Characteristics of Matter

Matter-In Depth

Matter can be defined as anything that has both mass and volume and occupies a certain space in the universe. The air we breathe, the food we eat, the water we drink, the clothes we wear, the different plants and animals, stones, sand, etc., are all examples of matter.

Matter and non-matter: Matter can be distinguished from non-matter in terms of mass, volume, and space it occupies. A chair, a computer, a car, and a bridge are all examples of matter. Each of them has mass and volume, and also occupies space. Non-matter, on the other hand, cannot be measured in terms of mass and volume. It does not occupy any space either. Examples of non-matter include thirst, anger, love, and smell.

Can air be classified as matter?

Though air is invisible and intangible, it does have mass and volume. But it occupies space. Hence, air can be classified as matter.

Examples of matter and non-matter

Matter	Non-matter
Air, building, animal, plant, water, fruit, vegetable, chair, table, computer, car, book, pen, pencil, bag	Cold, hot, big, small, anger, love, song, lecture

Know More

We measure the mass of matter, and not its weight. This is because the mass of matter is constant, but its weight can vary from place to place. To calculate the weight of any object, we multiply its mass with the acceleration due to gravity (g) which varies from place to place. Consequently, the weight of the object varies as well.

The SI unit of mass is **kilogram**.

The CGS unit of mass is **gram**.

The FPS unit of mass is **pound**.

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

The common unit of measuring volume is **litre**.

$1 L = 1000 mL = 1 dm^3$

Characteristics of Matter

Let us investigate the characteristics of matter.

By now we know that the nature of matter is particulate and not continuous. The particles of matter have certain characteristics. The characteristics of particles of matter are as follows:

- Matter is made up of extremely small particles called **atoms**. Atom is the smallest possible unit of matter that exhibits all the properties of that matter.
- When atoms combine with one another, minute particles are formed, which are called **molecules.**
- The particles of matter have spaces between them.
- The particles of matter are in continuous motion.
- The particles of matter attract one another.

The Phlogiston Theory

- It was used to explain the combustion reactions during the seventeenth and eighteenth centuries.
- According to it,"any material undergoing combustion mainly contains a mysterious matter called phlogiston and also some clax."
- When a substance is burnt, the phlogiston goes into the surrounding and the clax is left as ash.
- During the burning of a candle in a closed container, the air present inside the container becomes saturated with phlogiston. No further phlogiston can be accommodated in the air and as a result, the candle gets extinguished.

Whiz Kid

While preparing sugar syrup, we dissolve sugar in water. However, after adding a certain amount of sugar, we observe that sugar does not dissolve anymore and gets settled at the bottom of the container. Why is it so?

The water is able to dissolve only up to a certain amount of sugar particles. Once its maximum capacity for dissolving the sugar particles is reached, it does not dissolve any more of them. In other words, there is no space left between the water particles to accommodate any more sugar particles. So, any additional sugar added simply settles at the bottom of the container.

Know More

Gas pressure

Particles of gas always move with high speed. Pressure is created when gaseous particles hit the walls of the container in which they are enclosed.

For example, you must have observed that the continuous blowing of a balloon causes it to burst. This is because the gas particles put pressure on the inner walls of the balloon. Excess blowing in of air increases the number of gas particles inside the balloon. As a result, the pressure of the gas increases and, ultimately, the balloon bursts.

The Solid State

States of Matter-An Overview

We know that everything is made up of matter, yet things exist in different forms. What makes things look different from one another?

Matter is a broad umbrella covering different sub-categories which we know as the **states of matter**.

The view of the hills during winters is ideal for observing the three main states of matter—solid, liquid and gas. Here, you can see heavy clouds which are nothing but collections of vapourised water particles. You can also see liquid water falling from these same clouds as rain. And of course, there is the dusting of snow which is in fact solidified water.

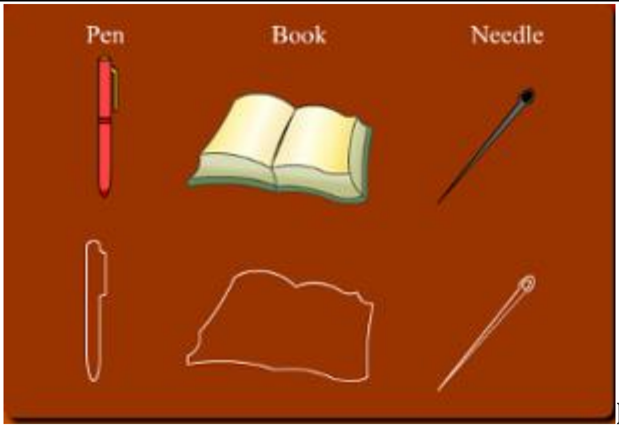
The different states of matter are:

- Solid
- Liquid
- Gaseous
- Plasma
- Bose-Einstein condensate

The Solid State

Matter is said to be solid if it has a fixed **shape** and a fixed **volume**. For example, a pen. It has a fixed shape and a fixed volume; hence, it is solid. Matter that does not have a fixed shape is not solid, as is the case with water. The particles of solids have a minimum or no kinetic energy and therefore the particles do not have any movement. The intermolecular spaces between the particles of solid are very small due to stronger attraction among the particles. Solids, therefore, cannot be compressed.

Activity Time



Procedure: Collect a pen, a book, and a needle. Trace the shapes of these materials in a notebook and compare the tracings. Also, try compressing each material.

Result: When you compare the tracings, you will observe that each material has a distinct shape and boundary. When you try compressing the materials, you will observe that each material has negligible [[mn: glossary]]compressibility[[/mn: glossary]].

Conclusions: The following conclusions can be made about a solid.

- It has a fixed shape, fixed volume, and a fixed boundary.
- There are very little **intermolecular** spaces in a solid. Hence, it has a tendency to maintain its shape. This means that it has negligible compressibility.
- It is **rigid**. It may break under force, but it is difficult to change its shape.
- It rarely **diffuses** in another solid. Example- Diffusion of chalk powder on a blackboard. This is the reason why it is difficult to clean (rub) a used blackboard that has not been cleaned for several days.

Whiz Kid

Solids have the following forms.

