पु•ना International School

Shree Swaminarayan Gurukul, Zundal

Class -IX

Science (Chemistry)

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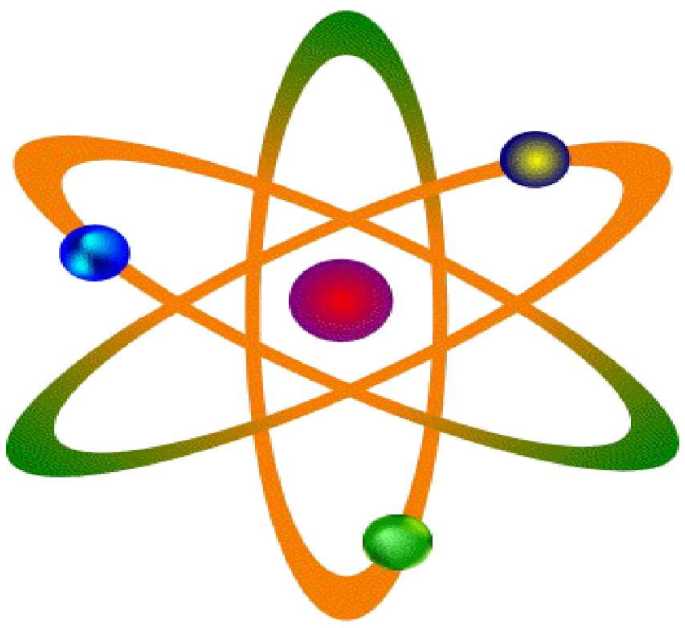
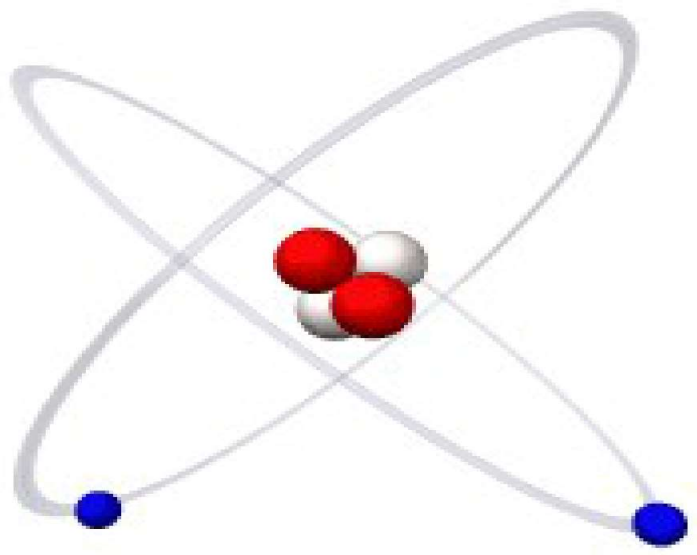
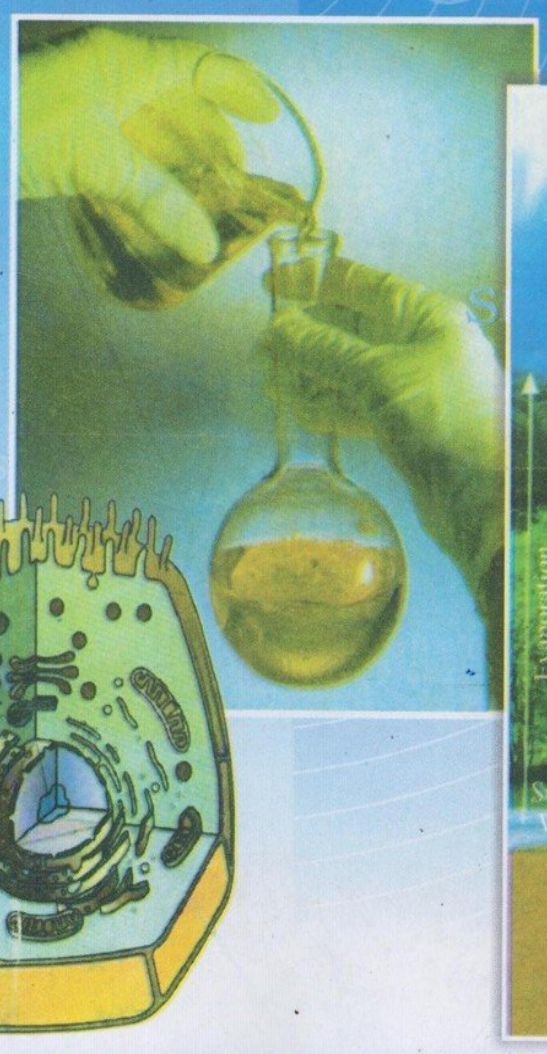
Year- 2020-21

