

ANSWER

For a coloured liquid the bottom of the meniscus cannot be seen clearly, so a different reading is taken.

- In the case of coloured liquids, the mark on the measuring cylinder should coincide with the **top of the meniscus**.
- For water and other colourless liquids, the mark coincides with the **bottom of the meniscus**.
- In both cases the eyes must be at the level of the meniscus.

Therefore, the level of a coloured liquid is read at the top of the meniscus.

QUESTION 22 *Activity 9.6 · p. 145*

Activity 9.6: Let us calculate

• Collect various objects with a cuboid shapes, such as a notebook, a shoe box, or a dice.

• Measure the length (l), width (w), and height (h) of the objects using a scale. Suppose the length of the notebook is 25 cm, the width is 18 cm, and the height is 2 cm.

• Calculate the volume by using the following formula: Volume = l × w × h

• Record in your notebook.

ANSWER

The volume of a cuboid is the product of its length, width and height.

Volume = l × w × h

Notebook: Volume = 25 cm × 18 cm × 2 cm = 900 cm^3

a Recording in the notebook

Object	l (cm)	w (cm)	h (cm)	Volume (cm^3)
Notebook	25	18	2	25 × 18 × 2 = 900
Shoe box (sample values)	30	18	10	30 × 18 × 10 = 5400

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The shoe-box values are only an example; use the readings from your own objects.

Therefore, the volume of the notebook is 900 cm³.

QUESTION 23 *Activity 9.7 · p. 146*

Activity 9.7: Let us measure

• Collect various objects from your surroundings, such as a stone, metal keys, and so on.

• Fill a measuring cylinder with water up to any desired volume, say 50 mL (Fig. 9.19a) and record the initial volume taken in Table 9.2.

• Tie the object, say a stone, with a thread and slowly lower it into the measuring cylinder.

• **What do you notice?**

• Record the final volume after the level rises, say 55 mL, as shown in Fig. 9.19b.

• Subtract the initial volume from the final volume after the object is put into the measuring cylinder. This is the volume of the object.

• Record your observations in Table 9.2.

ANSWER

The rise in the water level is equal to the volume of the object (method of displacement).

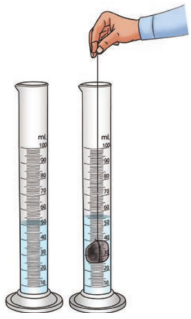

Fig. 9.19: Level of water in the measuring cylinder (a) Without object; (b) With object

a **What do you notice?**

The water level **rises** when the stone is lowered, because the stone occupies space and displaces water.

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b Table 9.2: Volume of irregular solids

S.No.	Object	Initial (A)	Final (B)	B – A	Volume
1.	Stone	50 mL	55 mL	5 mL	5 cm³
2.	Metal key (sample)	50 mL	52 mL	2 mL	2 cm³
3.	Any other (sample)	50 mL	58 mL	8 mL	8 cm³

Row 1 is given in the chapter; rows 2 and 3 are sample readings. Your own readings will differ. Volume in mL is written as cm³ for solids.

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c Density of the stone

Density = Mass ÷ Volume = 16.400 g ÷ 5 cm^3 = 3.28 g/cm^3

Therefore, the volume of the stone is 5 cm^3 and its density is 3.28 g/cm^3.

QUESTION 24 *Ever heard of … · p. 148*

Why does ice float on water?

ANSWER

Ice floats because it is lighter (less dense) than liquid water.

a Explanation

- The density of water is **highest at 4 °C**.
- As the temperature drops and water turns into ice at 0 °C, its particles arrange themselves in a way that takes up **more space** (expansion).
- The same mass now occupies a larger volume, so the density **decreases** (Density = Mass/Volume), and ice floats on the surface.

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b Why it is important

In cold weather the floating ice forms a layer on top, keeping the water underneath warm enough for fish and other creatures to survive.

Therefore, ice floats on water because its density is less than that of liquid water.