- **Crystalline**: Calcite (rhombic), fluorite (octahedral) and quartz (hexagonal) are crystalline solids.
- **Polycrystalline**: Metals are polycrystalline solids.
- **Amorphous**: Glass is an amorphous solid.
- **Polymeric**: Natural rubber is a polymeric solid.

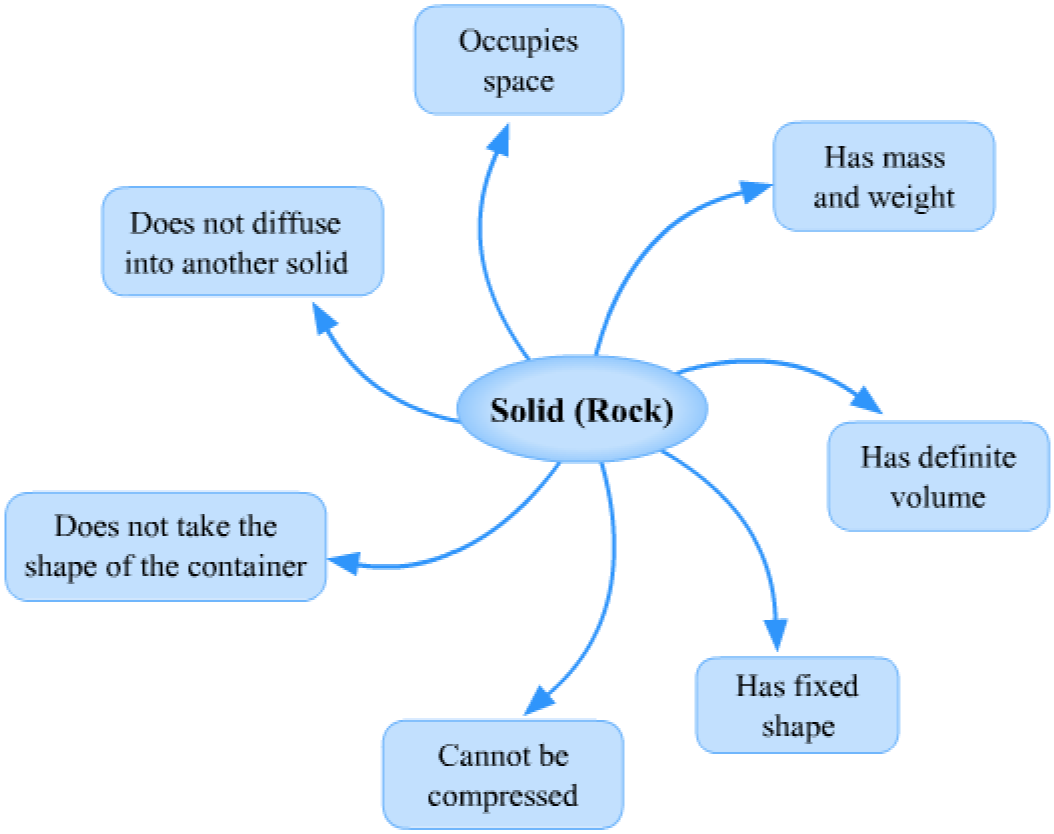
It is possible to stretch certain substances without breaking them. These substances are made up of long chains of atoms bonded together (usually carbon atoms bonded by covalent bonds). These substances are called polymeric substances. This is why the shape of rubber changes when stretched even though it is solid.

Did You Know?

Although sponge is solid, it can be bent and squeezed. Sponge has minute holes on its surface. Air is trapped in these holes. This air is expelled as we press or squeeze sponge. This makes it possible to bend and squeeze sponge.

The Solid State

The following diagram illustrates the properties of a solid.



The Liquid State

Unlike a solid, a liquid has no fixed shape. However, it does have a fixed volume. It takes the shape of the container in which it is kept. For example, water does not have a fixed shape, but its volume is fixed. When a certain volume of water is poured into a container, it takes the shape of the container, but its volume remains the same. On the other hand, a pen (which is a solid) has a fixed shape and volume. A liquid is not rigid, i.e., it flows freely. The intermolecular spaces in a liquid are greater than in case of a solid. Hence, a liquid has more compressibility than a solid. The particles of liquids have more kinetic energy than solid particles and therefore has greater speed than solid particles.

Characteristics of a liquid on the basis of the particle nature of matter

- A liquid does not have a fixed shape. It takes the shape of the container in which it is kept.
- A liquid has a fixed volume.
- It is not rigid, i.e., it flows freely.
- It has more compressibility than a solid. So, it can easily diffuse in other liquids.
- In most cases, the density of a substance in the liquid state is lesser than its density in the solid state.

Usually liquids have lower density than solids, yet ice floats in water. Can you say why?

Ice is lighter than water since a particular mass of ice occupies more space than the same mass of water. In ice, water molecules are closely packed because of the tight bonding between them. This makes ice lighter than water.

Know More

Solids, liquids and gases can diffuse in liquids. The dissolution of salt or sugar in water and the dissolution of ink in water are examples of the same. Gases such as oxygen and carbon dioxide diffuse and dissolve in water bodies. It is because of these gases that aquatic plants and animals are able to survive underwater.