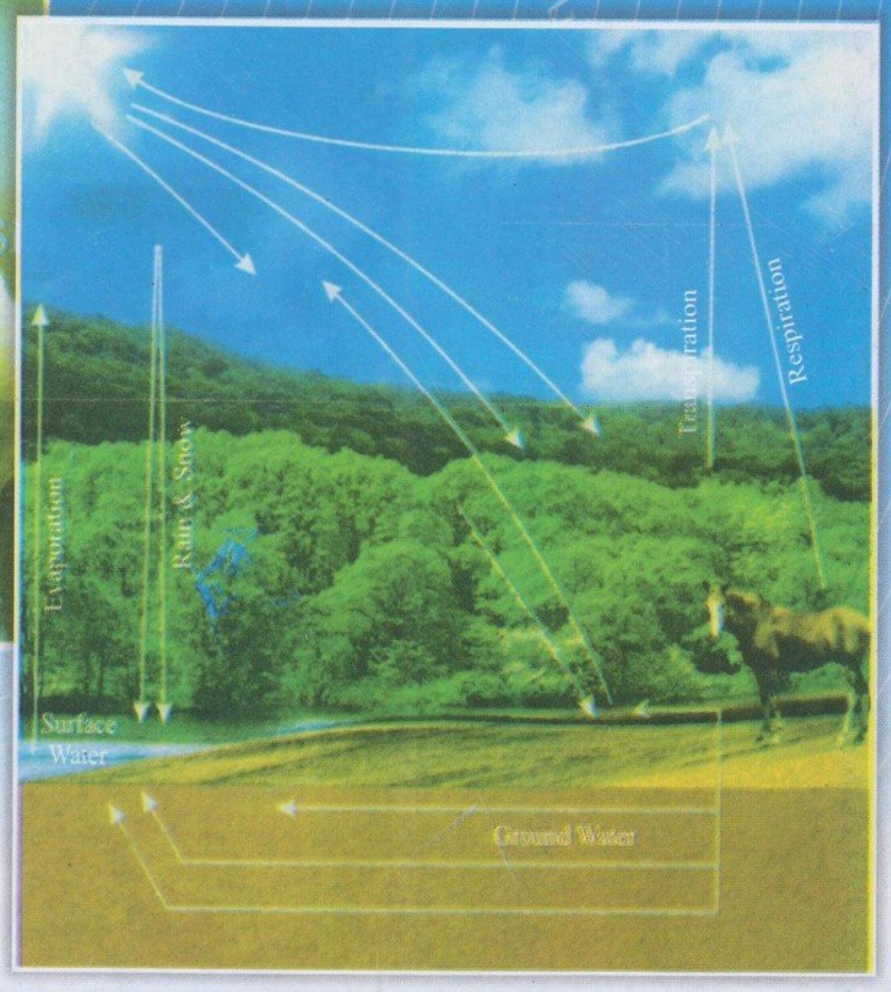




SCIENCE

Textbook for Class IX





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CHAPTER - 1
MATTER IN OUR SURROUNDINGS

1a) Matter :-

Matter is anything which occupies space and has mass.

b) Classification of matter :-

- **Early Indian philosophers classified in the form of five basic elements as air, earth, fire, sky and water called Panch Tatva.**
- **On the basis of the physical state matter is classified as solids, liquids and gases.**
- **On the basis of chemical composition matter is classified as pure substances and mixtures.**

Pure substances may be elements or compounds.