QUESTION 25 *Think like a scientist · p. 148*

Take a glass tumbler and fill it with tap water. Carefully place a raw whole egg into the water and observe what happens. You will notice that the egg sinks to the bottom (Fig. 9.24). What change can you make to this setup to make the egg float in water instead of sinking?

ANSWER

The egg sinks in tap water because it is denser than tap water. To make it float, the water must become denser than the egg.



Fig. 9.24: Raw whole egg sinks in water

a Change to be made

- Dissolve **common salt** in the water, a spoonful at a time, stirring well each time.
- The salt solution has a higher density than tap water. After enough salt has dissolved, the density of the solution becomes more than that of the egg and the egg **floats**.
- If more tap water is added, the density falls again and the egg sinks.

Therefore, dissolving enough salt in the water increases its density so that the egg floats instead of sinking.

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9.2

CLASS 8 SCIENCE · CHAPTER 9

Exercises

Keep the curiosity alive · 14 questions

Directions (Questions 1–14): These are the exercise questions given at the end of the chapter under “Keep the curiosity alive”, in the same order as in the textbook. Questions 13 and 14 are open-ended activities; model answers based on the chapter are given.

QUESTION 1 *Keep the curiosity alive · p. 149*

State whether the statements given below are True [T] or False [F]. Correct the false statement(s).

(i) Oxygen gas is more soluble in hot water rather than in cold water.

(ii) A mixture of sand and water is a solution.

(iii) The amount of space occupied by any object is called its mass.

(iv) An unsaturated solution has more solute dissolved than a saturated solution.

(v) The presence of different gases in the atmosphere is also a uniform mixture.

ANSWER

Check each statement against the facts learnt in the chapter.

	T / F	Reason and corrected statement
(i)	**F**	The solubility of gases decreases as temperature increases. **Correct:** Oxygen gas is more soluble in **cold** water than in hot water.
(ii)	**F**	Sand does not mix evenly with water; it settles. **Correct:** A mixture of sand and water is a **non-uniform mixture**, not a solution.
(iii)	**F**	Mass is the amount of matter in an object. **Correct:** The amount of space occupied by any object is called its **volume**.
(iv)	**F**	A saturated solution holds the maximum solute. **Correct:** An unsaturated solution has **less** solute dissolved than a saturated solution (it can still dissolve more).
(v)	**T**	Gases mix evenly, so the atmosphere is a uniform mixture.

Therefore: (i) F, (ii) F, (iii) F, (iv) F, (v) T.

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QUESTION 2 *Keep the curiosity alive · p. 150*

Fill in the blanks.

(i) The volume of a solid can be measured by the method of displacement, where the solid is _____ in water and the _____ in water level is measured.

(ii) The maximum amount of _____ dissolved in _____ at a particular temperature is called solubility at that temperature.

(iii) Generally, the density _____ with increase in temperature.

(iv) The solution in which glucose has completely dissolved in water, and no more glucose can dissolve at a given temperature, is called a _____ solution of glucose.

ANSWER

Fill each blank using the definitions in the chapter.

	Completed sentence
(i)	The solid is **immersed** (dipped) in water and the **rise** in water level is measured.
(ii)	The maximum amount of **solute** dissolved in a **fixed quantity of solvent** at a particular temperature is called solubility at that temperature.
(iii)	Generally, the density **decreases** with increase in temperature.
(iv)	It is called a **saturated** solution of glucose.

Therefore: (i) immersed, rise; (ii) solute, fixed quantity of solvent; (iii) decreases; (iv) saturated.

QUESTION 3 *Keep the curiosity alive · p. 150*

You pour oil into a glass containing some water. The oil floats on top. What does this tell you?

(i) Oil is denser than water

(ii) Water is denser than oil

(iii) Oil and water have the same density

(iv) Oil dissolves in water

ANSWER

A liquid floats on another liquid when it is less dense than that liquid.

