

NCERT Solution for Class 9 Science Chapter 1 Matter in Our Surroundings

Exercise-1.1-1.2 (Page 3)

1. Which of the following are matter?

Chair, air, love, smell, hate, almonds, thought, cold, lemon water, smell of perfume.

Answer: Matter is anything that can be touched. In other words, matter is an entity that physically exists in nature. In the provided options, the following are matter—

- Chair
- Air
- Almonds
- Lemon Water

2. 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.

Answer: At high temperatures, with the increase in heat, the molecules in a substance gain kinetic energy and exhibit fast movement resulting in diffusion. This diffusion is the reason behind the smell from hot foods that reaches you even if you are a few meters away.

In contrast to this, low temperatures restrict the movement of molecules in the air. The molecules remain intact and closely bind with one another, thereby, inhibiting diffusion. This is the reason why you can not smell medium hot or cold foods from a distance.

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

Answer: The molecules of water are loosely bound as the force of attraction between them is weak. This weak force of attraction is the property of water and other fluids. The same can be observed when you put your hand in a bucket of water and move your hand through it.

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

Answer: Characteristics of particles of matter are:

- The particles are extremely small in size.
- The particles in a matter have a definite space between them.
- The particles are constantly in motion.
- The particles bind with each other.

Exercise 1.3 (Page 6)

5. The mass per unit volume of a substance is called density. (density=mass/volume). Arrange the following in the order of increasing density – air, exhaust from the chimneys, honey, water, chalk, cotton, and iron.

- The increasing order of density for the given substances is as follows: -

Air
 Exhaust from the chimney
 Cotton
 Water
 Honey
 Chalk
 Iron

This is because solids have the highest density, followed by liquid, and then gases.

6. Answer the following.

A) Tabulate the differences in the characteristics of matter.

Characteristics	Solid	liquid	Gases
Shape & Volume	A solid has a fixed shape and volume.	A liquid has no fixed shape but has a fixed volume.	Gases neither have fixed shape nor a fixed volume.

Intermolecular Force	The particles in a solid have the maximum force of attraction between them.	The particles in a liquid, even though they have a strong force of attraction, it is quite less than found in solids but higher than that found in gases.	Force of attraction between particles present in gases is almost negligible.
Rigidity/ Fluidity	Particles in a solid cannot move freely; therefore, they are rigid and cannot flow.	Particles in a liquid can move freely and can therefore flow and are not rigid.	Particles found in a gas are in constant random motion moving in all directions and can, therefore, flow and are not rigid.
Compressibility	Solids are incompressible due to the tightly-packed molecules.	Liquids, even though they are almost incompressible, they can be compressed to a certain extent due to the little spaces present between the molecules.	Gases are highly compressible due to the presence of large spaces between the particles.
Density	Solids have the highest density.	Liquids have a lower density than solids, but more than gases.	Gases have very low density.
Kinetic Energy	The molecules present in solids possess the least amount of kinetic energy.	The molecules present in a liquid have kinetic energy higher than that in solids but lesser than gases.	The molecules in gases possess the highest amount of Kinetic energy.

B) Comment upon the following: rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy, and density.

- **Rigidity** – This is the property possessed by a substance to maintain its original shape even when subjected to an external force. Solids are rigid; however, liquids and gases are not. The force of attraction present between the molecules in solids is extremely strong, making solids rigid in nature.
- **Compressibility** – It is the ability of the particles in a substance to shrink the space present between the molecules, to reduce the volume when external pressure is applied to it. Gases are highly compressible due to the large spaces present between its molecules and also the presence of many empty spaces.
- **Fluidity** – This is the property a substance possesses, which allows them to flow or, in simpler words, these particles move around freely. Liquids and gases possess this property and are therefore known as fluids, whereas solids are rigid.
- **Filling a gas container** – When a liquid or a gas is kept in a container, the molecules present inside them allows them to move freely and take up the shape of the container they are placed in. Filling a gas container means that the molecules present in the gas due to its ability to move freely and almost negligible force of attraction between the particles move in random directions to fill the container and take its shape.
- **Shape** – It is the structure of an object within fixed frames or boundaries that give the object its shape.
- **Kinetic Energy** – This is the energy possessed by the particles produced by the constant motion of the particles. Gases have the highest kinetic energy due to the free movement of the particles and therefore being in constant motion. Solids have the least energy, while liquid has more than solids but less than gases.
- **Density** – The mass of a substance per unit volume is known as the density. It is expressed in terms of $D=M/V$. D denotes density; M denotes mass, and V denotes

volume. The more the molecules are tightly packed, the higher will be the density. Therefore, solids have the highest density, followed by liquids than gases.