Mixtures may be homogeneous mixtures or heterogeneous mixtures.

2) Physical nature of matter :-

i) Matter is made up of particles.

ii) The particles of matter are very tiny.

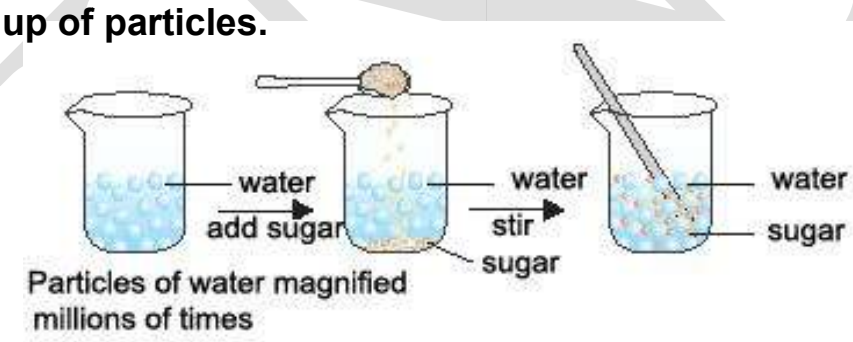
iii) The particles of matter have space between them.

iii) The particles of matter are continuously moving.

iv) The particles of matter attract each other.

a) Matter is made up particles :-

Activity :- Take some water in a beaker and note its level. Dissolve some salt or sugar in it with the help of a glass rod. The salt dissolves in the water but the level of water does not change. This is because the particles of water get into the space between the particles of water. This shows that matter is made up of particles.

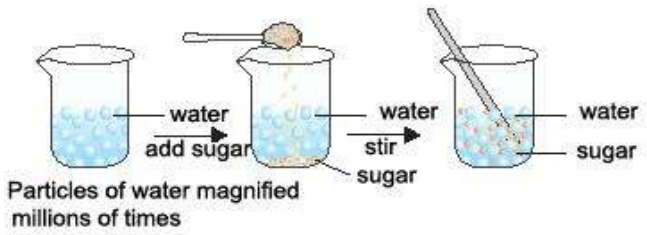


b) The particles of matter are very tiny :-

Activity :- Dissolve 2 – 3 crystals of potassium permanganate in 100ml of water in a beaker. Take 10ml of this solution and dissolve in 100ml of water. Take 10ml of this solution and dissolve in 100ml of water. Repeat this process 5 – 6 times. This shows that a few crystals of potassium permanganate can colour a large volume of water because there are millions of tiny particles in each crystal.

C) The particles of matter have space between them :-

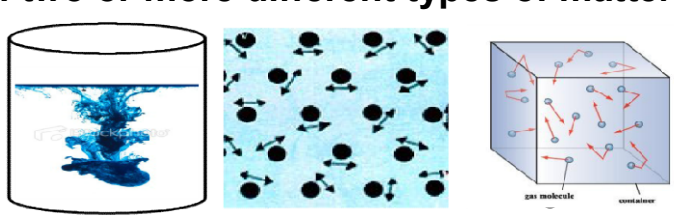
Activity :- Take some water in a beaker and note its level. Dissolve some salt or sugar in it with the help of a glass rod. The salt dissolves in the water but the level of water does not change. This is because the particles of salt get into the space between the particles of water.



d) Particles of matter are continuously moving :-

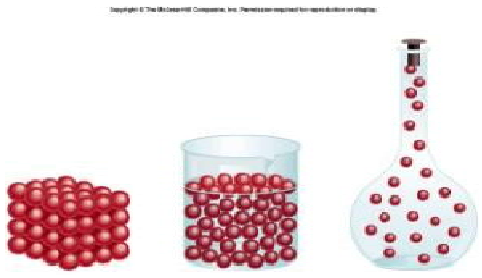
Activity :- Take some water in a beaker and put a drop of blue or red ink slowly along the sides of the beaker. Leave it undisturbed for a few hours. The ink spreads evenly throughout the water due to the movement of the particles of water and ink.