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Option	Reason
(i)	Incorrect. If oil were denser, it would sink below the water.
(ii)	**Correct.** Oil floats on water, so oil is less dense and water is denser than oil.
(iii)	Incorrect. With the same density, the oil would not stay as a separate layer on top.
(iv)	Incorrect. Oil does not dissolve in water; it stays as a separate layer.

Therefore, the correct answer is (ii) Water is denser than oil.

QUESTION 4 *Keep the curiosity alive · p. 150*

A stone sculpture weighs 225 g and has a volume of 90 cm³. Calculate its density and predict whether it will float or sink in water.

ANSWER

Use Density = Mass ÷ Volume, then compare with the density of water (1 g/cm³).

a Calculation

Mass = 225 g, Volume = 90 cm³

Density = 225 g ÷ 90 cm³ = 2.5 g/cm³

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b **Prediction**

The density of the sculpture (2.5 g/cm³) is greater than that of water (1 g/cm³), so it is denser than water.

Therefore, the density of the sculpture is 2.5 g/cm³ and it will sink in water.

QUESTION 5 *Keep the curiosity alive · p. 150*

Which one of the following is the most appropriate statement, and why are the other statements not appropriate?

(i) A saturated solution can still dissolve more solute at a given temperature.

(ii) An unsaturated solution has dissolved the maximum amount of solute possible at a given temperature.

(iii) No more solute can be dissolved into the saturated solution at that temperature.

(iv) A saturated solution forms only at high temperatures.

ANSWER

A saturated solution is one in which no more solute can be dissolved at that temperature.

	Why it is (or is not) appropriate
(i)	Not appropriate. A saturated solution has reached the limit and cannot dissolve more solute at that temperature.
(ii)	Not appropriate. An unsaturated solution has **not** dissolved the maximum amount; more solute can still dissolve.
(iii)	**Most appropriate.** This is the definition of a saturated solution at a given temperature.
(iv)	Not appropriate. A saturated solution can form at any temperature once the maximum solute for that temperature has dissolved.

Therefore, statement (iii) is the most appropriate.

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QUESTION 6 *Keep the curiosity alive · p. 150*

You have a bottle with a volume of 2 litres. You pour 500 mL of water into it. How much more water can the bottle hold?

ANSWER

Convert both volumes to the same unit and subtract.

2 litres = 2 × 1000 mL = 2000 mL
More water = 2000 mL − 500 mL = 1500 mL = 1.5 litres

Therefore, the bottle can hold 1500 mL (1.5 litres) more water.

QUESTION 7 *Keep the curiosity alive · p. 150*

An object has a mass of 400 g and a volume of 40 cm³. What is its density?

ANSWER

Density is mass per unit volume.

Density = Mass ÷ Volume = 400 g ÷ 40 cm^3 = 10 g/cm^3

Therefore, the density of the object is 10 g/cm^3 (= 10 000 kg/m^3).

QUESTION 8 *Keep the curiosity alive · p. 150*

Analyse Fig. 9.25a and 9.25b. Why does the unpeeled orange float, while the peeled one sinks? Explain.

ANSWER

Whether an object floats depends on its density compared with the density of water (1 g/cm^3).

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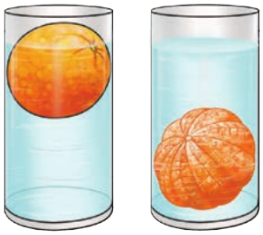

Fig. 9.25: (a) unpeeled orange floats; (b) peeled orange sinks

a Explanation

- The peel of the unpeeled orange contains many tiny **air pockets**. They add volume to the orange but very little mass.
- Because Density = Mass ÷ Volume, the unpeeled orange as a whole has a density **less than that of water**, so it floats.
- When the peel is removed, the air-filled part is gone. The remaining fruit has a density **more than that of water**, so the peeled orange sinks.

Therefore, the unpeeled orange floats because its average density is less than water, while the peeled orange is denser than water and sinks.