7. Give reasons: -

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

The particles present inside a gas have the negligible force of attraction but possess a high amount of kinetic energy, which permits them to flow and move freely in all possible directions. Therefore, these particles are in constant motion. Neither do they have fixed volume nor any fixed shape. Therefore, when placed in a vessel, it fills the vessel and takes its shape.

b. A gas exerts pressure on the walls of the container.

Due to the high kinetic energy, the minimum force of attraction and constant motion of the particles within the container that the gas is kept in, the particles move around freely in all directions and not only do these particles collide with each other but also collide with the container's wall at a greater force. This force that acts per unit area of the container when hit by the gas particles is called pressure.

c. A wooden table should be called a solid.

What makes a wooden table solid? Let us look at some of the characters that a wooden table possesses, which makes it a solid.

- Fixed shape and volume.
- Presence of high force of attraction between the molecules causing the particles to be tightly packed.
- Rigidity and lack of compressibility.

Therefore, it has got a fixed mass, volume, and shape.

d. We can easily move our hands in the air, but to do the same through a solid block of wood, we need a karate expert.

The particles present in the air which is essentially gas has the negligible force of attraction and large empty spaces between the molecules, whereas a block of wood which is essentially a solid has a high force of attraction and tightly packed molecules which makes it easier for us to move

our hand through air's empty spaces but not a solid block of wood, which only a karate expert could do.

8. Liquids generally have a lower density than solids. But you must have observed that ice floats on water. Find out why.

Even though solids tend to have a higher density than water due to its high force of attraction and closely packed molecules, which make it very dense, ice contains small pores when water freezes to change its form to ice, which creates several empty spaces inside of it. As a result, the volume of ice becomes greater than water, and greater volume means lesser density. This leads to the density of ice becoming lesser than that of water and allows it to float on ice.

Exercise-1.4 (Page 9)

1. Convert the following temperature to Celsius scale:

a. 300K b. 573K

Answer: As we all know $0^{\circ}\text{C}=273\text{K}$, this can be used to convert Kelvin scale to Celsius scale.

a. $(300\text{K} - 273\text{K}) = 27^{\circ}\text{C}$

b. $(573\text{K} - 273\text{K}) = 300^{\circ}\text{C}$

2. What is the physical state of water at:

a. 250°C b. 100°C ?

Answer:

a. The boiling point of water is 100°C . Any temperature above it will turn water into vapour (gas). Hence, the physical state of water at 250°C will be **gaseous**.

b. At 100°C , water starts boiling and exists in two states- **liquid** and **gaseous state**. This is because, at this temperature, the water transforms into gas.

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

Answer: The temperature remains constant during the change of state because the heat is used to cause transition of matter. This maintains a constant temperature during the process. This constant temperature is known as latent heat.

4.Suggest a method to liquefy atmospheric gases.

Answer: Atmospheric gases can be liquefied using two ways-

1. By lowering the temperature- When temperature drops, the matter converts from gas to liquid, a process known as condensation.
2. By increasing pressure- This works by compressing the molecules of the gases leading to reduction in the space between them and packing them closely together in limited space.

Exercise-1.5 (Page 10)

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

Answer: In order to understand the reason behind the above question, you would need to understand the working principle of a desert air cooler.

A desert air cooler works by initiating evaporation of water (on cooler pads) which, in turn, cools down the surrounding environment as the water when evaporates, absorbs the heat— latent heat of vaporization.

Back to the question, when the weather is hot and dry, the moisture in the air remains less concentrated and allows effective evaporation of water inside the cooler. In humid conditions, the environment becomes dense with moisture which restricts further evaporation of water from the cooler pads.