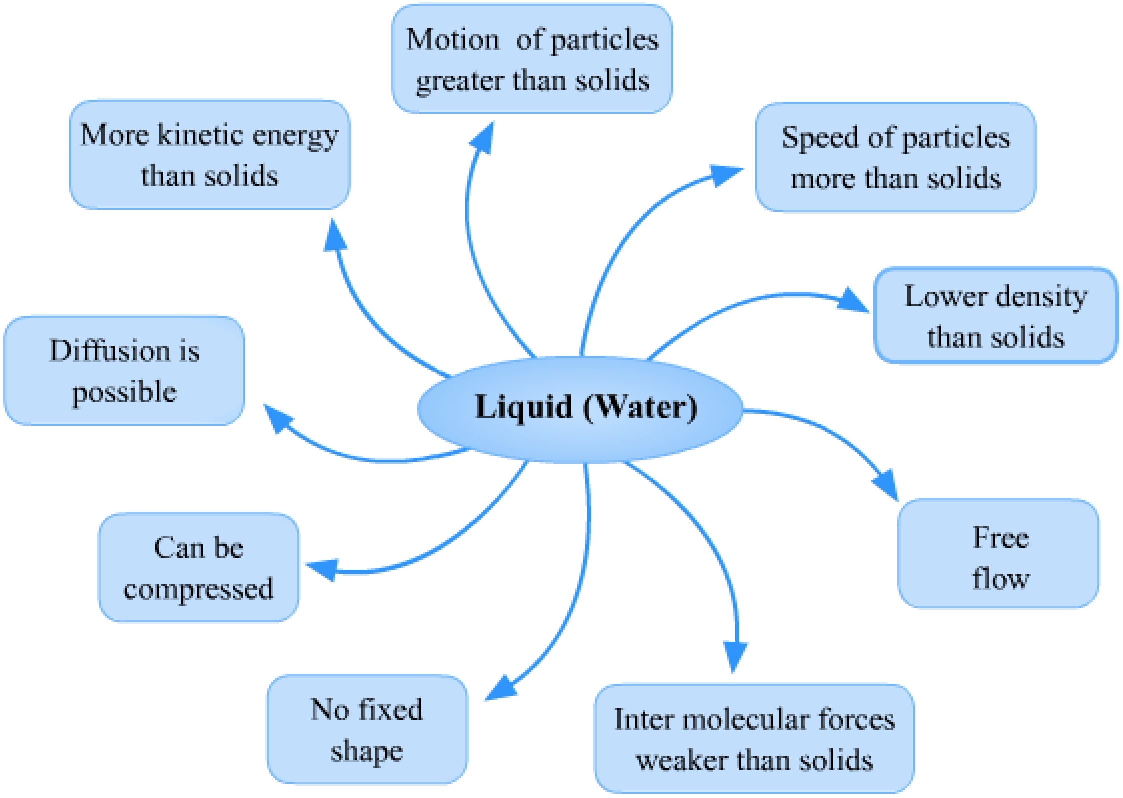
This high rate of diffusion in liquids is because of the fact that a liquid has larger intermolecular spaces.

Did You Know?

Bronze, an **alloy**, expands when its state changes from liquid to solid. This property of bronze is utilized in moulding statues.

The Liquid State

The following diagram illustrates the properties of a liquid.

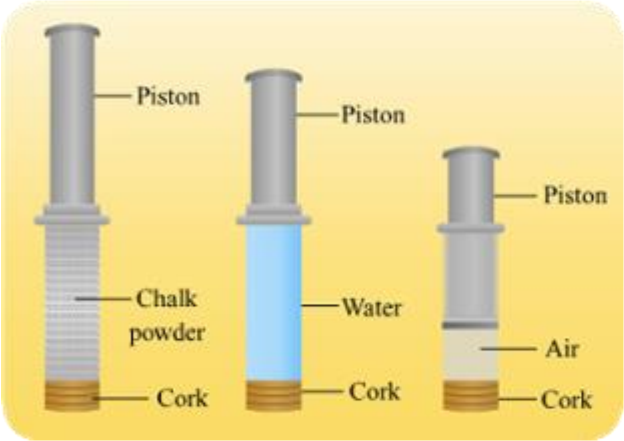


The Gaseous State

A gas neither has a fixed shape nor a fixed volume. Hence, it does not have a fixed boundary. It can flow in all directions and can be easily compressed. In a given space, the number of particles in a gas is lesser than in the case of a solid or a liquid. The constituent particles of a gas show a random motion because of the presence of large spaces between them. Consequently, the kinetic energy of the particles in a gas is more than in the case of a solid or a liquid. Due to the large distances between the particles, the forces of attraction between them are very low or negligible.

Activity Time

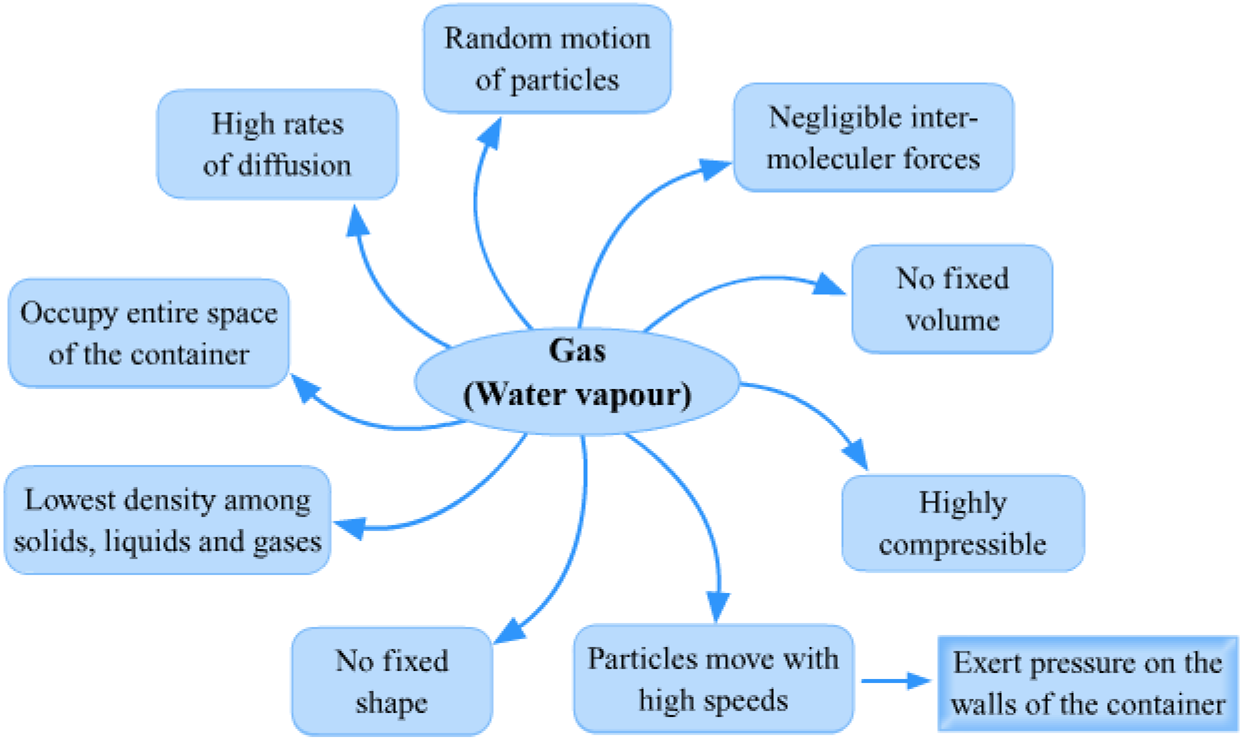
Procedure: Take three 100 mL syringes and remove their pistons. Close the nozzles of the syringes with rubber corks. Fill one syringe with chalk powder and another with water. Now, reinsert the pistons and push them.



