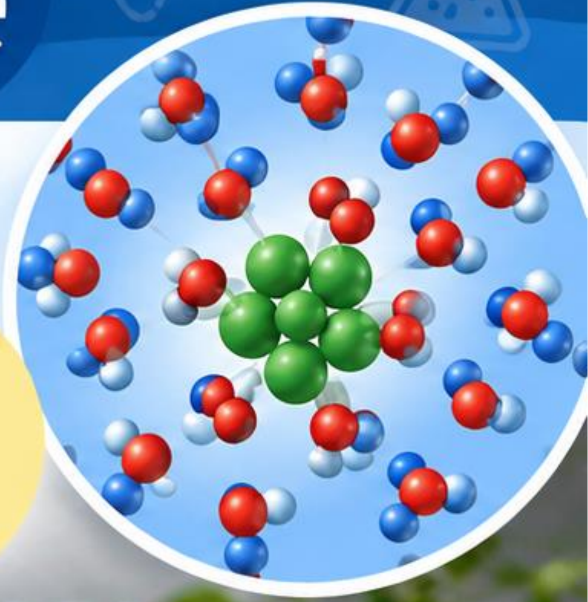
8th CLASS

Physical Science

Chapter : 4

SOLUTIONS



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1. Mixtures and Solutions

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What is a mixture?

A **mixture** is formed when two or more substances are mixed together.

Examples:

Salt + water

Sugar + water

Air

Sand + water

Salt + sand

Key Idea: A mixture contains two or more substances mixed together.

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Types of Mixtures

Mixtures can be broadly
-- classified into:
1. Uniform mixtures
2. Non-uniform mixtures

1. Uniform Mixture

A mixture in which the components are **evenly distributed throughout** is called a **uniform mixture**.

Examples

Salt water

Sugar solution

Air

Alloy
(e.g., brass)

2. Non-uniform Mixture

A mixture in which the components are **not evenly distributed** is called a **non-uniform mixture**.

Examples

Sand and water

Sawdust and water

Uniform mixtures have the same composition throughout, while **non-uniform mixtures** have different composition in different parts.

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3. What are Solute, Solvent and Solution?

A **solution** is a uniform mixture formed when one substance dissolves in another.

Solute

The substance that **dissolves** in a solvent is called the **solute**.

Examples:

- Salt (in salt water)
- Sugar (in sugar solution)
- Baking soda

Salt   Sugar   Baking soda

Solvent

The substance in which the solute **dissolves** is called the **solvent**.

Example:

- Water

Water

Solution

The uniform mixture formed after dissolving the solute in the solvent is called a **solution**.

Example:

- Salt solution (salt water)

Salt solution

Example: Salt Solution

Salt
(Solute)

+

Water
(Solvent)

Salt solution
(Solution)

Salt + Water → Salt solution

- Salt → Solute
- Water → Solvent
- Salt solution → Solution

Important Point

The substance present in the **larger amount** is generally considered the **solvent**.

Solute + Solvent → Solution

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4. Examples of Solutions

A solution can exist in solid, liquid or gaseous state.

Solute	Solvent	Nature of solution	Example / Picture
Zinc 	Copper 	Solid	Brass (Zinc + Copper) 
Salt 	Water 	Liquid	Salt water 
Air components 	Air 	Gaseous	Air (mixture of different gases) 

Key Idea: Solutions can be formed in solid, liquid or gaseous state depending on the physical state of the solute and solvent.

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ORS – A Daily-Life Solution

ORS helps the body recover fluids when a person becomes dehydrated.

What is ORS?

ORS **(Oral Rehydration Solution)** is used to help the body recover fluids when a person becomes dehydrated.

What does ORS contain?

ORS contains substances such as **salt and sugar** dissolved in **water**.

Salt (solute)

Sugar (solute)

Water (solvent)

Mixed together forms a **solution (ORS)**

How does ORS work?

- The components dissolve in water.
- They are evenly distributed throughout the water.
- The solution helps to replace lost fluids and salts in the body.
- It prevents dehydration.

ORS keeps you healthy and active!

Other Daily-life Examples of Solutions

Salt water


Salt dissolved in water

Sugar solution


Sugar dissolved in water

ORS


Salt and sugar in water

Soft drinks


Various substances dissolved in water

Air


Mixture of gases (a solution)

Alloys


Metals mixed together (e.g., brass)

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6. Solubility

Solubility tells us how much solute can dissolve in a solvent at a particular temperature.

What is solubility?

Solubility is the ability of a solute to dissolve in a given amount of solvent at a particular temperature.

Example

When salt is added gradually to water:

Salt + Water → Salt solution

Key Idea

A fixed quantity of solvent has a **limited capacity** to dissolve a solute at a particular temperature.

1 Add a small amount of salt

Salt dissolves completely.

2 Add more salt

Salt continues to dissolve.

3 Add still more salt

Salt dissolves completely (up to a limit).

4 Add excess salt

Some salt remains undissolved. The solution is saturated.

Conclusion: This shows that **solubility is limited.** A fixed amount of water can dissolve only a certain amount of salt at a particular temperature.

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7. Unsaturated and Saturated Solutions

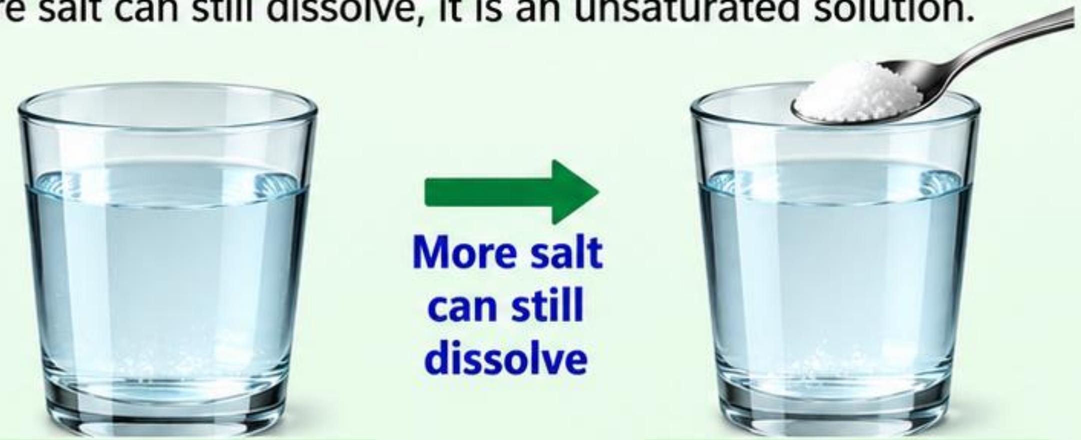
The amount of solute that can dissolve depends on the **temperature** and the **nature of the solute and solvent.**

Unsaturated Solution

A solution in which **more solute can still dissolve** at a given temperature is called an **unsaturated solution.**

Example:

If a glass of water contains some dissolved salt and more salt can still dissolve, it is an unsaturated solution.



Salt dissolved completely

Solution is unsaturated

Saturated Solution

A solution in which **no more solute can dissolve** at a particular temperature is called a **saturated solution.**

Key idea:

A saturated solution contains the **maximum amount of solute** has dissolved at that temperature.

Salt dissolves (up to a limit)

Saturated solution (Undissolved salt at bottom)

Important Point: Solubility tells us how much solute can dissolve in a solvent at a particular temperature.

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8. Concentrated and Dilute Solutions

The amount of solute present in a solution determines its **concentration**.

Concentrated solution

A solution containing a **relatively large amount of solute** is called a **concentrated solution.**

More solute (Higher concentration)

Dilute solution

A solution containing a **relatively small amount of solute** is called a **dilute solution.**

Less solute (Lower concentration)

Easy comparison

Feature	Dilute solution	Concentrated solution
Amount of solute	Less solute	More solute
Concentration	Lower concentration	Higher concentration
Appearance (example)	Lighter in taste (e.g., sugar water with little sugar)	Stronger in taste (e.g., sugar water with more sugar)
Amount of solute dissolved	Small	Large

Key Point Concentration of a solution depends on the **amount of solute** present in it.

Same solvent (water) can form both dilute and concentrated solutions depending on how much solute is dissolved.