The intermixing of two or more different types of matter on their own is called diffusion.



e) **Particles of matter attract each other** :-

Activity :- **Take an iron nail, a piece of chalk and a rubber band. Try breaking them by hammering, cutting or stretching. It is more easier to break the chalk, less easier to break the rubber band and difficult to break the iron nail. This is because the particles in the iron nail are held together with greater force than in the rubber band or chalk.**

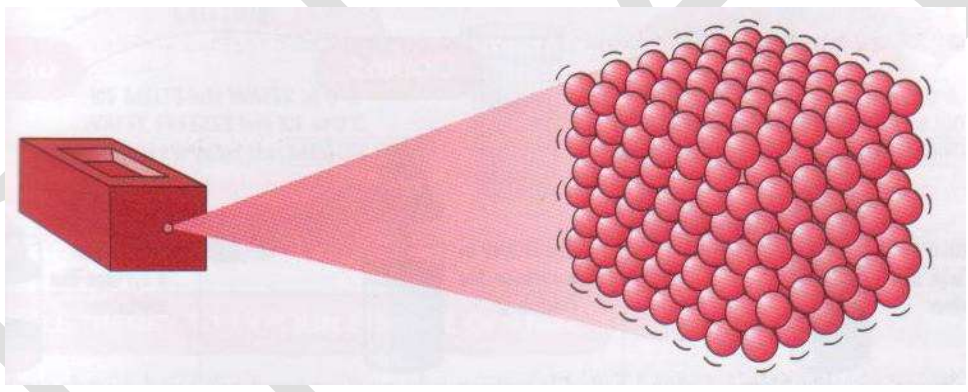


3) **States of matter** :-

Matter exists in three different states. They are :- i) Solid ii) Liquid iii)Gas

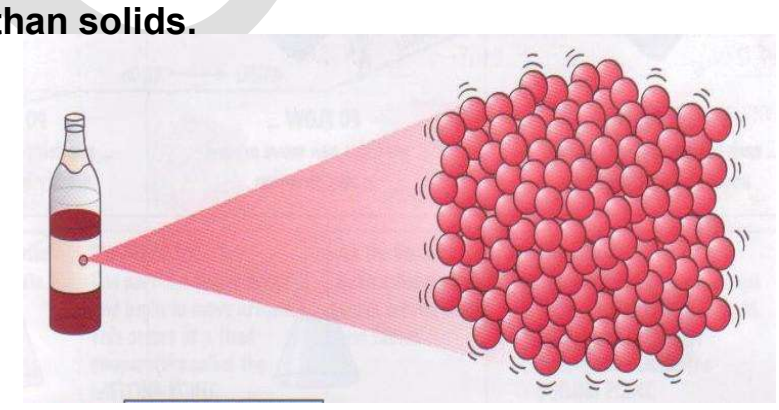
a) **Properties of solids** :-

i) **Solids have definite shapes and fixed volume.**
ii) **The space between the particle is minimum.**
iii) **The force of attraction between the particles is maximum.**
iv) **The movement of the particles is minimum.**
v) **They are least compressible.**
vi) **Their rate of diffusion is least.**



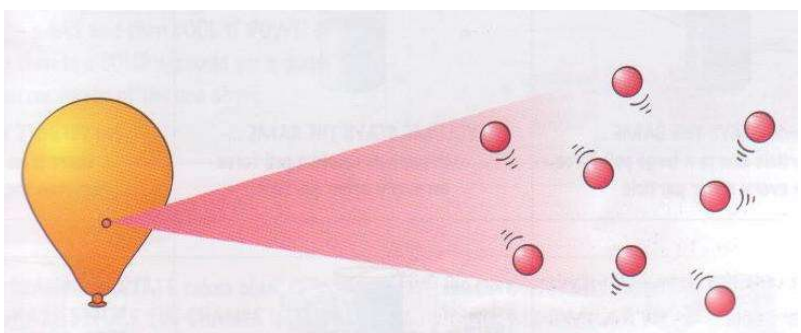
b) **Properties of liquids** :-

i) **Liquids have no definite shape but have fixed volume. Liquids take the shape of the container.**
ii) **The space between the particles is intermediade.**
iii) **The force of attraction between the particles is intermediate.**
iv) **The movement of the particles is intermediate.**
v) **They are less compressible.**
vi) **Their rate of diffusion is more than solids.**