Result: The force required to push the pistons of syringes containing chalk powder and water will be greater than that required to push the piston of the syringe containing air.

The Gaseous State

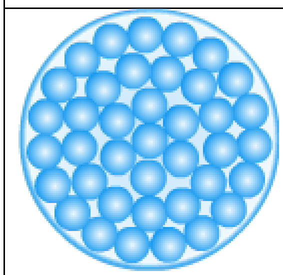
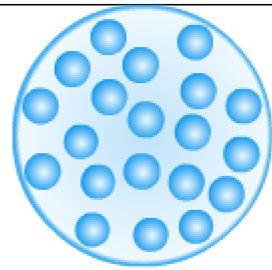
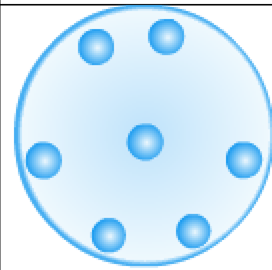
The following diagram illustrates the properties of a gas.



Differentiating between the Three States of Matter

Differentiating the Three States of Matter

Solid	Liquid	Gas

Definite shape Occupies space Definite volume Cannot be compressed Rigid Does not diffuse in other solids	No definite shape Occupies space Definite volume Slightly compressible Not rigid Can diffuse in other liquids	No definite shape Occupies space No definite volume Highly compressible Not rigid Can diffuse in other gases
 **Solid**	 **Liquid**	 **Gas**

Solved Examples

Easy

Questions	**Solid**	**Liquid**	**Gas**
Does it occupy space?			
Does it have a definite volume?			
Can it be compressed?			
Does it take the shape of the container enclosing it?			
Can it diffuse in a like state of matter?			

Example 1: **Answer the questions with a 'Yes' or a 'No' for each of the three states of matter.**

Solution:

Questions	**Solid**	**Liquid**	**Gas**
Does it occupy space?	Yes	Yes	Yes
Does it have a definite volume?	Yes	Yes	No
Can it be compressed?	No	Yes	Yes

Does it take the shape of the container enclosing it?	No	Yes	Yes
Can it diffuse in a like state of matter?	No	Yes	Yes

Differentiating the Three States of Matter

Solved Examples

Easy

Example 2:**Identify the state I'm in.**

Object	State
Glass	Bose-Einstein condensate
Welding arc	Solid
Liquid helium	Gas
Mercury	Plasma
Fog	Liquid

Solution:

i → b; ii → d; iii → a; iv → e; v → c

Medium

Example 3:

Guess who I am.

i) The container I'm placed in does not matter. My shape does not change. I'm ______.

ii) I'm flexible and particles can move with some speed. I'm ______.

iii) I possess highest kinetic energy and my particles move with high speed. I'm ______.

iv) I'm charged and have high temperature. I'm ______.

Solution:

(i) solid

(ii) liquid

(iii) gas

(iv) plasma

The Plasma and The Bose-Einstein Condensate

Plasma

This state of matter comprises super-energetic and super-excited particles. It was discovered in Crookes tube by Sir William Crookes in 1879.

Here are a few examples of plasma.

The sun, Fluorescent lights, Neon signs, Nebulae

Characteristics of plasma

- It is the most common state of matter found in the universe.
- Like a gas, it does not have a definite shape and volume.
- It is found in the sun, the stars, the interstellar space and the intergalactic space.
- High temperature is needed to maintain the ionization of the particles of plasma.
- Plasma is influenced by electric and magnetic fields.

Know Your Scientist

Sir William Crookes (1832–1919)

Sir William Crookes was a chemist and physicist of British origin. He is credited with the invention of Crookes tube. He discovered thallium and also identified the first known sample of helium. He developed Crookes tube to investigate cathode rays. In the course of his investigation, he discovered plasma—the fourth state of matter.

The Bose–Einstein condensate was discovered by Albert Einstein and S.N. Bose in 1924–25.

Characteristics of the Bose–Einstein condensate

- It consists of super-unenergetic and super-cold particles.
- It is formed when a gas of extremely low density is cooled to an extremely low pressure.
- It can be created with few elements. Rubidium is one such element.

The following properties are exhibited by Bose–Einstein condensate

- **Superfluidity:** It is the property by virtue of which matter shows frictionless flow at temperature near 0 K.
- **Superconductivity:** It is the property by virtue of which matter shows zero electrical resistance when cooled below a specified temperature.

Examples of Bose-Einstein Condensate are:

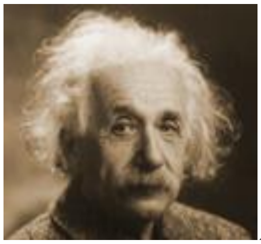
- Helium-4 cooled below 2.17 K
- A gas of rubidium atoms

Know Your Scientist

Satyendra Nath Bose (1894–1974)

Satyendra Nath Bose was a physicist of Indian origin. He specialized in mathematical physics. He is known for his collaborative theory on the Bose–Einstein Condensate—the fifth state of matter. He was awarded the Padma Vibhushan in 1954.

Albert Einstein (1879–1955)



Albert Einstein (1879–1955) was a physicist of German origin. He is credited with the development of the theory of relativity that revolutionized studies in physics. He is known as 'the father of modern physics'. His works include derivation of relationship between energy and mass as

$E = mc^2$ (where, E = energy, m = mass of a body and c = velocity of light). He received the Nobel Prize in Physics in the year 1921 for his contributions to physics and for the discovery of the laws of photoelectric effect.

Change of State-An Overview

In daily life, we see different kinds of changes in the states of matter. The formation of ice cubes from water in the refrigerator is an example of a change in the state of matter from liquid to solid. When water is boiled, vapours are formed. This is an example of change in the state of matter from liquid to gas.