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9. Solubility of a Solid – Activity

We can find the **solubility** of a solid by adding it little by little to a fixed amount of water.

Activity: Add spoonfuls of **salt** to a fixed amount of water and observe whether the salt dissolves completely.

1 Take water | 2 Add a spoonful of salt | 3 Add more salt | 4 Keep adding salt | 5 Excess salt remains

1. Take a fixed amount of water in a glass.
2. Add one spoonful of salt and stir. It dissolves completely.
3. Add more spoonfuls of salt and stir. It still dissolves.
4. Continue adding salt.
5. After some time, extra salt remains undissolved at the bottom.

Observations

- Initially, salt dissolves completely.
- With further addition, eventually some salt remains undissolved.
- This indicates that water has a **limited capacity** to dissolve salt at a given temperature.

Conclusion

A fixed amount of water can dissolve only a certain amount of salt at a particular temperature.

Solubility is limited!

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10. Effect of Temperature on Solubility

In general, the solubility of most solids **increases with increase in temperature.**

Activity: To study the effect of temperature on the solubility of baking soda in water.

1 Take water

Take about 50 mL of water in a beaker.

2 Measure temperature

Measure the temperature of water.

3 Add baking soda

Add baking soda and stir. Continue adding until some remains undissolved.

4 Heat to 50°C

Heat the mixture to about 50°C. Stir and observe.

5 Heat to 70°C

Heat further to about 70°C and observe again.

Observation

At 50°C

Less baking soda dissolves. Some remains undissolved.

At 70°C

More baking soda dissolves than at 50°C.

Result

More baking soda dissolves at **70°C** than at **50°C**.

Conclusion

The solubility of baking soda in water **increases with increase in temperature.**

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11. Solubility of Gases

Gases can also **dissolve in liquids.**

Examples of gases that dissolve in water

Oxygen dissolves in water.

Dissolved oxygen helps aquatic life to survive.

Carbon dioxide dissolves in water.

Carbon dioxide gives a fizzy taste to soft drinks.

Ammonia can dissolve in water.

Ammonia dissolves in water to form ammonium solution.

Chlorine can dissolve in water.

Chlorine dissolves in water (used for disinfection).

Nitrogen can dissolve in water.

Nitrogen also dissolves in water.

Importance of dissolved oxygen

Aquatic organisms need dissolved oxygen in water for their survival.

Effect of Temperature on Gas Solubility

For gases, temperature increase leads to a decrease in solubility.

Temperature ↑ → **Solubility of gas in water generally ↓**

Cold water can dissolve more oxygen than warm water.

Cold Water
(more gas dissolves)

Cold water can dissolve more oxygen.

Warm / Hot Water
(less gas dissolves)

Warm water can dissolve less oxygen.

Key Point

The solubility of gases in liquids **decreases with increase in temperature.**

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12. Uniform and Non-uniform Mixtures – Quick Revision

Mixtures are formed by mixing **two or more substances.** They are of two types.

Uniform mixture (Homogeneous mixture)

- Composition is uniform.
- Components are evenly distributed.
- Individual components are not easily distinguished.

Examples

Salt water
(Salt dissolved in water)

Air
(Mixture of gases)

Alloy
(Mixture of metals)

Non-uniform mixture (Heterogeneous mixture)

- Composition is not uniform.
- Different parts may have different composition.
- Components may be visible.

Examples

Sand + water
(Particles are visible)

Sawdust + water
(Particles are visible)

Vegetable salad
(Different components visible)

Key Point

- Uniform mixtures look the same throughout.
- Non-uniform mixtures do not look the same throughout.
- Examples of uniform mixtures: salt water, air, alloy.
- Examples of non-uniform mixtures: sand + water, sawdust + water.

In a uniform mixture, components are evenly mixed.
In a non-uniform mixture, components are not evenly mixed.

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13. Why Do Objects Float or Sink?

When an object is placed in water, some objects **float** and some objects **sink**.

Objects that float

A wooden stick
generally floats.

Objects that sink

An iron nail
generally sinks.

A stone
generally sinks.

Key points

- Objects float or sink depending on their **density** compared to water.
- Objects less dense than water float.
- Objects more dense than water sink.

Conclusion: An object **floats** if it is less dense than water and **sinks** if it is more dense than water.

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14. Density

Density tells us **how much mass is packed** into a given volume.

Meaning of Density

Density tells us **how much mass is packed** into a **given volume.**

Iron
(more dense)

Wood
(less dense)

More mass in the same volume

Less mass in the same volume

Formula

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

or

$$d = \frac{m}{V}$$

Where:

- d = Density
- m = Mass
- V = Volume

Examples

Example 1: Iron block

Mass = 780 g
Volume = 100 cm^3

$$\text{Density} = \frac{780}{100}$$

Density = 7.8 g/cm^3

Example 2: Wooden block

Mass = 60 g
Volume = 100 cm^3

$$\text{Density} = \frac{60}{100}$$

Density = 0.6 g/cm^3

Key Points

- Density is the mass per unit volume.
- It tells us how much mass is packed into a given volume.
- Different substances have different densities.
- The unit of density is g/cm^3 (or kg/m^3).

Greater density means more mass in the same volume.

15. Density – Simple Understanding

Density describes how **closely matter is packed** into a given volume.

Dense forest

- Many trees are present in a small area.
- More matter in a given space.

This is a dense forest.

Less dense forest

- Fewer trees are present in the same area.
- Less matter in a given space.

This is a less dense forest.

Conclusion: Density describes how **closely matter is packed** into a given volume.

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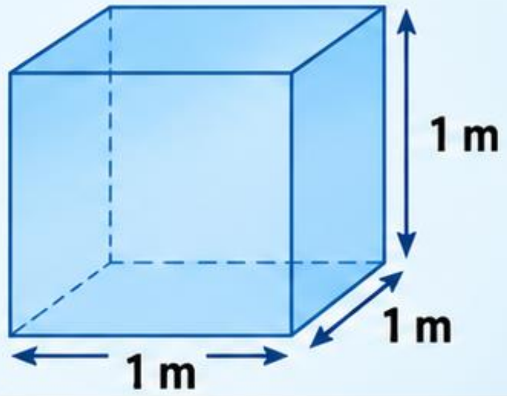
16. Units of Density

Density tells us how much **mass is packed into a given volume.**

SI unit of Mass

Mass → kilogram (kg)

SI unit of Volume



Volume → cubic metre (m^3)

Density Formula

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

SI unit of density:

kg/m^3

Smaller Unit of Density

For smaller quantities, density may also be expressed in:

g/cm^3

Useful Conversion

$1\ g/cm^3 = 1000\ kg/m^3$

$1\ kg/m^3 = 0.001\ g/cm^3$

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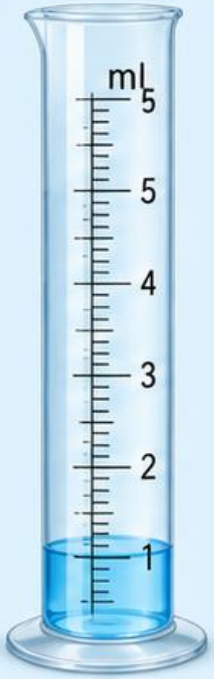
17. Density of Water

The density of water is about **1 gram per millilitre** (1 g/mL).

1 mL of water

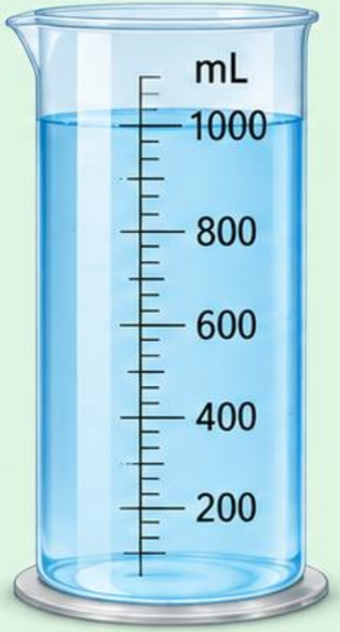


1 mL of water
≈ 1 g

1 mL

Mass = 1 g

1000 mL of water



1000 mL of water
≈ 1000 g = 1 kg

1000 mL (1 L)

Mass = 1000 g (1 kg)

Relationship

Since 1000 mL = 1 L, water has a mass of about 1 kg per litre.