C) **Properties of gases** :-

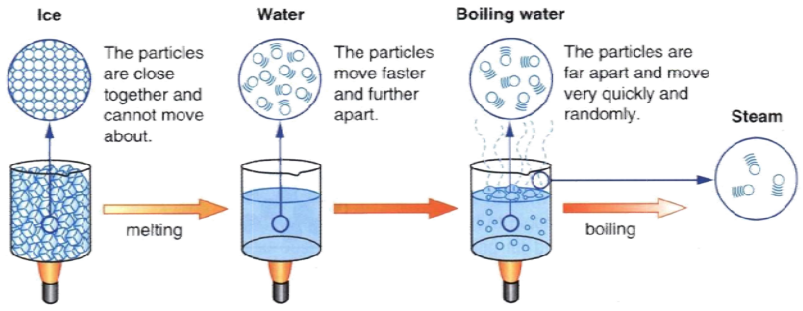
i) **Gases have no definite shape or fixed volume. Gases occupy the whole space of the container.**
ii) **The space between the particles is maximum.**
iii) **The force of attraction between the particles is minimum.**
iv) **The movement of the particles is maximum.**
v) **They are most compressible.**
vi) **Their rate of diffusion is more than solids and liquids.**



4) **Change of state** :-

When a solid is heated it changes into liquid. When a liquid is heated it changes into gas. When a gas is cooled it changes to liquid. When a liquid is cooled it changes into solid.

Eg:- If ice is heated it changes into water. If water is heated it changes into steam. If steam is cooled it changes into water. If water is cooled it changes into ice.



▲ Changes of state in matter.

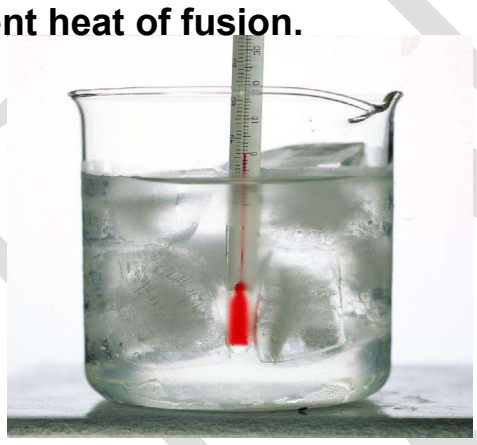
a) **Melting (Fusion)** :-

When a solid is heated, the particles begin to vibrate with greater speed and begin to move more freely. Then at a particular temperature the solid melts and changes into liquid. The process of melting is also known as fusion.

The temperature at which a solid melts is called its melting point. The melting point of ice is 00C or 273 K.

Latent heat of fusion :-

The amount of heat energy required to change 1kg of a solid into liquid at atmospheric pressure at its melting point is called the latent heat of fusion.



b) **Boiling** :-

When a liquid is heated, its particles begin to move even faster. Then at a particular temperature the liquid begins to boil and changes into gas (vapour).

Boiling is a bulk phenomenon. When a liquid boils the bulk of the liquid changes into vapour.

The temperature at which a liquid starts boiling is called its boiling point. The boiling point of water is 1000C or 373K (273 + 100).

Latent heat of vaporisation :-

The amount of heat energy required to change 1kg of a liquid into gas at atmospheric pressure at its boiling point is called the latent heat of vaporisation.

c) **Sublimation** :-

The change of state directly from solid to gas or from gas to solid is called sublimation.