The following terminologies are used to describe the changes in the states of matter.

- Change from the solid state to the liquid state is called **melting**.
- Change from the liquid state to the solid state is called **freezing**.
- Change from the liquid state to the gaseous state is called **vapourisation**.
- Change from the gaseous state to the liquid state is called **condensation**.

There are two other changes between the three states of matter—sublimation and deposition.

Sublimation: It is the process in which a substance changes directly from the solid state to the gaseous state without entering into the liquid state. The changing of snow into water vapour is an example of sublimation. Some common examples of substances that sublime are dry ice, camphor, and naphthalene.

Deposition: It is the process opposite to sublimation. In this, a substance changes directly from the gaseous state to the solid state. Frost is an example of deposition.

Did You Know?

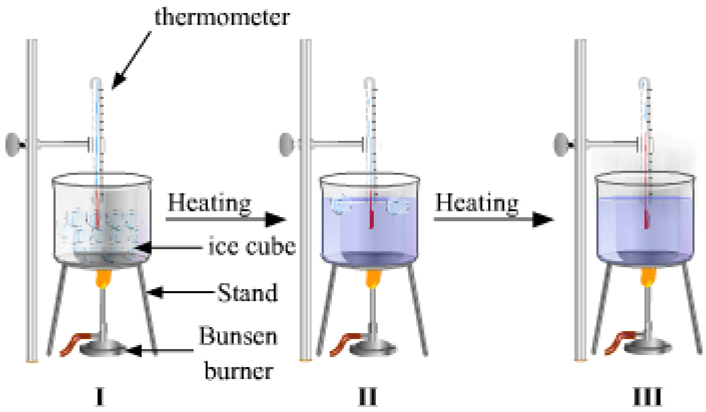
When we open the refrigerator, we see freezing fog. This is nothing but condensed water.

Air contains vapours. When we open the refrigerator, the temperature comes down. This condenses the vapours into tiny drops of water and produces freezing fog.

Temperature Affecting the Change of State

Let us perform an activity to understand the effect of temperature on the different states of matter.

Procedure: Take about 150 g of ice in a beaker and use a laboratory thermometer to note the temperature of ice. Start heating the beaker on a low flame and record the temperature when the ice starts melting. Observe the temperature when all the ice gets converted into water. Stir the water with a glass rod till it starts boiling.



Result: In the beginning, the temperature of ice is below 0°C. When ice begins melting, the temperature is recorded to be 0°C. Temperature remains constant at 0°C untill all the ice melts. The continued heating of water causes its temperature to rise.

Conclusion: It can be concluded from this activity that an increase in temperature changes a substance from its solid state to its liquid state, and further heating (i.e., further increase in temperature) changes the liquid so formed into vapour.

Temperature Affecting the Change of State

You know that matter, irrespective of its state, consists of particles. What happens to these particles of matter while it is undergoing a change in its state? For us to understand this, we need to first know that:

- The particles of matter possess kinetic energy.
- A force of attraction exists between any two particles.

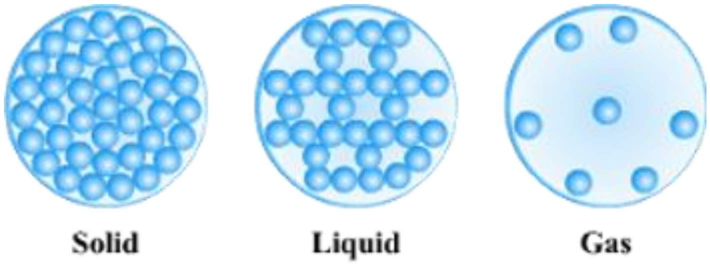
Kinetic energy of the particles of matter: A moving particle/object possesses a certain amount of energy because of its motion. This energy is called kinetic energy. The particles of matter are in constant motion. Therefore, they possess kinetic energy.

Particle-particle force of attraction: Every particle of matter attracts the particles near it. An increase in the distance between particles decreases the force of attraction between them. Conversely, a decrease in distance increases this force of attraction.

The given figure shows the kinetic energy of particles and the particle-particle force of attraction in the three states of matter.

Kinetic energy of particles: Gas > Liquid > Solid

Particle–particle force of attraction: Solid > Liquid > Gas



Temperature Affecting the Change of State

When a solid substance is heated, there is an increase in the kinetic energy of its constituent particles. As a result, the particles start vibrating with greater speed. This extra energy helps the particles to overcome the particle-particle force of attraction. Soon, they leave their positions and start moving more freely. Consequently, the substance melts into its liquid state. This is known as **melting point**. The melting point of ice is 0°C.

Liquids have a characteristic temperature at which they turn into solids. This is called **freezing point**. The freezing point of water is 0°C.

Further heating increases the kinetic energy of the liquid particles. This increases the velocity of the particles. At a certain temperature, they obtain enough energy to break free from the particle-particle force of attraction. At this point, the liquid changes into its gaseous state. This is known as **boiling point**. The boiling point of water is 100°C.

During the conversion of ice into water, the temperature remains constant until all the ice melts into water. The supplied heat is used up for changing water from its solid state to its liquid state. The heat energy is absorbed by the ice without showing any rise in temperature. This heat energy is called **latent heat**.