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

Answer: The earthen pot has tiny pores on its surface which allows the water to evaporate slowly. During evaporation, the evaporating water absorbs the heat from the

water in the pot. Since the water draws heat, the temperature of water in the pot lowers with evaporating water, keeping it cooler than the temperature outside. This can, thus, be used only in summers.

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

Answer: Evaporation absorbs heat as it is an endothermic process.

Volatile solvents like acetone, petrol, and perfume, evaporate from your skin easily and this rapid evaporation absorbs heat from your skin, rendering it cool. So, it's not the acetone or perfume that is cool, it is their rapid evaporation that leaves a cold feeling on the skin.

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

Answer: Surface area is directly proportional to the rate of evaporation.

Evaporation becomes faster with an increase in the surface area. When the hot tea from the cup is poured into a saucer, it cools down quickly due to the rise in the evaporation rate in the wide saucer.

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

Answer: In summer, people prefer wearing light coloured cotton clothes to enhance the rate of evaporation. Light colours absorb less heat and reflect more heat. The cotton clothes are porous and efficiently absorb the sweat. The absorbed sweat is exposed to the outer atmosphere resulting in the evaporation that lowers the temperature on the body.

Exercise (Main) (Page 12)

1. Convert the following temperature to the Celsius scale.

(a) 293K

(b) 470K

Solution:

As you know,

$$0^{\circ}\text{C} = 273\text{K}$$

Temp. on Celsius scale = temp. on the Kelvin scale - 273

(a) 293K

Temp. on Celsius scale = temp. on the Kelvin scale - 273

$$= 293 - 273$$

$$= 20^{\circ}\text{C}$$

(b) 470K

Temp. on Celsius scale = temp. on the Kelvin scale - 273

$$= 470 - 273$$

$$= 197^{\circ}\text{C}$$

2. Convert the following temperatures to the Kelvin scale.

(a) 25°C (b) 373°C

Solution:

$$0^{\circ}\text{C} = 273\text{K}$$

Temperature on Kelvin scale = Temperature on Celsius scale + 273

(a) 25°C

Temp. on Kelvin scale = Temp. on Celsius scale +273

$$= 25 + 273$$

$$= 298\text{K}$$

(b) 373°C

Temp. on kelvin scale = temp. on Celsius scale +273

$$= 373 + 273$$

$$= 646\text{K}$$

3. Give a reason for the following observations:

(a) Naphthalene balls disappear with time without leaving any solid.

(b) We can get the smell of perfume while sitting several meters away.

Solution:

- a) In many households, small naphthalene balls are kept in stored woollen and silk clothes to protect them from the attack of moths and other insects. It is noticed that these naphthalene balls disappear with time without leaving behind any residue. This is because naphthalene balls undergo **sublimation**. Sublimation means the changing of a solid directly into vapours on heating, and of vapours into solid on cooling. When volatile solids are heated, their particles move so quickly that they separate completely to form vapour or gas. Naphthalene is thus a volatile solid; therefore, it changes into vapour completely, and no solid is left behind.
- b) When an individual opens-up the perfume bottle in a particular corner of the room, the fragrance dissipates quickly throughout the room. The fragrance spreads as a result of the process of diffusion of the vapours of the perfume in the air. This process of diffusion pertains to the spreading and mixing of one substance with another as a result of the

particles being in motion. Diffusion is slowest in solids and quickest in gases; its rate increases along with an increase in the temperature of the diffusing particle.

Thus, when the bottle of perfume is opened, then the liquid perfume changes quickly into vapours. The perfume vapours move very rapidly in all directions in the air, mix with its particles, and, hence, spread with the air in the whole room.

4. Arrange the following in increasing order of forces of attraction between the particles – water, sugar, oxygen.

Solution:

Solids have the highest force of attraction, followed by a liquid, and then the gas has the least attractive forces. Therefore, the particles of solid are tightly packed, and the particles of gas are free to move.

Therefore,

- Oxygen (gas), (particles have the least force of attraction)
- Water (liquid), (particles have the force of attraction which is more than that of gases but less than that of solids)
- sugar (solid), (particles have the maximum force of attraction)

5. What is the physical state of water at-

(a) 25°C (b) 0°C (c) 100°C?

