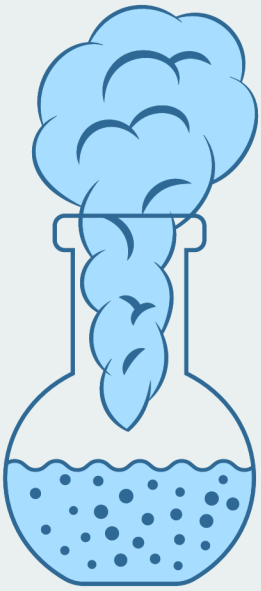
ADHYANNPEDIA.com


Class 9 Science

# C1: Matter in Our Surroundings

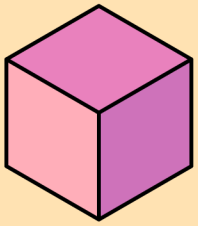
FREE

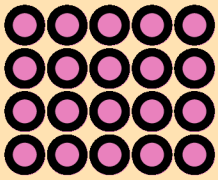
NCERT SOLUTIONS



# Matter in our surroundings

## SOLID





- rigid
- fixed shape
- fixed volume

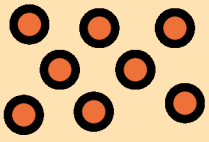
freezing

melting

deposition

sublimation

## LIQUID

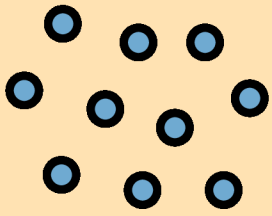


- not rigid
- not a fixed shape
- fixed volume

evaporation

condensation

## GAS



- not rigid
- not a fixed shape
- no fixed volume

# Matter in our surroundings

## 📄 Page 3 – 🟩In-Text Questions

**Q1. Which of the following are matter? Chair, air, love, smell, hate, almonds, thought, cold, lemon water, smell of perfume.**

Matter is anything that has **mass** and **occupies space**. It can be seen, touched, and felt. Substances like **chair, air, almonds, and lemon water have mass and occupy space,** so they are considered matter. Whereas **love, smell, hate, thought, cold, and smell of perfume are emotions, feelings, or sensations.** They do not have mass or volume, so they are not matter. Hence, only the substances that exist physically and have weight and volume are classified as matter.

**Q2. Give reasons for the following observation:**

**The smell of hot sizzling food reaches you several meters away, but to get the smell from cold food you have to go close.**

This is because the **particles of matter are constantly moving and can spread in all directions.** When **food is hot,** the kinetic energy of its particles increases. These particles mix with the air quickly and travel faster, which allows the smell to reach us even from a distance. **On the other hand,** the smell from **cold food spreads slowly** because its particles have less energy and move slower. So, **the rate of diffusion increases with temperature**, which is why we can smell hot food from far away.

**Q3. A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?**

This observation shows that **particles of matter have space between them.** Water is a liquid, and in liquids, the particles are not as tightly packed as in solids. Due to the gaps between the water particles, the diver can easily pass through them. Hence, the ability of a diver to move through water proves that there is inter-particle space in liquids, allowing movement.

**Q4. What are the characteristics of the particles of matter?**

- The particles of matter are very, very small.
- The particles of matter have spaces between them.
- The particles of matter are constantly moving.
- The particles of matter attract one another.

---

## 📄 Page 6 – 🟩In-Text Questions

**Q1. Arrange the following in order of increasing density: air, exhaust from chimneys, honey, water, chalk, cotton and iron.**

The order of increasing densities of the given substances is :**Air < Exhaust from chimneys < Cotton < Water < Honey < Chalk < Iron**

**Q2(a). Tabulate the differences in the characteristics of the three states of matter.**

| Property | Solid | Liquid | Gas |
|---|---|---|---|
| Shape and Volume | Solids have a fixed shape and a fixed volume. | Liquids have a fixed volume but they have no fixed shape. | Gases have neither a fixed shape nor a fixed volume. |
| Compressibility | Solids cannot be compressed much. | Like solids, liquids cannot be compressed much. | Gases can be compressed easily |
| Fluidity | Particles of solid cannot move freely. | These particles move freely. | Gaseous particles are in a continuous, random motion. |
| Particle packing | These particles attract each other very strongly. | The force of attraction between liquid particles is less than solid particles. | The force of attraction is least between gaseous particles. |
| Density | Solids have high densities. They are heavy. | Liquids have moderate to high densities. They are usually less dense than solids. | Gases have very low densities. They are very, very light |