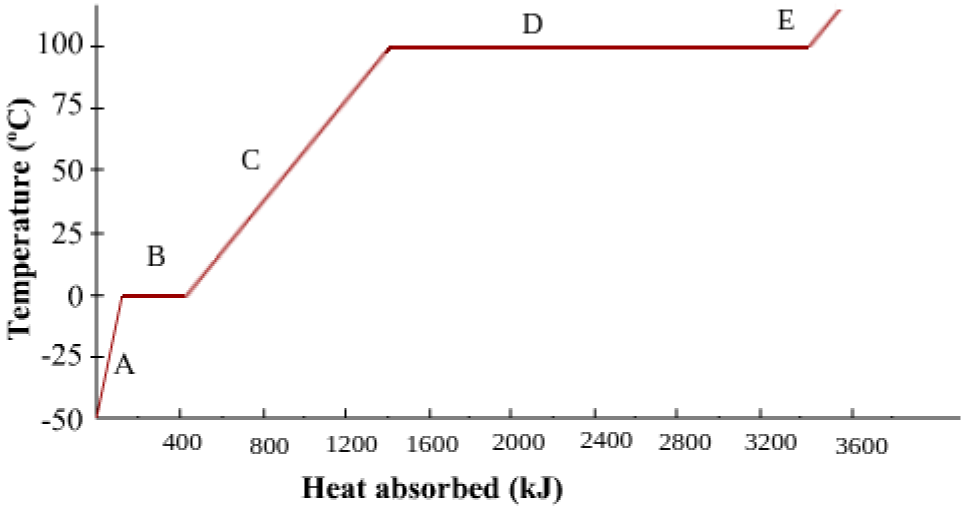
The amount of heat required to convert 1 kg of a solid into its liquid state without a change in temperature (i.e., at its melting point) is called **latent heat of fusion**. For ice, the latent heat of fusion is 334 kJ kg^{-1}. This implies 334 kJ of heat has to be provided to convert 1 kg of ice at 0°C into 1 kg of water at 0°C. Conversely, 334 kJ of heat is released when 1 kg of water freezes at 0°C to give 1 kg of ice at 0°C.

Know More

Latent heat of vapourization is the amount of heat required to convert 1 kg of a liquid into its vapour state without a change in temperature. For water, the latent heat of vapourization is 2260 kJ kg^{-1}. This means that 2260 kJ of heat must be provided to convert

1 kg of water at 100°C into 1 kg of vapour at 100°C. Conversely, 2260 kJ of heat is released when 1 kg of water vapour condenses at 100°C to give 1 kg of water at 100°C.

Heating curve



If the increase in temperature during heating and the absorbed heat are plotted on a graph, then the curvature which is formed is called the **heating curve**.

In the figure, 'A' represents the rise in the temperature of the substance in its solid state from
−50ºC to 0°C; 'B' shows the latent heat of fusion; 'C' shows the increase in the temperature of the substance in its liquid state from 0°C to 100°C; 'D' shows the latent heat of vapourisation, and 'E' shows the increase in the temperature of the substance in its gaseous state.

Solved Examples

Easy

Example 1:

If the melting point of a solid is high, then the _________ between the particles is stronger.

Solution:

force of attraction

Medium

Example 2:

Which has more energy: solid wax at 42°C or liquid wax at 42°C?

Solution:

Liquid wax at 42°C has more energy than solid wax at the same temperature.

Hard

Example 3:

Choose the process which will absorb heat/energy from the surroundings.

A.Conversion of ice into water

B.Conversion of water vapour into snow

C.Precipitation of water vapour as rain

Solution:

The correct answer is A.

Temperature Affecting the Change of State

Measuring Temperature

Three scales are commonly used for measuring temperature, namely, the **Celsius scale**, the **Fahrenheit scale**, and the **Kelvin scale.**

The relation between the Celsius and the Kelvin scale can be expressed as C + 273 = K

The relation between the Celsius and the Fahrenheit scale can be expressed as follows:

$$\frac{C}{5} = \frac{F-32}{9}$$

Example: 30°C can be expressed as 303 K and 86 °F.

Celsius to Kelvin: 30 + 273 = 303 K

Celsius to Fahrenheit:

$$\frac{30}{5} = \frac{F-32}{9}$$
$$\Rightarrow 6 = \frac{F-32}{9}$$
$$\Rightarrow 54 = F-32$$
$$\Rightarrow F = 86$$

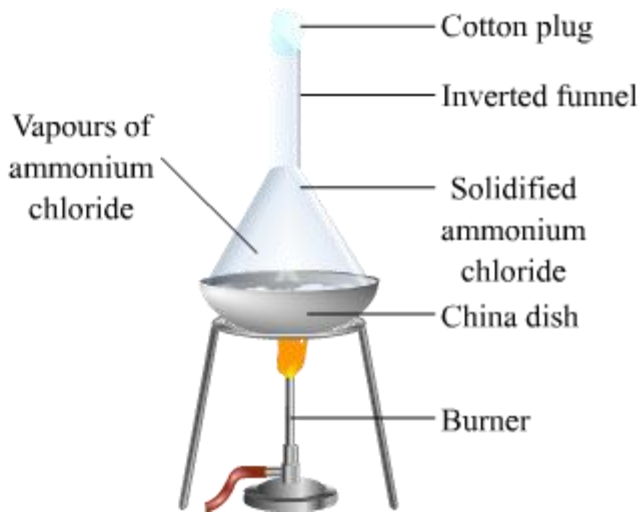
Did You Know?

Cool Facts

- The temperature zero Kelvin is known as absolute zero. Nothing can be colder than zero Kelvin.
- Dry ice is frozen carbon dioxide. Its temperature is −78.5°C. It turns directly into carbon dioxide gas without undergoing a liquid phase. Its sublimation characteristic and super-cold temperature make dry ice suitable for refrigeration. It is commonly used to export frozen materials across long distances.

Whiz Kid

Take some ammonium chloride salt in a china dish. Crush the salt and cover the dish with a funnel, as shown in the figure. Plug the stem of the funnel using some cotton. After this, start heating the dish slowly using a burner.



Result of the activity:

Upon heating, ammonium chloride will vapourise without transforming into its liquid form (**sublimation**). Later, the vapours will get cooled on the walls of the funnel and will directly convert into solid ammonium chloride (**deposition**).

Note: The same activity can be done using camphor or naphthalene.

Pressure Affecting the Change of State

We know that change in temperature affects the state of matter. Change in pressure, too, affects the state of matter. Let us see how.

We have a gas in a closed container. Say, we put some weight on the lid of the container. This increases the pressure on the container, which in turn causes the gas particles to come close to one another. As a result, the kinetic energy of the particles reduces. Nevertheless, the particles are still quite far away from one another and, hence, are still in the gaseous state. When the pressure on the container is increased further, the gas particles come very close to one another. Gradually, the gas **liquefies**.

Did You Know?

Water boils below 100°C (at approx. 92°C) in Mussoorie.

Mussoorie is a hill station set at a height of about 2000 m above sea level. Atmospheric pressure decreases as you go up from the sea level. Decrease in pressure lowers the boiling point of water below 100°C.