Density of water
≈ 1 g/mL
(or 1 kg/L)

Key Point

1 mL of water has a mass of about 1 g, so the density of water is **1 g/mL** or **1 kg/L**.

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18. Relative Density

Relative density compares the density of a substance with the **density of water** at the same temperature.

Meaning

Relative density tells us how many times the density of a substance is compared to the density of water (at the same temperature).

Formula

$$\text{Relative Density} = \frac{\text{Density of substance}}{\text{Density of water at that temperature}}$$

Important Point

Relative density is a ratio, so it has **no unit.**

Examples

1. Water

Density of water $= 1\ g/cm^3$

Relative density of water

$= 1$

2. Aluminium

Density of aluminium $\approx 2.7\ g/cm^3$

Relative density of aluminium

$= \frac{2.7}{1}$

$= 2.7$

3. Iron

Density of iron $\approx 7.8\ g/cm^3$

Relative density of iron

$= \frac{7.8}{1}$

$= 7.8$

Key Point

- Relative density tells how many times a substance is denser (or less dense) than water.
- It has **no unit** because it is a **ratio of two quantities with the same unit.**

19. Mass and Weight

Students often use the words **mass** and **weight** interchangeably, but scientifically they are different.

Mass

- Mass is the **quantity of matter** in an object.
- SI unit: **kilogram (kg)**
- Maasured using a balance.
- Mass is the same everywhere.

Measured using a balance

Weight

- Weight is the **force with which Earth attracts** an object.
- SI unit: **newton (N)**
- Related to gravitational force.
- Weight can change from place to place (different planets).

Measured using a spring balance

Key differences

Feature	Mass	Weight
Meaning	Quantity of matter in an object	Force due to gravity
SI unit	kilogram (kg)	newton (N)
Measured using	Balance	Spring balance
Depends on gravity?	No (same everywhere)	Yes (changes from place to place)
Nature	Scalar quantity	Vector quantity (force)

Remember: **Mass** tells how much **matter** is in an object, while weight tells how strongly **Earth pulls** that object.

20. Measuring Mass

A **digital weighing balance** can be used to measure mass.

Procedure

1 Switch on the balance.

2 Check whether the display shows zero.

3 If necessary, press the reset/zero button.

4 Place the empty container or watch glass on the balance.

5 Tare/reset the balance to zero.

6 Place the object on the balance.

7 Read and record the displayed mass.

Mass of the object = 27.36 g

Observation

A digital weighing balance gives the mass directly in **grams (g)**.

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21. Measuring Volume

Volume is the **space occupied** by an object or substance.

What is Volume?

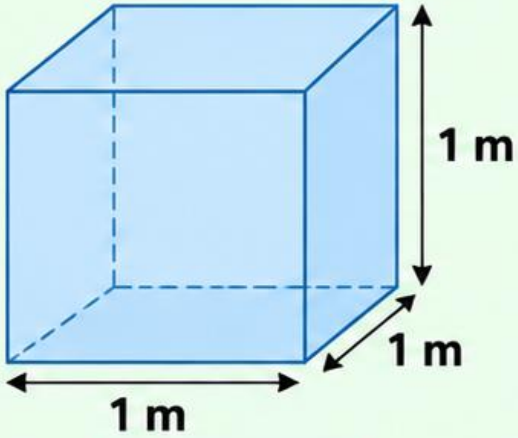
Volume is the **space occupied** by an object or substance.

Solid
occupies space (has volume)

Liquid
occupies space (has volume)

Gas
occupies space (has volume)

SI unit of Volume



m^3

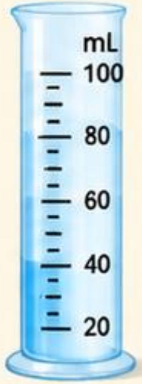
The SI unit of volume is cubic metre (m^3).

Common Units for Liquids and Smaller Objects

Litre (L)

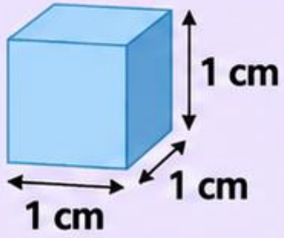
1 L = 1000 mL

Millilitre (mL)



Used for small volumes

Cubic centimetre (cm^3)



1 cm^3 is the volume of a cube of side 1 cm.

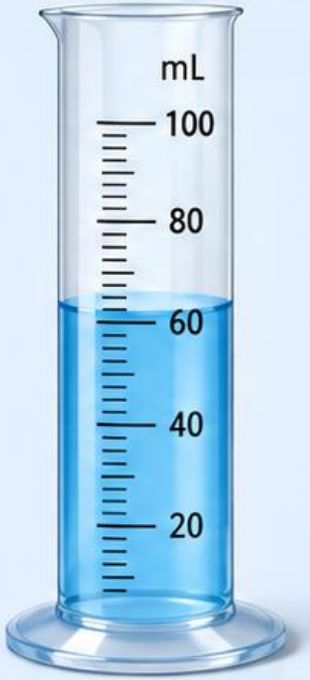
Important Conversion

$$1\ mL = 1\ cm^3$$

22. Measuring Volume of Liquids

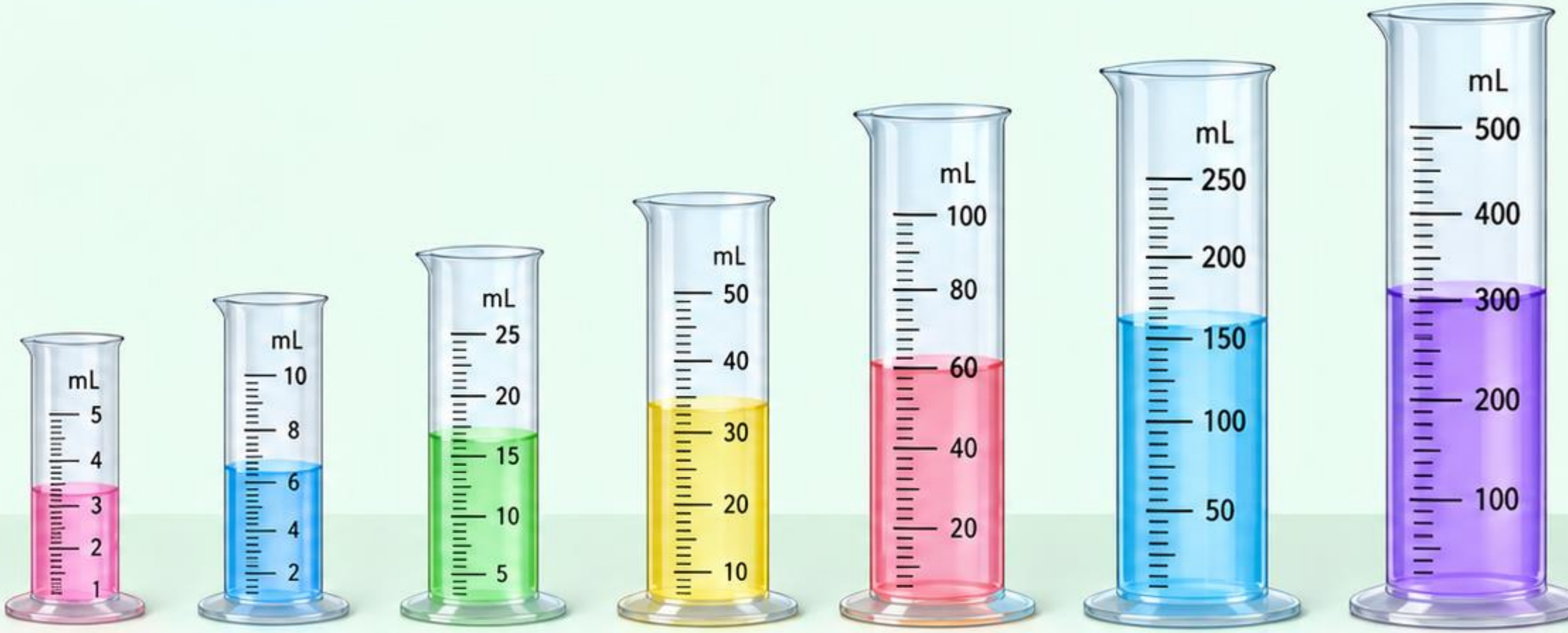
A **measuring cylinder** is used to measure the volume of a liquid.