QUESTION 9 *Keep the curiosity alive · p. 150*

Object A has a mass of 200 g and a volume of 40 cm³. Object B has a mass of 240 g and a volume of 60 cm³. Which object is denser?

ANSWER

Find the density of each object and compare.

Object	Calculation	Density
A	200 g ÷ 40 cm³	5 g/cm³
B	240 g ÷ 60 cm³	4 g/cm³

Therefore, object A (5 g/cm³) is denser than object B (4 g/cm³), even though B has the larger mass.

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QUESTION 10 *Keep the curiosity alive · p. 151*

Reema has a piece of modeling clay that weighs 120 g. She first moulds it into a compact cube that has a volume of 60 cm³. Later, she flattens it into a thin sheet. Predict what will happen to its density.

ANSWER

Density depends on mass and volume, not on the shape of the object.

Density of the cube = 120 g ÷ 60 cm³ = 2 g/cm³

- Flattening only changes the **shape**; no clay is added or removed, so the **mass** stays 120 g.
- The clay takes up the same amount of space, so the **volume** stays 60 cm³.
- The density of a substance is independent of its shape or size.

Therefore, the density of the clay will not change; it remains 2 g/cm³.

QUESTION 11 *Keep the curiosity alive · p. 151*

A block of iron has a mass of 600 g and a density of 7.9 g/cm³. What is its volume?

ANSWER

Rearrange Density = Mass ÷ Volume to get Volume = Mass ÷ Density.

Volume = Mass ÷ Density = 600 g ÷ 7.9 g/cm³
Volume = 75.95 cm³ ≈ 76 cm³

Check: 7.9 g/cm³ × 75.95 cm³ ≈ 600 g.

Therefore, the volume of the iron block is about 75.9 cm³ (≈ 76 cm³).

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QUESTION 12 *Keep the curiosity alive · p. 151*

You are provided with an experimental setup as shown in Fig. 9.26a and 9.26b. On keeping the test tube (Fig 9.26b) in a beaker containing hot water (~70 °C), the water level in the glass tube rises. How does it affect the density?

ANSWER

The test tube is filled with water and closed with a stopper through which a glass tube passes (Fig. 9.26).

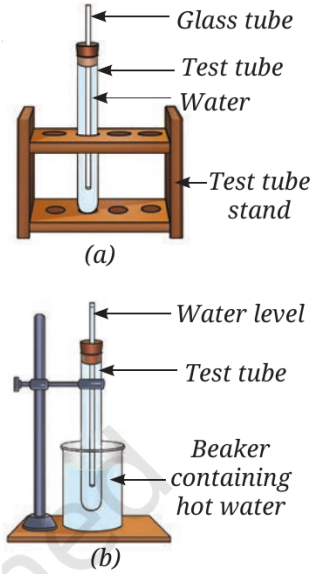

Fig. 9.26: (a) before heating; (b) test tube kept in a beaker of hot water

a Explanation

- On heating, the water particles move away from each other and spread out, so the **volume** of the water increases. This is why the water level rises in the glass tube.
- The **mass** of the water does not change.
- Since Density = Mass ÷ Volume, the volume increases while the mass is constant, so the density **decreases**.

Therefore, when the water is heated its volume increases and its density decreases.

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QUESTION 13 *Keep the curiosity alive · p. 150*

Prepare some questions based on your learnings so far …

ANSWER

This is an open-ended activity. Model questions (with answers) from the chapter are given; you can frame your own.

	Question	Answer
Why?	Why does ice float on water?	Ice is less dense than liquid water.
When?	When is a solution called saturated?	When no more solute can dissolve in it at that temperature.
Where?	Where is dissolved oxygen needed?	In water, to sustain aquatic life such as plants and fishes.
How?	How does temperature affect the solubility of gases?	It generally decreases as the temperature increases.
Why not?	Why not use a 50 mL cylinder to measure 70 mL?	It needs two steps; a 100 mL cylinder does it in one step with good accuracy.

Therefore, framing questions such as these helps to revise the chapter; write your own and answer them.