Solution:

a) 25°C

25°C is the normal room temperature; therefore, the water exists in liquid form.

b) 0°C

0°C is known as the freezing point of water and the melting point of ice.

Thus, at this point, water exists in both liquid and solid form. This happens because at this point, all the water which in the form of ice has not melted completely, thus some of the solid substance remains. At the same time, all the water in the form of the liquid has not frozen yet, so some of the liquid remains.

c) 100°C

100°C is also known as the boiling of water. When the water reaches this point of temperature, it starts boiling and starts turning into vapours. Thus, at this point, water is in both liquid and gaseous states.

6. Give two reasons to justify –

(a) Water at room temperature is a liquid.

(b) An iron almirah is a solid at room temperature.

Solution:

a) Water at room temperature is a liquid because of the following reasons:

1. At room temperature, the intermolecular forces are strong enough to keep its particles bound to each other. The particles are close together, but they are not as close as in solids. The particles are somewhat loosely packed but not as loose as in gases.
2. The boiling point of water is 100°C, which means that water starts boiling and turning into vapours at this temperature. The freezing point of water is 0°C, which means that water starts freezing and turning into ice at this temperature. Between 0°C and 100°C, the water remains in its liquid form only.

b) An iron almirah is solid at room temperature because of the following reasons:

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1. At room temperature, the almirah has a fixed shape because the particles of a solid are closely packed, and their positions are fixed due to strong forces of attraction between them. It has a fixed volume as well and a high density.
2. The melting and boiling points of iron are as high as 1538°C and 2862°C , respectively. The room temperature is about $20\text{-}35^{\circ}\text{C}$. Hence, at room temperature, iron almirah remains solid due to unattainable boiling and melting temperatures.

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

Solution:

Every substance has some forces of attraction between its particles that hold them together. It is essential for a substance to overpower the forces of attraction amongst its particles in order to change its state. This can be facilitated with the help of external heat that can, in turn, be utilized to overcome the attraction force amongst the particles while there is a change in its state. Latent heat is the heat energy that needs to be supplied in order to ensure a change in the actual state of a substance. As it is a 'hidden' heat, latent heat does not result in an actual change in the temperature because it is hidden in the substance that is experiencing a change in its state.

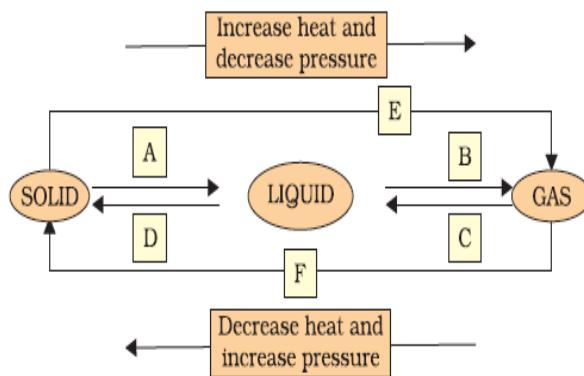
Ice is more effective in cooling than water at 273K because ice can absorb latent heat as well as heat energy in order to attain this temperature and the liquid form (this process is also known as the latent of fusion). Water at 0°C can absorb heat energy only to remain at this temperature. Thus, water can absorb less amount of energy from surroundings compared to ice due to which ice will give more cooling effect as compared to water at the same temperature.

8. What produces more severe burns, boiling water, or steam?

Solution:

When water changes into steam, it absorbs latent heat, but when steam condenses to form water, an equal amount of latent heat is given out. It has been found that the burns caused by steam are much more severe than those caused by boiling water though both of them are the same temperature of 100°C . This happens due to the fact that in steam, there is hidden heat in the form of latent heat, which is not present in boiling water. Consequently, when steam touches the skin and therefore condenses, it gives out a larger quantity of heat as compared to the boiling water at the same temperature. Therefore, as steam gives out more heat, the burns caused by it are also severe.

9. Name A, B, C, D, E, and F in the following diagram showing a change in its state.



Solution:

- A. Fusion or melting
- B. Vapourisation or boiling
- C. Condensation
- D. Solidification or freezing
- E. Sublimation
- F. Deposition



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