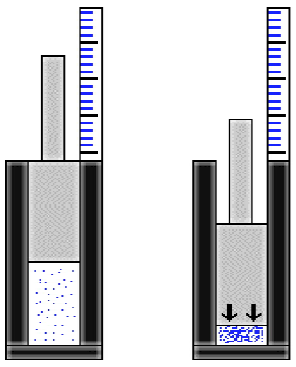
Eg :- If solid camphor or ammonium chloride is heated, it changes into vapour. If the vapours are cooled it changes into solid.

d) **Effect of pressure on gases** :-

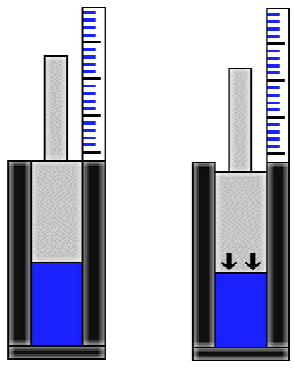
When pressure is applied on gas the particles come closer and the gas changes into liquid.

We can liquefy gases by applying pressure and reducing the temperature.

Compressed solid carbon dioxide is called dry ice. If the pressure is reduced it changes directly to gas without coming into liquid state. So solid carbon dioxide is known as dry ice.



GAS



LIQUID

5) Interconversion of the three states of matter :-

The states of matter are inter convertible. The state of matter can be changed by changing the temperature or pressure.

6) Evaporation :-

a) Evaporation :-

The change of a liquid into vapour at any temperature below its boiling point is called evaporation.

Evaporation is a surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction and changes to vapour state.

b) Factors affecting evaporation :-

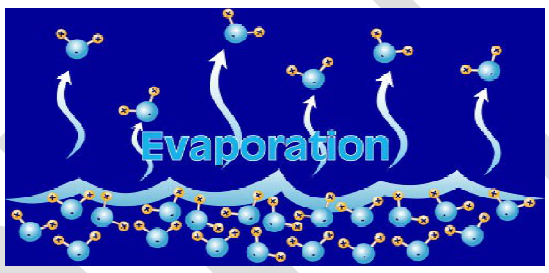
The rate of evaporation depends upon surface area, temperature, humidity and wind speed.

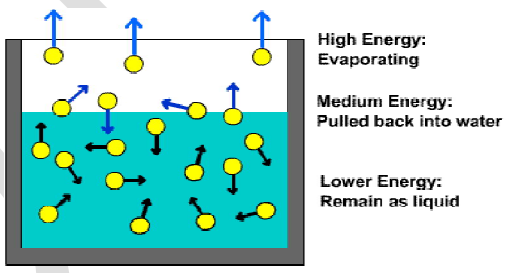
Increase in the surface area increases the rate of evaporation.

Increase in temperature increases the rate of evaporation.

Increase in humidity decreases the rate of evaporation.

Increase in wind speed increases the rate of evaporation.





c) Evaporation causes cooling :-

When a liquid evaporates, the particles of the liquid absorb heat from the surroundings and evaporates. So the surroundings become cold.

Eg :- People sprinkle water on the roof or open ground because during evaporation water absorbs heat makes the hot surface cool.

During summer we sweat more because during evaporation the sweat absorbs heat from our body making the body cool.

Wearing cotton clothes in summer keeps us cool because cotton absorbs sweat and when the sweat evaporates it absorbs heat from our body making the body cool.

Intext Exercise

(Page No. 3)

1. Which of the following are matter?

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

Ans. Chair, air, smell, almonds, cold drink and smell of perfume are matter.

2. Give reasons for the following observation:

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

Ans. Since hot sizzling food has temperature higher than cold food and at higher temperature diffusion rate (movement) of particles is very fast, due to this the smell of hot sizzling food reaches us from several metres away.

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

Ans. If diver has ability to cut through water in a swimming pool then it shows that the particles of matter have a kind of force working between them. Because of this force the particles of matter remain together till some external force is applied.

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

Ans. The characteristics of particles of matter are as follows:

i) Particles of matter have spaces between them.

ii) Particles of matter are in continuous motion.

iii) Particles of matter have an attractive force between them to keep them together.

(Page No. 6)

1. The mass per unit volume of a substance is called density.

(density = mass/volume).

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

Ans. Arranging substances in their increasing order of densities:

Air< exhaust from chimneys< cotton< water< honey< chalk< iron.

2. (a) Tabulate the differences in the characteristics of states of matter.