Whiz Kid

Liquid crystals are believed to be an independent state of matter as their properties lie in between those of liquids and solid crystals. They exist in a specific temperature range. They behave as solids below that temperature range and as liquids above that temperature range.

Know More

Why we need to liquefy gases

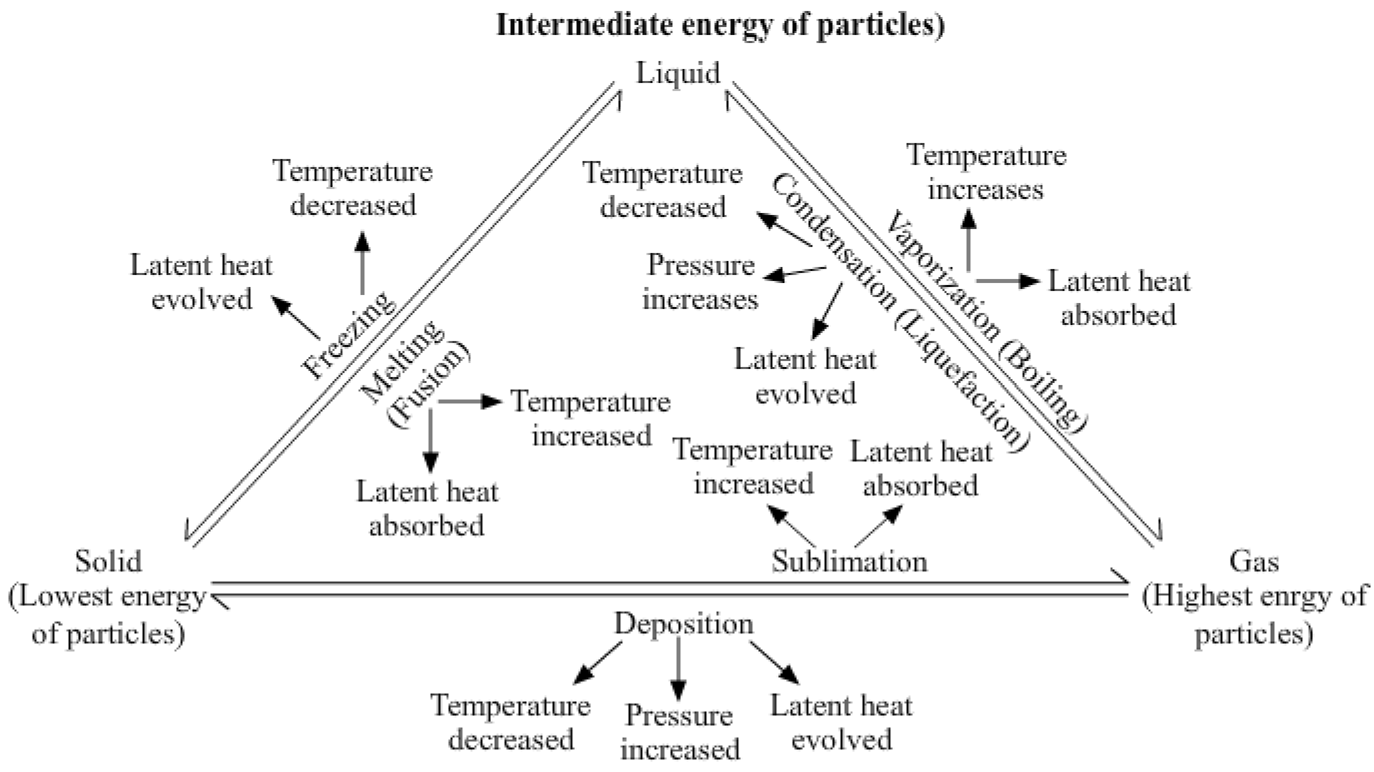
Together with low temperature, high pressure is generally used to liquefy gases.

A highly combustible gas is released during the fractional distillation of crude oil. This gas is known as petroleum gas. Petroleum gas is also trapped over the reserves of oil present beneath Earth's crust. Petroleum gas is liquefied by applying high pressure and low temperature. This is known as liquefied petroleum gas or LPG. LPG is used as a domestic fuel.

Other uses of liquefaction of gases

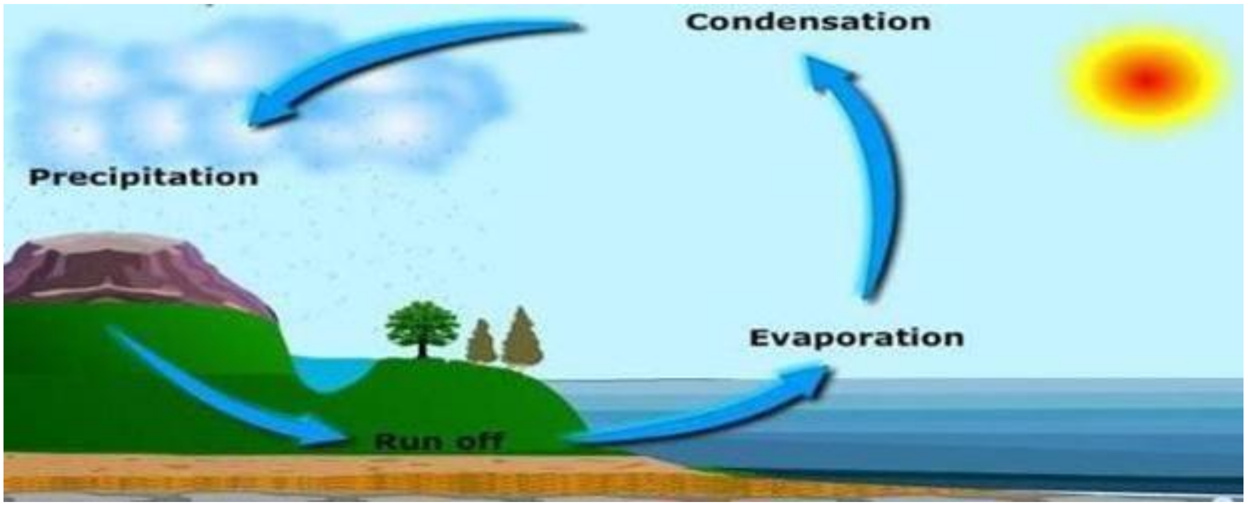
- Liquefaction of gases is helpful for their easy storage and transportation.
- Liquefied gases can be used in various fields; for example, in air conditioning and refrigeration systems (gases used are liquid ammonia and liquid sulphur dioxide).
- Liquid oxygen is supplied to hospitals for patients. It is also used as a rocket propellant.
- Liquid nitrogen is used in **cryosurgery**.
- Liquid chlorine is supplied to water treatment plants for purification of water.
- Liquid hydrogen in combination with liquid oxygen forms the fuel for rocket propulsion.