Measuring Cylinder



A **measuring cylinder** is used to measure the volume of a liquid.

Measuring Cylinders of Different Capacities



5 mL | 10 mL | 25 mL | 50 mL | 100 mL | 250 mL | 500 mL

Key Point

Measuring cylinders are available in different capacities such as:
5 mL, 10 mL, 25 mL, 50 mL, 100 mL, 250 mL and **500 mL.**

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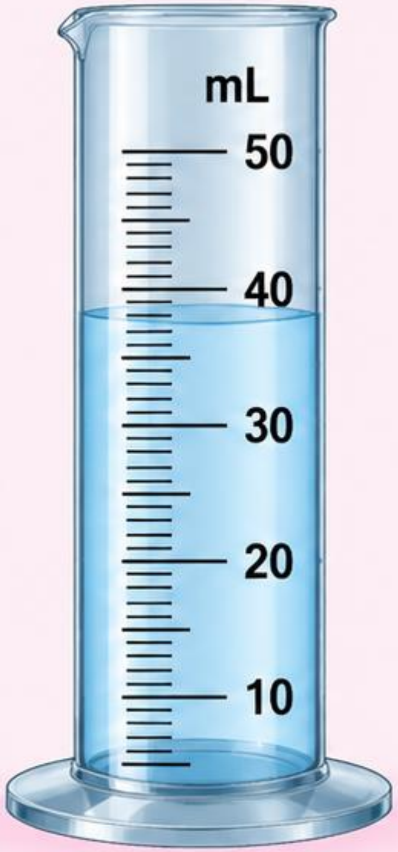
23. Least Count of a Measuring Cylinder

The **least count** is the smallest measurement that can be directly read from a measuring instrument.

Measuring Cylinder



Least Count

The **least count** is the smallest measurement that can be directly read from a measuring instrument.

How to find the least count?

$$\text{Least Count} = \frac{\text{Difference between two bigger marks}}{\text{Number of smaller divisions between them}}$$

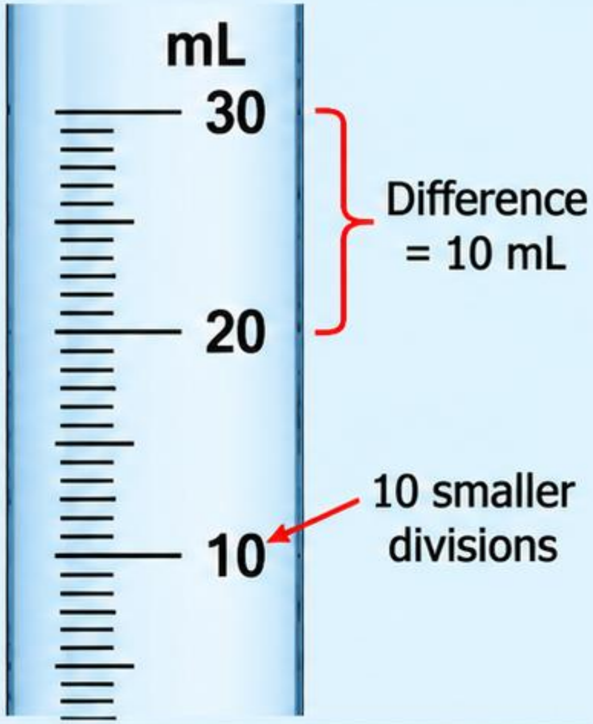
Example

If the difference between two larger markings is **10 mL** and there are **10** smaller divisions:

$$\text{Least Count} = \frac{10}{10} = \mathbf{1\ mL}$$

Thus, the measuring cylinder can measure as small as **1 mL**.

Close view of markings



$$\text{Least Count} = \frac{10\ \text{mL}}{10} = \mathbf{1\ mL}$$

Key Point The least count depends on the markings of the instrument. A smaller least count gives a more accurate measurement.

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24. Reading a Measuring Cylinder

Measure carefully for accurate results.

Correct procedure

1. Place the measuring cylinder on a **flat surface**.
2. Pour the liquid carefully.
3. Bring the liquid to the required level.
4. Observe the liquid surface.
5. Read the scale carefully.
6. For water and other colourless liquids, read the **bottom of the meniscus**.

Fig. 5.17: Pouring water into the measuring cylinder

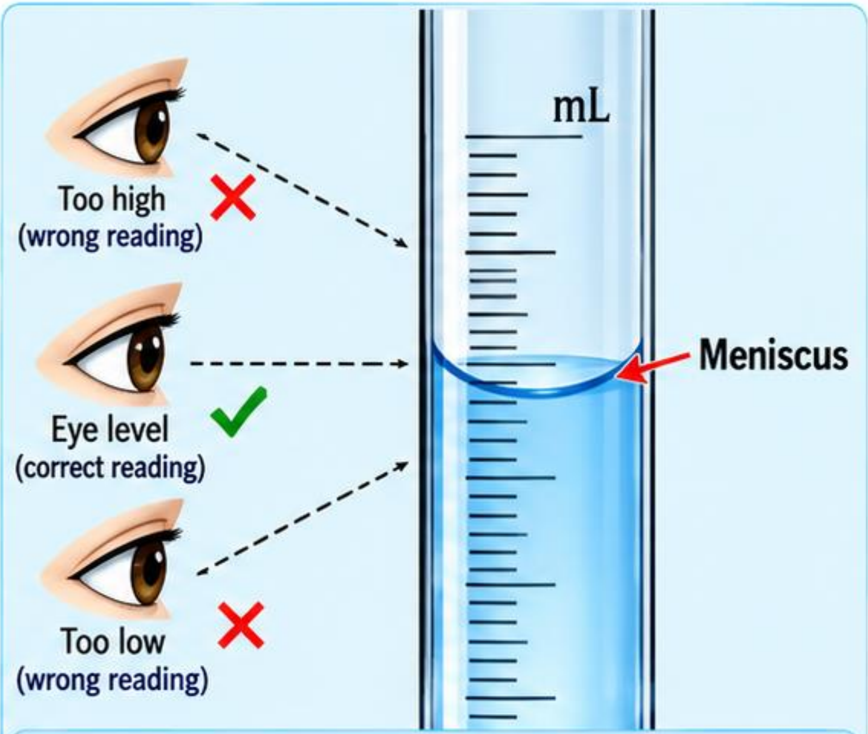

Fig. 5.18: Measuring the reading

Meniscus

The curved surface of a liquid in a measuring cylinder is called the **meniscus.**

For water:

Read the bottom of the meniscus.

25. Why Should a Measuring Cylinder Be Kept Upright?

A measuring cylinder should be placed **vertically/upright** on a **flat surface** while taking the reading.

1. Correct Position (Upright)

When the measuring cylinder is kept **vertically/upright** on a **flat surface**, we get an **accurate volume measurement**.

Correct – Upright

2. Wrong Position (Tilted)

If the measuring cylinder is tilted, the liquid level appears different and the reading will be **incorrect**.

Incorrect – Tilted

3. Advantage

- Keeps the liquid surface **horizontal**.
- Gives a clear and correct reading at **eye level**.
- Helps to measure the volume **accurately**.
- Prevents **errors** in measurement.

Therefore, a measuring cylinder should be kept upright on a flat surface while taking the reading.

Correct position gives a correct reading.

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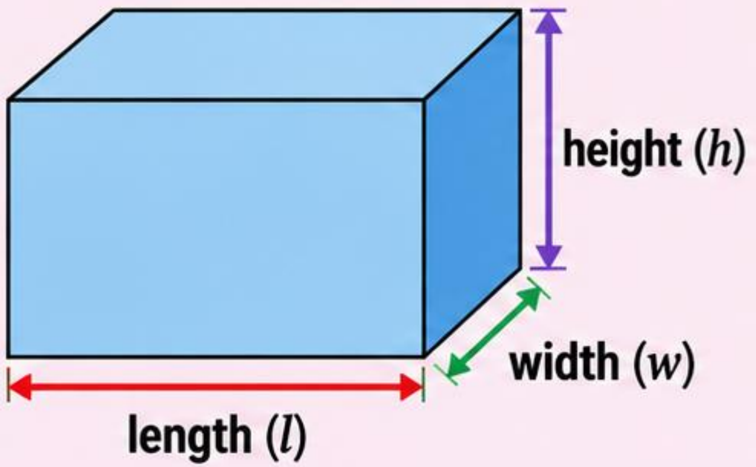
26. Volume of Regular Solids

Volume is the **amount of space** occupied by a solid object.