(b) Comment upon the following:

rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and density.

Ans. (a)

Solid	Liquid	Gas
Particles are rigid and uncompressible.	Particles are not rigid but can be compressed to limited extent.	Particles are not at all rigid and can be compressed easily.
They possess a definite shape and volume.	They have only a definite volume but acquire shape of container in which they are kept.	They don't have a definite shape or volume.
They don't have the ability to flow.	They can easily flow from higher to the lower level.	They can flow in all the possible directions.
Example: salt, sugar, chalk, gold, silver etc.	Example: water, alcohol, diesel, petrol etc.	Example: air, CNG, smoke etc.

(b) Rigidity→ It is the property of matter to maintain its shape even if external forces work and the solids show this property.

Compressibility → It is the property of matter to allow decrease in volume under high pressure and the gases show this property.

Fluidity → It is the property of a substance to easily flow and allow change in its shape under external forces and this property is exhibited by both liquids and gases.

Filling a gas container → Gases can be compressed easily hence they can be filled within a vessel at high pressure. This property of gases allows their convenient filling into a small container or cylinder and that also in a large volume. It also allows their easy transport from one place to the other e.g. CNG.

Shape→ According to the type of matter shape differs depending upon location of particles like solids have definite shape while liquids acquire the shape of their container and gases as such don't have any shape.

Kinetic energy → It is the kind of energy present in an object when it is under motion as the particles of that object/matter are continuously moving therefore matter has kinetic energy. However greater is the movement more will be the kinetic energy and vice-a-versa i.e. solid < liquid < gas.

Density → Mass per unit volume of a substance/matter is known as its density i.e. density = mass/volume

3. 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 to do the same through a solid block of wood we need a karate expert.

Ans.(a) Since the attraction force between particles of a gas is negligible i.e. extremely less hence particles freely move/flow in all possible directions as a result gas fills completely the vessel in which it is kept.

(b) Freely moving particles of gas hit the walls of its container continuously and randomly therefore such random and erratic motion of gas particles exerts pressure on the walls of the container.

(c) The wooden table particles are quite rigid, have a fixed location and also possess a definite shape and volume. Due to all these properties we should call a wooden table a solid substance.

(d) Air is a mixture of gases and since particles of gas are far apart so same is true for air therefore we can easily move our hand in air. But a solid block of wood is hard and rigid that resists any change in location of its particles hence we need a karate expert in case of a solid block of wood.

4. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why.

Ans. When water freezes to form ice,some empty spaces are created. As a result,volume increases for the same mass of water. In other words, mass per unit volume or density of ice is lower than that of water and hence ice floats over water.

(Page No. 9)

1. Convert the following temperature to Celsius scale:

i) 300 K

ii)573 K

Ans. i) $K = 273 + °C$

$°C = K - 273 = 300 - 273 = 27°C$

ii) $°C = 573 - 273 = 300°C$

2. What is the physical state of water at:

a. $250°C$

b. $100°C$

Ans. a) 100∘∘C is the boiling point of water. Therefore, at 250∘∘C i.e. at a temperature higher than its boiling point is gaseous.

b) At 100∘∘C, the boiling point of water, water exists both as a liquid as well as a gas.

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

Ans. During the change of state the heat or energy provided to particles of matter is utilized in overcoming the forces of attraction of the particles as a result the temperature of substance or matter remains constant during change of state.

4. Suggest a method to liquefy atmospheric gases.

Ans. If we decrease temperature and increase pressure we can liquefy the atmospheric gases.

(Page No. 10)

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

Ans. A hot dry day means that the temperature of the atmosphere is high and humidity of air is low. Both these factors increase the rate of evaporationand thus enormous cooling is produced.

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

Ans. During summers the water present on the surface of the earthen pot evaporates which causes the cooling effect. Besides, earthen pot bears pores on it hence evaporation occurs continuously and so a large amount of cooling is produced.

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

Ans. Some liquids get quickly vaporized and they are called volatile liquids. Acetone, petrol and perfume are also volatile liquids therefore they get heat from our palm and cause cooling.