Inter-Conversion among Solids, Liquids, and Gases



Evaporation

Evaporation: A Brief Overview



The circulation of water on our planet Earth takes place in a cyclic manner. This cyclic process is known as the **water cycle**.

Evaporation is the process in which physical state of a substance changes from liquid state to gaseous at a temperature below its boiling point.

Evaporation depends on the following factors.

- Humidity
- Temperature
- Wind speed
- Surface area

Humidity

When the humidity is high during summer days, we feel more hot and sweaty than usual. Why is this so?

High humidity means that the air surrounding us is rich in water vapours and, hence, has a lesser tendency to take up more water vapours. In consequence, when we sweat, the sweat takes longer to vaporize. This is the reason why we feel particularly hot and sweaty in times of high humidity.

Temperature, Wind Speed and Surface Area

Temperature, Wind Speed and Surface Area

There are two conditions in which the earlier activity is carried out:

- The hot and windy condition under the running fan
- The cold and non-windy condition inside the closet

The test tube and the first china dish are placed in the hot and windy condition. In this case, the rate of evaporation of water is high because of the following factors.

- Moving air (running fan)
- High temperature

Now, between the china dish and the test tube, the surface area of the former is more than that of the latter. As a result, the rate of evaporation is higher in case of the china dish than in case of the test tube.

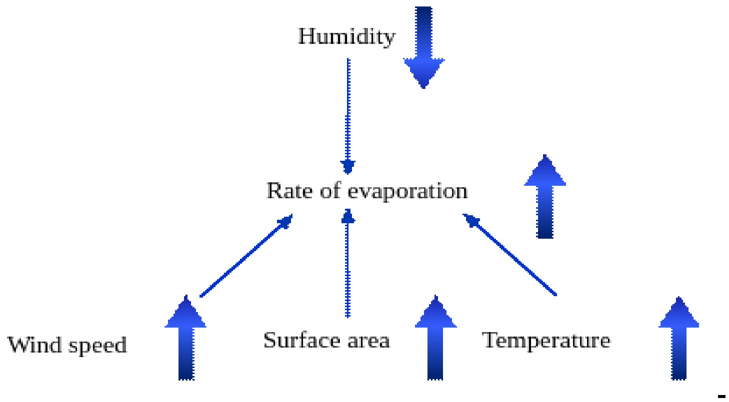
The second china dish is placed in the cold and non-windy condition. In this case, the rate of evaporation of water is low because of the following factors.

- No moving air
- Low temperature

Also, as the water evaporates, the humidity inside the closed space of the closet rises. Consequently, the rate of evaporation decreases.

So, the rate of evaporation (r. o. e.) of water with respect to each container is as follows:
r. o. e. from the first china dish > r. o. e. from the test tube > r. o. e. from the second china dish

Conclusion



Project Ideas

Clouds in a Bottle

- Add one to two teaspoons of water in a plastic bottle and shake it well so that the water spreads across the walls of the bottle.
- Next, put a lit splinter in the bottle. This will cause the water inside to evaporate. As the water vapours rise, they will condense on the smoke particles to form clouds.
- Link this activity to atmospheric cloud formation as a result of evaporation and to the types of clouds formed depending upon the height where water vapours condense.

Solved Examples
Medium
Example 1:
The rate of evaporation in a lake will be higher on a _________.
1. hot and dry summer day
2. hot and humid summer day

Solution:
The correct answer is A.

The rate of evaporation will be higher on a hot and dry summer day. This is because the air will not contain as much water vapour as it will on a hot and humid day.

Example 2:
Which of the following will dry faster?

1. **A cloth hanging on a wire**
2. **A cloth lying on a flat floor**

Solution:
The correct answer is A.

A cloth hanging on a wire will have more surface area exposed for evaporation as compared to a cloth lying on a flat floor.

Easy

Example 3:

We feel cold after bathing in cold water during summers. This is because of ________.

1. **condensation**
2. **evaporation**

Solution:

The correct answer is B.

The evaporation of water from the body causes the body to cool.

Did You Know? Cetyl alcohol is sprayed as a layer on the water in the reservoirs to reduce evaporation.

Here are a few examples showing the cooling effect of evaporation.

1. Water present in an earthen pot remains cool: An earthen pot has minute pores all across its surface. Water keeps coming out of these pores. This water absorbs heat from the pot and evaporates. Consequently, the water present inside the pot remains cool.

2. The skin becomes cool when deodorant or perfume is sprayed: Perfumes and deodorants contain alcohol—a highly volatile substance. When deodorant is applied to the skin, it absorbs heat from the area and gets evaporated. This is the reason why the skin becomes cool when sprayed with deodorant or perfume.

3. We perspire more during summers. The water molecules present in our sweat absorb heat energy from our body and change into vapours. Consequently, the body gets cooled because of this loss of heat.

4. People sprinkle water on the roof during a hot sunny day. This is done as the sprinkled water absorbs heat from the roof and changes into water vapours. The roof cools as a result of the loss of heat.

5. During summers, people prefer to wear cotton clothes: Cotton absorbs water and also allows air to pass through itself. This aspect of cotton makes it the preferred material for clothes worn during summers. Cotton clothes absorb sweat and expose it to air. As a result, the sweat evaporates and heat energy (equal to the latent heat of vaporization) is lost by the body. This cools the body.

6. A desert cooler gives cool air. The water in the cooler is sprinkled onto the pads by the pump. This allows easy evaporation. The air outside the cooler is pulled in through the moist pads where it is cooled by evaporation. The cooled air is then pushed out of the cooler by the fan.