Volume of a Cuboid



Formula

$$V = l \times w \times h$$

Where:

l = length

w = width

h = height

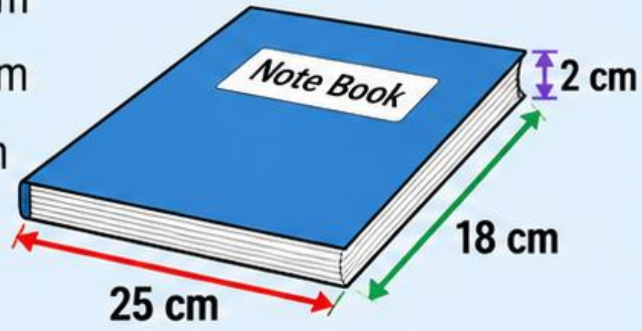
Example

Notebook dimensions:

Length (l) = 25 cm

Width (w) = 18 cm

Height (h) = 2 cm



Therefore:

$V = 25 \times 18 \times 2$

$$\boxed{V = 900\ cm^3}$$

Key Points

- Volume of a cuboid = length × width × height.
- The unit of volume is cm^3 (or m^3).
- Volume tells us how much space a solid occupies.
- Always use the same unit for all three measurements.

In the example, the notebook occupies a volume of **900 cm^3.**

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27. Volume of Irregular Solids

Objects such as stones do not have **regular geometrical shapes.**

Water Displacement Method

The volume of an irregular solid can be measured using the **water displacement method**.

Principle

When an irregular solid is immersed in water, it **displaces an amount of water equal to its volume.**

Formula

Volume of object = Final volume – Initial volume

Procedure and Example

1 Initial volume

Pour water into a measuring cylinder and note the initial volume (V_1).

Initial volume, V_1 = 40 mL

2 Immerse the object

Gently lower the irregular solid (e.g., a stone) completely into the water.

Final volume, V_2 = 70 mL

3 Find the volume

Subtract the initial volume from the final volume.

Volume of object = $V_2 - V_1$
= 70 mL – 40 mL
= 30 mL

Stone
(irregular solid)

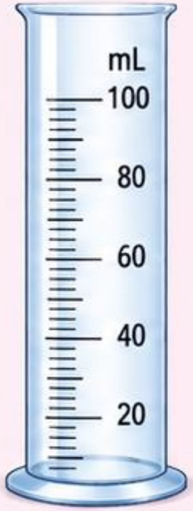
Key Point The volume of an irregular solid is equal to the volume of water it displaces.

28. Water Displacement Method – Procedure

Used to find the volume of an **irregular solid**.

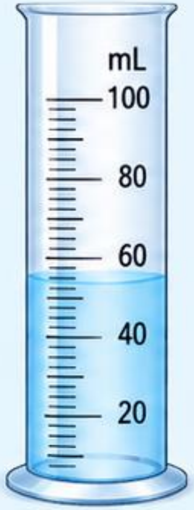
Procedure

1 Take a measuring cylinder.

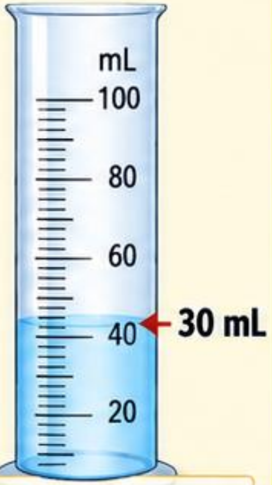


Measuring cylinder

2 Pour water into it.



3 Record the **initial volume.**

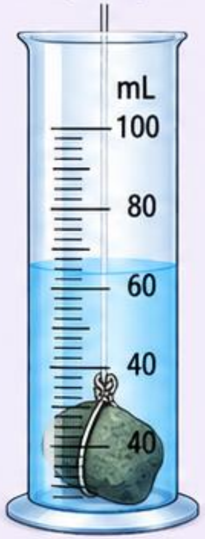


Initial volume (V_1) = 30 mL

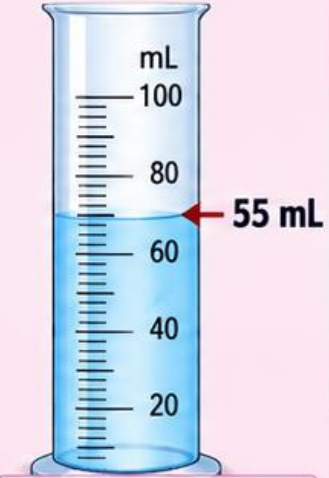
4 Tie the irregular object with a thread.

Stone (irregular object)

5 Slowly immerse it completely in water.



6 Record the **final volume.**



Final volume (V_2) = 55 mL

7 Subtract the initial volume from the final volume.

Volume of object

$$V = V_2 - V_1$$

Example

Initial volume = 30 mL

Final volume = 55 mL

$$V = 55 - 30$$

$$\boxed{V = 25\ mL}$$

Since:

$$1\ mL = 1\ cm^3$$

the volume is:

$$25\ cm^3$$

Key Point

- When an irregular solid is immersed in water, it displaces an amount of water **equal to its volume.**
- The volume of the object = Final volume − Initial volume.

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29. Determining Density Experimentally

To determine density, we need:
1. Mass
2. Volume

1 Measure the mass

Find the mass of the object using a digital weighing balance.

Mass = 16.40 g

2 Measure the volume

Find the volume of the object using the water displacement method.

Initial volume = 20 mL

Final volume = 25 mL

Volume of object = 25 – 20 = 5 **mL**
= **5 cm^3**

Formula

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Units: g/cm^3

Example from textbook

Mass = 16.40 g
Volume = 5 cm^3

$$Density = \frac{16.40}{5}$$

Density = 3.28 g/cm^3

Key Point

Density is the mass per unit volume of a substance.

SI unit: **g/cm^3**

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30. Density and Shape

The density of a substance is **independent of its shape or size**, provided the substance remains the same.

Same substance – different shapes

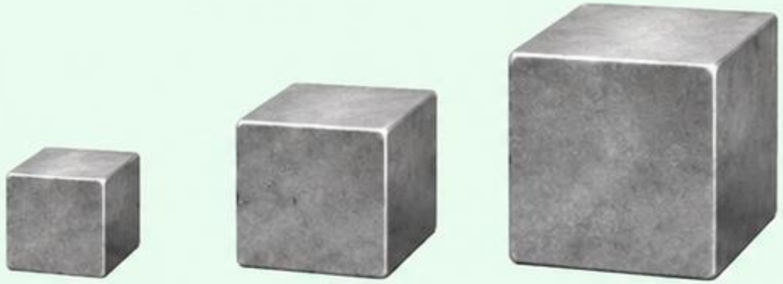
A piece of clay (same substance)

Block **Ball** **Disc**

All are made of the same clay.
Their shape is different, but the density **remains the same.**

Same substance – different sizes

Pieces of the same metal (iron)



1 cm	2 cm	3 cm
Density of iron $= 7.9\ g/cm^3$	Density of iron $= 7.9\ g/cm^3$	Density of iron $= 7.9\ g/cm^3$

Key Points

- Changing the shape of a piece of a substance **does not by itself change its density**.
- The density of a substance is **independent of its shape or size,** provided the substance remains the same.
- However, density can depend on conditions such as **temperature,** particularly for gases.