QUESTION 14 *Keep the curiosity alive · p. 151*

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

ANSWER

This is an open-ended activity. Model reflections based on the chapter are given.

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Friend says	Reflection
“I think a saturated solution cannot dissolve any more solute at all.”	But we thought: at a given temperature that is true, but on heating, solubility generally increases and it can dissolve more.
“Maybe hot water holds more oxygen.”	No. The solubility of gases decreases as temperature increases, so cold water holds more oxygen.
“Shouldn’t it be that heavy objects sink and light objects float?”	It depends on **density**, not just weight: a heavy wooden log floats, while a small iron nail sinks.
“I think the density of clay changes when its shape changes.”	No. Density is independent of shape or size; it depends on temperature and pressure.

Therefore, reflecting on such questions with the help of density and solubility clears many doubts.

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CLASS 8 SCIENCE · CHAPTER 9

9.3 Discover, Design and Debate

Interdisciplinary projects · 3 questions

Directions (Questions 1–3): These are the interdisciplinary project and debate questions given under “Discover, design, and debate”. They are open-ended; model outlines based on the chapter are given, and you should add your own observations and research.

QUESTION 1 *Discover, design, and debate · p. 151*

Research project on Dead Sea: Why is there no aquatic life in the Dead Sea? Try to find out if there are any other similar water bodies.

ANSWER

This is an open-ended project. A model outline based on the ideas of the chapter is given; confirm the data from books or reliable websites.

a Why there is no aquatic life

- The water of the Dead Sea is extremely **salty**; it holds a very large amount of dissolved salt, much more than ordinary sea water.
- Aquatic plants and fishes cannot survive in such highly concentrated salt water, so the Dead Sea has almost no aquatic life.
- Such salty water is also very dense, so objects (and people) float easily in it.

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b Other similar water bodies

- Very salty lakes elsewhere, such as the **Great Salt Lake** (USA), **Lake Assal** (Djibouti) and **Sambhar Lake** (Rajasthan, India), have little life; usually only a few specially adapted organisms live in them.

Therefore, the Dead Sea has no aquatic life because its water is extremely concentrated with salt; other very salty lakes show similar conditions.

QUESTION 2 *Discover, design, and debate · p. 151*

Investigate how well common salt dissolves in different solvents, such as water, vinegar, and oil. Compare the solubility of salt in each solvent and record your observations.

ANSWER

Use the same method as Activity 9.1 for each solvent so that the comparison is fair.

a Procedure

- Take the **same volume** (say 50 mL) of water, vinegar and oil in three separate glasses at room temperature.
- Add salt one level spoon at a time to each glass, stirring well, and count the spoons that dissolve before some salt remains undissolved.
- Record your observations in a table.

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b Expected observations (model)

Solvent	Observation	Solubility of salt
Water	Salt dissolves; clear solution; the most spoons dissolve	High
Vinegar	Salt dissolves (vinegar is mostly water), but fewer spoons than in water	Less than water
Oil	Salt does not dissolve and settles at the bottom	Almost nil

Therefore, salt dissolves best in water, to a smaller extent in vinegar, and hardly at all in oil; record your own spoon counts.

QUESTION 3 *Discover, design, and debate · p. 151*

Debate in class — Is water truly the most versatile solvent?

ANSWER

A debate has two sides. Points that can be used from the chapter are given.

In favour	Against
Dissolves many solids such as salt, sugar and baking soda.	Does not dissolve oil or ghee, and sugar and salt do not dissolve in oil; so water cannot dissolve everything.
Dissolves gases such as oxygen, which sustains aquatic life.	Gases dissolve only to a small extent, and less as water warms.
Used in ORS and primarily as the solvent for medicines in Ayurveda and Siddha.	Oils, ghee, milk and hydro-alcoholic extracts are also used as solvents for drug formulations.

Therefore, water dissolves the widest range of substances and is the most commonly used solvent, but it is not the only solvent; support your view with evidence.

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