**Q2 (b). Comment upon: Rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and density.**

- **Rigidity:** Rigidity refers to the property of a solid to resist change in its shape , when an outside force is applied. In most simple terms, **rigidity means 'stiffness'.** The particles in a solid are very closely packed and there are very strong forces of attraction between them, so solids possess high rigidity. Liquids and gases are not rigid because the positions of their particles are not fixed.
- **Compressibility:** . Compressibility is the property of a fluid (or a solid) due to which its volume decreases when pressure is applied. The particles in gases have large spaces between them due to which their volume decreases too much when pressure is applied on them. So, gases have high compressibility. On the other hand, the particles in solids and liquids are closely packed, so solids and liquids do not have much compressibility.
- **Fluidity:** The property of flowing easily is called fluidity. Gases and liquids exhibit the property of fluidity, so they are called fluids. Due to large interparticle distances and very weak forces of attraction, gases can flow extremely easily. So, the gases have very high fluidity . And because of comparatively smaller interparticle distances and stronger forces of attraction between their particles, the fluidity of liquids is less than that of gases. Solids are not fluids, they have no fluidity.
- **Filling a container:** A gas fills its container completely because due to high kinetic energy and negligible interparticle forces of attraction, the particles in a gas move with high speeds in all directions and occupy all the space in the container.
- **Shape:** The external form or appearance of a substance is called its shape. A solid has a fixed shape because the particles in a solid are closely packed and their positions are fixed due to strong forces of attraction between them. The liquids and gases do not have fixed shapes because the positions of particles in them are not fixed due to comparatively weaker forces of attraction between them.
- **Kinetic energy:** Gas > Liquid > Solid. The energy possessed by a material due to the motion of its particles is called kinetic energy. At a given temperature, the particles in a gas have the maximum

kinetic energy because they move with high speeds due to weakest forces of attraction among them. Liquids have lesser kinetic energy (than gases) whereas solids have the the least kinetic energy at a given temperature.

- **Density:** Generally Solid > Liquid > Gas. The mass per unit volume of a material is called its density. Solids have high densities because their particles are very close together. Liquids have usually lower densities than solids because their particles are somewhat more loosely packed than that in solids. Gases have the lowest densities because their particles are very far apart from one another.

**Q3. Give reasons:**

**(a) A gas fills completely the vessel in which it is kept.**

**(b) A gas exerts pressure on the walls of the container.**

**(c) A wooden table should be called a solid.**

**(d) We can easily move our hand in air but not through a wooden block.**

**(a)** In gas, the force of attraction between particles is negligible. So, they move freely in all the directions and acquire all the spaces in the vessel.

**(b)** Due to freely moving particles and high kinetic energy, particles of gas move randomly in all the directions and hit the walls of the container exerting pressure.

**(c)** A wooden table should be Solid Because it has a definite shape and fixed volume.

**(d)** Air is made of particles with a lot of space between them, so we can move our hand easily. In solids like wood, particles are tightly packed, so it's hard to pass through without great force.

**Q4. Liquids generally have lower density than solids. But ice floats on water. Why?**

Ice is the solid form of water, but it is less dense than liquid water. This is because in ice, water molecules form a special structure with more empty space between particles. As a result, ice occupies more volume than water but has the same mass.Since it is less dense, it floats on water. This is a unique property of water and is important for aquatic life in cold climates.

---

# 📄 Page 9 – 🟩In-Text Questions

**Q1. Convert to Celsius: (a) 300 K (b) 573 K**

°C = K − 273

(a) 300 K − 273 = **27 °C**

(b) 573 K − 273 = **300 °C**

**Q2. What is the physical state of water at: (a) 250 °C (b) 100 °C?**

(a) At 250°C, water exists in the **gaseous state (as steam),** because it is above its boiling point (100°C).
(b) At 100°C, water is at its **boiling point, so it exists as liquid and gas both** — it starts converting from liquid to steam.

**Q3. For any substance, why does the temperature remain constant during the change of state?**

**The temperature remains constant** as the heat gets used up in changing the state by overcoming the forces of attraction between the particles. **For example,** a solid melts on heating. Its temperature does not rise until the entire solid is converted into liquid. This heat energy gets hidden into the content and is known as the latent heat.

**Q4. Suggest a method to liquefy atmospheric gases.**

Atmospheric gases can be **liquefied by increasing pressure and lowering the temperature**. This brings gas particles closer together, allowing them to change into the liquid state.

---

## 📄 Page 10 – 🟩 In-Text Questions

**Q1. Why does a desert cooler cool better on a hot dry day ?**

A desert cooler works on the principle of evaporation. On a hot and dry day, the air has low humidity, so the rate of evaporation is high. When water evaporates, it absorbs heat from the surroundings, making the air cooler. Hence, the desert cooler gives better cooling because more water evaporates, removing more heat from the air.