Conclusion

**Density is a property of the substance itself, not its shape or size.
But for gases, density can change with temperature.**

SI unit of density:
g/cm^3

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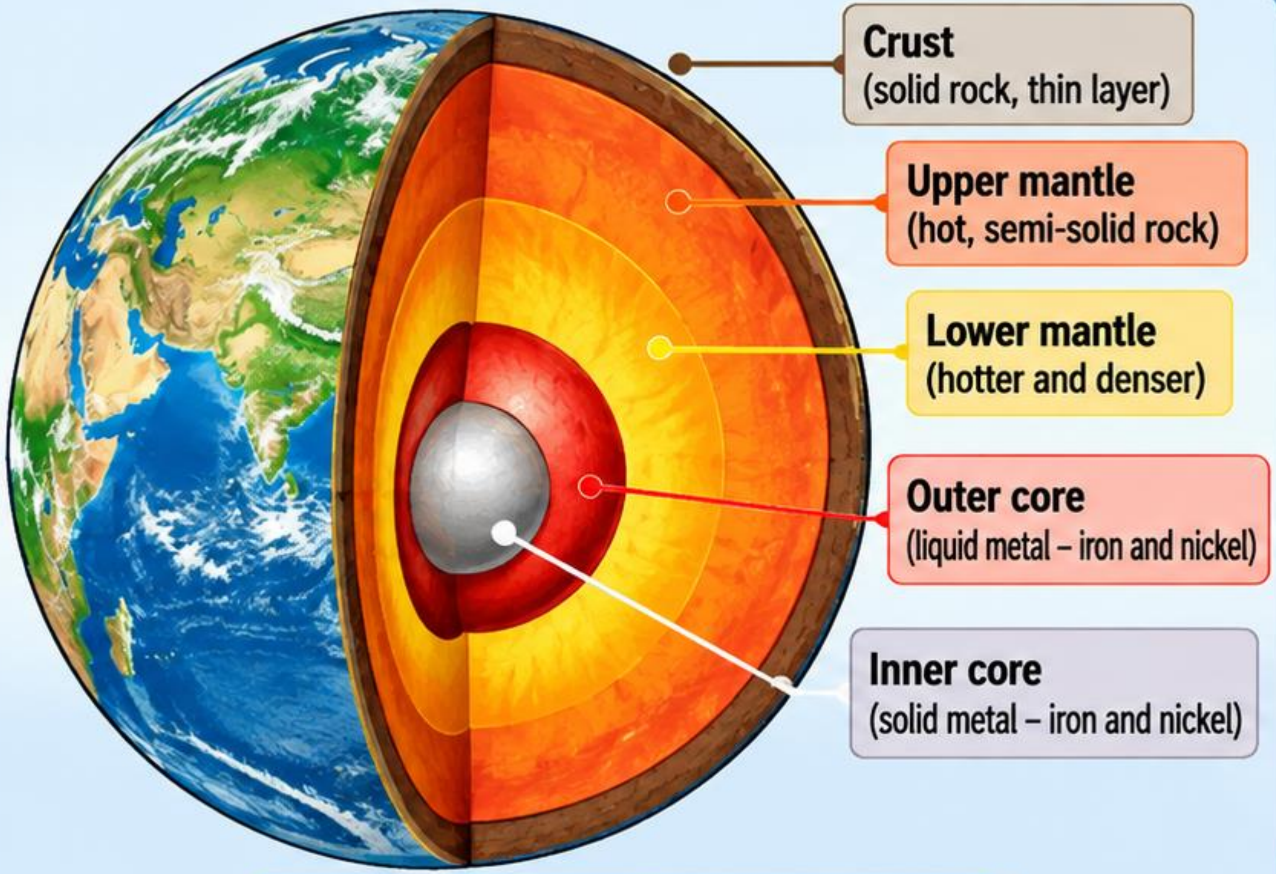
31. Density of Earth

As we move towards the centre of Earth, **pressure and temperature increase**, and the materials become more compact.



Internal Layers of Earth

Layer	Main Features	Density
Crust	Thin, solid rocky layer	Least dense
Upper mantle	Hot, semi-solid rock	More dense than crust
Lower mantle	Hotter and denser rock	Denser
Outer core	Liquid metal (iron and nickel)	Very dense
Inner core	Solid metal (iron and nickel)	Densest

Important Points

- Earth is made up of different layers with different densities.
- As we move towards the centre of Earth, **pressure and temperature increase**.
- Due to high pressure, the materials become more compact and denser.

Key Point

The density of materials inside the Earth **increases with depth due to increase in pressure and temperature.**

Earth is denser at the centre than at the surface.

32. Effect of Temperature on Density

Temperature changes the volume of a substance, so its **density also changes.**

General rule

Heating →
Density decreases

Cooling →
Density increases

Formula

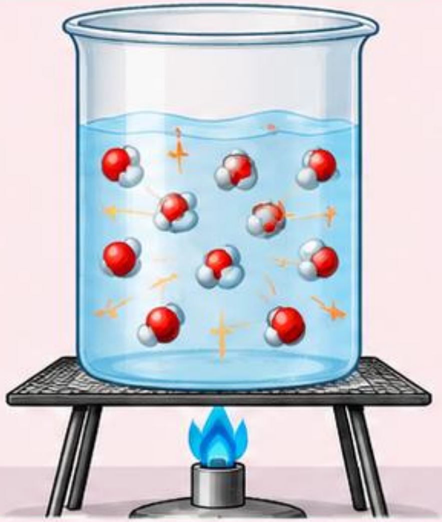
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

If volume increases while mass remains the same:

Density ↓

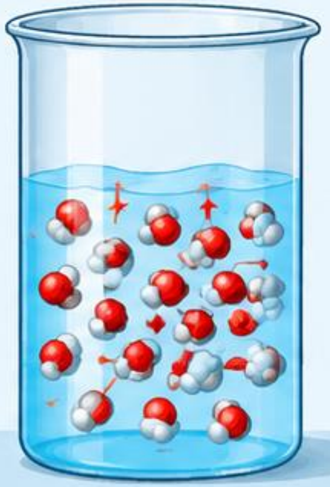
Example: Water

When water is heated



- Particles move more.
- Water expands.
- Volume increases.
- Mass remains the same.
- Therefore, density decreases.

When water is cooled



- Particles move less.
- Water contracts.
- Volume decreases.
- Mass remains the same.
- Therefore, density increases.

Why does heating decrease density?

- Particles tend to move more.
- The substance may expand.
- Volume increases.
- Mass remains essentially the same.
- Therefore density decreases.

Why does cooling increase density?

- Particles move less.
- The substance contracts.
- Volume decreases.
- Mass remains essentially the same.
- Therefore density increases.

Key Point

Heating → increase in volume → density decreases | Cooling → decrease in volume → density increases

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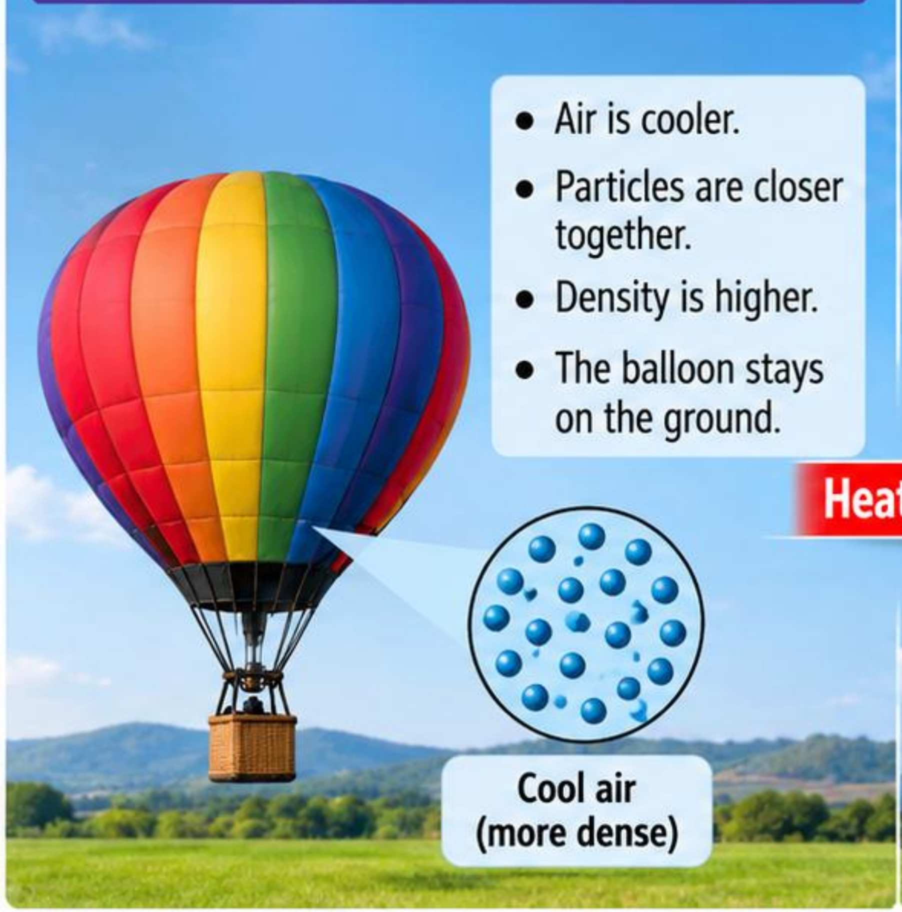
33. Hot-Air Balloons