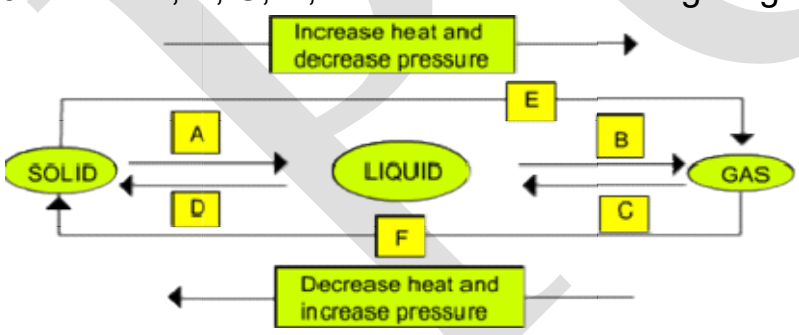
4. Why are we able to sip hot tea or milk faster from a saucer rather than a cup?

Ans. Saucer has a bigger surface area as compared to cup. Since evaporation is a surface phenomenon, by using a saucer instead of cup we are increasing the surface are for evaporation to occur. Faster evaporation of particles of tea or milk allows cooling and taking a sip becomes easier.

5. What type of clothes should we wear in summer?Ans. Cotton is a good absorbent of water hence it absorbs sweat quite well and pores in the fabric expose that sweat to easy evaporation hence we should prefer wearing cotton clothes in summer.

Exercise :-

1. Convert the following temperatures to the celsius scale.
(a) 293 K (b) 470 K.
Ans. a) $^{\circ}C = K - 273 = 293 - 273 = 20^{\circ}C$
b) $^{\circ}C = K - 273 = 470 - 273 = 197^{\circ}C$
2. Convert the following temperatures to the Kelvin scale.
(a) 25∘∘C (b) 373∘∘C
Ans. a) K = ∘∘C + 273 = 25 + 273 = 298 K
b)K = ∘∘C + 273= 373 + 273 = 646 K
3. Give reason for the following observations.
(a) Naphthalene balls disappear with time without leaving any solid.
(b) We can get the smell of perfume sitting several metres away.
Ans. a) Some substances possess the property of sublimation like camphor and naphthalene balls. Such substances directly change from solid to gaseous state without changing into liquid like ice→ water→ water vapour does. Therefore, naphthalene balls disappear with time without leaving any solid.
b) Being a volatile substance (gets evaporated easily) perfumes change from liquid to gaseous state very fast. Those particles mix up with air particles and diffuse to reach our nostrils such that we get the smell of perfume sitting several metres away.
4. Arrange the following substances in increasing order of forces of attraction between the particles— water, sugar, oxygen.
Ans. Oxygen < water< sugar.
5. What is the physical state of water at—
(a) 25∘∘C (b) 0∘∘C (c) 100∘∘C?
Ans. At 25∘∘C water is liquid, at 0∘∘C water is solid(ice), at 100∘∘C water exists as both liquid and gas.
6. Give two reasons to justify—
(a) water at room temperature is a liquid.
(b) an iron almirah is a solid at room temperature.
Ans. a) water at room temperature is liquid because at this temperature (i)it has fixed volume and (ii)it can flow.
b) An iron almirah is solid at room temperature because at this temperature (i) it has definite shape along with fixed volume and (ii) It can not flow like water and hence does not possess fluidity.
7. Why is ice at 273 K more effective in cooling than water at the same temperature?
Ans. While melting ice absorbs latent heat of melting from the surroundings and gets changed into water that makes the cooling effect more intense as compared to water at same temperature.
8. What produces more severe burns, boiling water or steam?
Ans. Steam at 373K has more heat energy equal to the latent heat of vaporisation than boiling water at 373K,therefore, steam produces more severe burns than boiling water.
9. Name A, B, C, D, E and F in the following diagram showing change in its state.



Ans. A – Fusion (Heating – Melting)
B – Vaporisation
C – Cooling – Condensation (Liquefaction)
D – Cooling – Freezing (Solidification)
E – Sublimation
F – Deposition