**Q2. How does the water kept in an earthen pot (matka) become cool during summer ?**

The earthen pot has tiny pores in its surface. Water slowly seeps out through these pores and evaporates. The heat required for evaporation is taken from the water inside the pot. As a result, the water loses heat and becomes cool. This is how evaporative cooling takes place in a matka.

**Q3. Why does our palm feel cold when we put some acetone or petrol or perfume on it ?**

Acetone, petrol, and perfume are volatile liquids, which means they evaporate quickly. When we put them on our palm, they start to evaporate. During evaporation, they absorb heat from our palm, making it feel cold. This cooling is due to evaporation absorbing heat from the skin.

**Q4. Why are we able to sip hot tea or milk faster from a saucer than a cup ?**

When hot tea or milk is poured into a saucer, its surface area increases. This allows more heat to escape quickly through evaporation. So, the liquid cools faster in a saucer than in a cup, where the surface area is smaller. That is why we can sip tea or milk faster from a saucer.

**Q5. What type of clothes should we wear in summer ?**

In summer, we should wear light - coloured, loose, and cotton clothes. Cotton absorbs sweat and exposes it to the air, where it evaporates. As the sweat evaporates, it takes heat from our body and cools us. Light colours also reflect heat, keeping us cooler than dark colours.

---

## 📄 Page 12 – 🟦 Exercise Question

**Q1. Convert to Celsius: (a) 293 K (b) 470 K**

(a) 293 K − 273 = **20 °C**(b) 470 K − 273 = **197 °C**

**Q2. Convert to Kelvin: (a) 25 °C (b) 373 °C**

K = °C + 273(a) 25 °C + 273 = **298 K**(b) 373 °C + 273 = **646 K**

**Q3. Give reasons: (a) Naphthalene balls disappear over time without leaving any solid. (b) We can smell perfume sitting several meters away.**

(a) **Naphthalene undergoes sublimation,** which means it changes directly from solid to gas without becoming liquid. That is why it disappears over time.(b) The **particles of perfume diffuse into the air and spread in all directions.** Since particles of gases move fast, the smell reaches us even if we are far away.

**Q4. Arrange in increasing order of intermolecular forces: water, sugar, oxygen.**

**The forces of attraction between the particles** in a solid are the strongest, in liquids are less strong whereas in gases are the weakest. Now, out of water, sugar and oxygen :(i) oxygen is a gas, so it has the weakest forces of attraction between its particles.(ii) water is a liquid, so it has stronger forces of attraction between its particles (than oxygen).(iii) sugar is a solid, so it has the strongest forces of attraction between its particles. Thus, the increasing order of forces of attraction between the particles of water, sugar and oxygen will be : **Oxygen < Water < Sugar**

**Q5. What is the physical state of water at : (a) 25°C ? (b) 0°C ? (c) 100°C ?**

(a) At 25°C, **water is a liquid.**(b) At 0°C, **water exists as solid and liquid both (melting point).**(c) At 100°C, **water exists as liquid and gas both (boiling point).**

**Q6. Give two reasons to justify: (a) Water at room temperature is a liquid. (b) An iron almirah is a solid.**

(a) The **two general properties of liquids are that liquids have 'a fixed volume' but 'no fixed shape'.** Now, water is a liquid at room temperature because : (i) water has a fixed volume (which does not change on changing its container). (ii) water has no fixed shape (it takes the shape of the container in which it is kept).(b) The **two general properties of solids are that solids have 'a fixed shape' and 'a fixed volume'.** An almirah is a solid at room temperature because : (i) an almirah has a fixed shape (which cannot be changed by pressing it with hands). (ii) an almirah has a fixed volume (which depends on the dimensions according to which it is made).

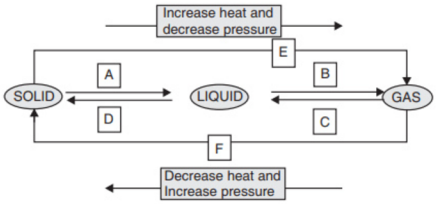
**Q7. Why is ice at 273 K more effective in cooling than water at the same temperature?**

Ice at 273 K absorbs **latent heat of fusion** when it melts. This extra heat absorption makes it more effective in cooling than water at 273 K, which has already melted and cannot absorb this latent heat again.

**Q8. What produces more severe burns – boiling water or steam? Why?**

Steam causes more severe burns than boiling water because it contains the **latent heat of vaporization.** When steam condenses on skin, it releases this extra heat energy, causing deeper burns.

**Q9. Name A, B, C, D, E and F in the following diagram showing changes in state :**




**A** – Melting **B** – Vaporization **C** – Condensation **D** – Freezing **E** – Sublimation **F** – Deposition