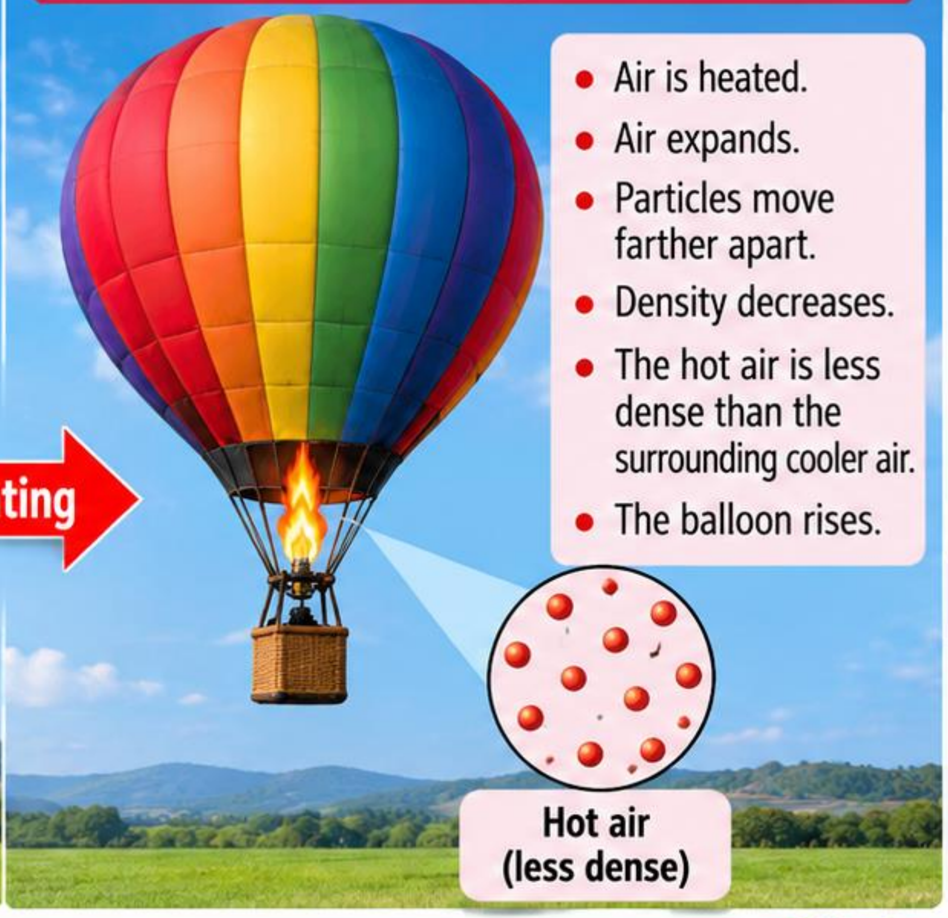
Heating air **decreases its density**. The hot air is less dense than the surrounding cooler air. So, the balloon rises.

Before heating (cooler air)



Heating

After heating (hot air)



Why does the balloon rise?

1. Heating makes air expand.
2. Volume increases.
3. Density decreases.
4. Hot air is less dense than the surrounding cooler air.
5. So, the buoyant force pushes the balloon up and it rises.

Key Point

- Hot-air balloons work because heated air has **lower density** than the cooler air outside.

Conclusion

When air is heated, its density decreases, and the hot air rises. This is why hot-air balloons go up in the sky.

Heating air → Density decreases → Balloon rises

34. Effect of Pressure on Density

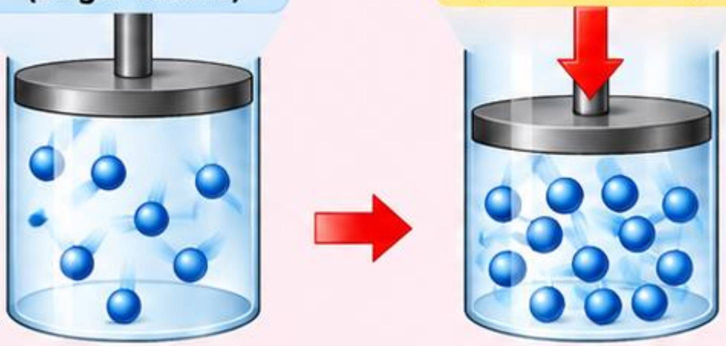
The effect of pressure is different for different states of matter.

Gases

When pressure increases:

- Brings gas particles closer.
- Decreases volume.
- Increases density.

Low pressure (Larger volume) | **High pressure (Smaller volume)**

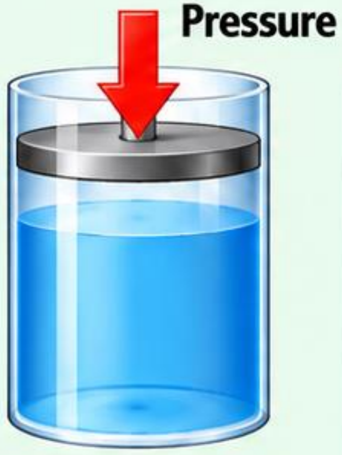


Particles are far apart **(less dense)** | Particles are closer **(more dense)**

Pressure ↑ → Density of gas ↑

Liquids

- Liquids are not easily compressed.
- Therefore, pressure has a **small effect** on their density.

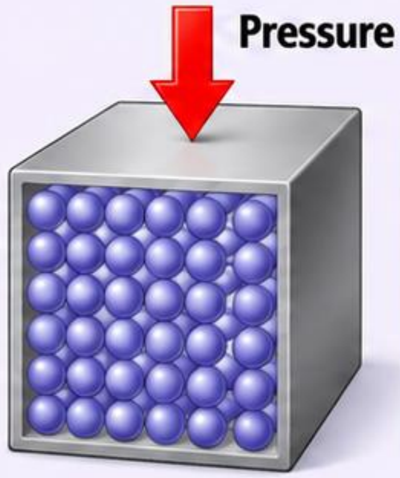


Liquid volume changes very little

Even when high pressure is applied, the volume of liquid decreases only a very little, so its density changes very little.

Solids

- Particles in solids are already very close together.
- Therefore, ordinary changes in pressure generally have a **negligible effect** on their density.



Solids are almost incompressible. So, their density does not change significantly with pressure.

Key Point

- Increasing **pressure** → decreases volume → increases density (gases).
- Pressure has a small effect on density (liquids).
- Ordinary changes in pressure have a negligible effect on density (solids).

Summary:

Gases – large effect
Liquids – small effect
Solids – negligible effect

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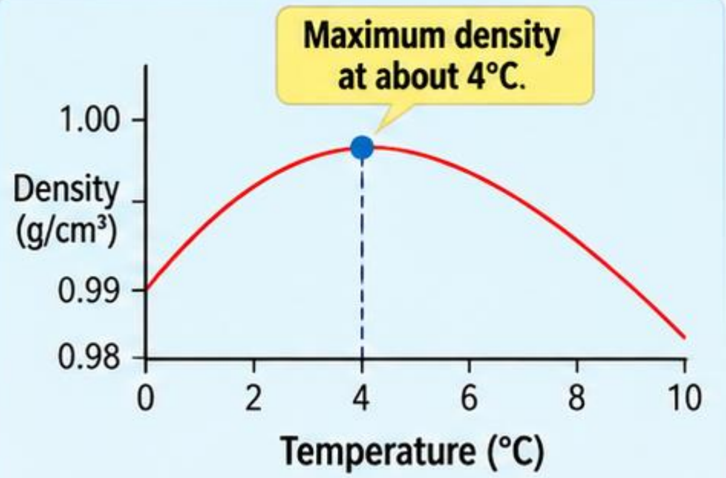
35. Why Does Ice Float on Water?

This is an **important** application of **density**.

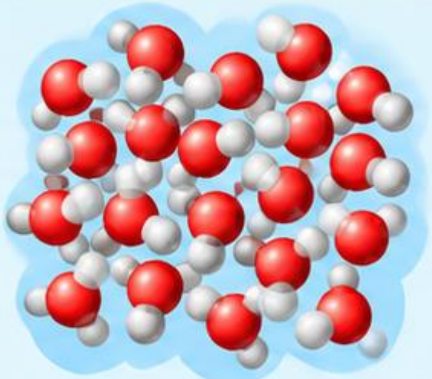
Density of water

- Water has an unusual property.
- Its density is **maximum at about 4°C.**
- Below 4°C, water starts to expand.



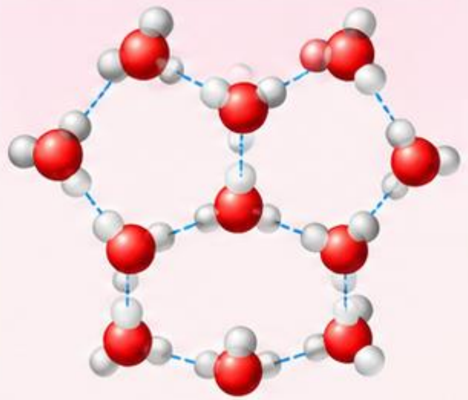
Structure of water and ice

Liquid water (at 4°C)



- Molecules are close together.
- More dense.
- Less space between molecules.

Ice (below 0°C)



- Molecules form an open structure with more space.
- Less dense than liquid water.
- Occupies more space for the same mass.

Ice floating on water

- Ice has a lower density than liquid water.
- So, it occupies more space for the same mass.
- Therefore, ice floats on water.

Density of ice < Density of water

Key Point

- Water's density is maximum at **about 4°C.**
- When water cools below **4°C** and freezes, it occupies more space.
- Ice has a lower density than liquid water, so it floats.

Ice floats because it is less dense than water.

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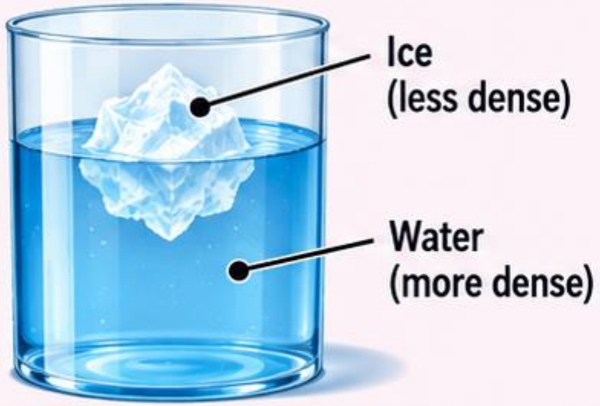
36. Importance of Floating Ice

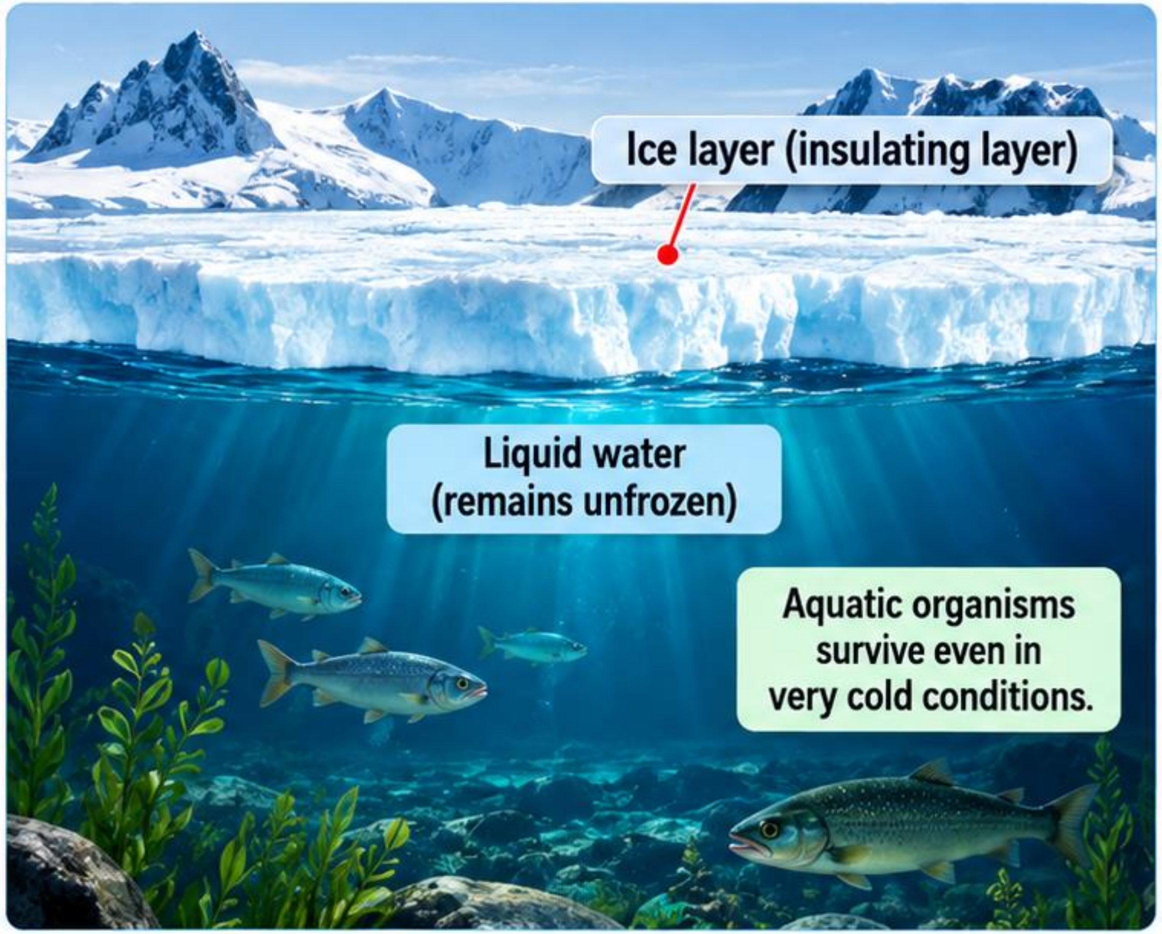
Ice floating on the surface of water is **important for aquatic life.**

Why does ice float?

- Ice has a lower density than liquid water.
- When water cools and freezes, it occupies more space.
- Therefore, ice floats on water.

Density of ice < Density of water





Importance of Floating Ice

1. The ice layer acts as an **insulating layer.**
2. It reduces the loss of heat from the water below.
3. The water underneath remains in liquid state.
4. This allows fish and other aquatic organisms to survive even in very cold conditions.

Key Point

- Ice floatls because it is less dense than water.
- The floating ice layer helps aquatic life by keeping the water below in liquid form.

Without floating ice, lakes and oceans could freeze solid, and many aquatic organisms could not survive.

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37. Floating and Sinking – Concept Summary

An object floats or sinks depending on its **density** and **other factors**.

When does an object float?

An object generally tends to float when:

Density of object < Density of liquid

Wood
(less dense than water)

When does an object sink?

An object generally tends to sink when:

Density of object > Density of liquid

Stone
(more dense than water)

Examples in water

Key Point

- An object floats if its density is less than the density of the liquid.
- An object sinks if its density is greater than the density of the liquid.
- Density is not the only factor involved in determining whether an object floats or sinks in a particular situation.

Objects can float or sink depending on their density and other factors.


thank you