

Class - 8

(1)

Chapter - 6

Heat transfer

1) Matter is the substance which occupies space and has mass.

It is composed of large number of molecules.

2) The three states of matter are solid, liquid and gas.

Distinction :- i) On the basis of volume -

- A solid has a definite volume or size
- Liquids also have a definite volume
- Gases do not have a definite volume.

ii) On the basis of shape -

- Solids have a definite shape whereas both liquids and gases have no definite shape.

3) Distinction between liquid and vapour (or gas)

a) On the basis of arrangement of molecules -

Liquids and gases have molecules which are not in a rigid arrangement.

b) Intermolecular separation -

The intermolecular space in liquids is more than that in solids whereas the separation between the molecules in gas is quite large as compared to that in liquids and solids.

3) a) Inter-molecular force :- The intermolecular forces are less strong (moderate) in liquid but weakest in the gases.

d) Kinetic energy of molecules :- Liquid has intermediate K.E as its particles are not too much free but vapour (or gas) has the highest K.E as its particles are free to move.

4) The change of liquid into its vapour at all temperatures from its surface is called evaporation.

Explanation of evaporation on the basis of molecular motion :- In a liquid, molecules while in motion collide with each other. Some molecules which gain energy reach to the surface of liquid while others which lose energy remain inside the liquid. Thus the molecules on the surface of liquid have higher kinetic energy than those inside the liquid. During evaporation, the molecules on the surface which have sufficient kinetic energy to do work against the force of attraction ~~on~~ them due to other molecules inside the liquid, escape out from the surface in space. These escaping molecules form the vapour of the liquid. The process continues till all the liquid evaporates.

5) No, all the molecules of a liquid does not take part in evaporation.

The molecules on the surface of liquid have high kinetic energy than those inside the liquid. During evaporation, only the molecules on the surface does work against the force of attraction on them by other molecules inside the liquid. Thus the molecules of liquid on the upper surface only take part in evaporation.

6) If there is no external supply of heat, the liquid will draw the necessary heat from its surrounding making the surrounding cooler. Thus the liquid changes into vapour.

7) During evaporation, the molecules on the surface which have sufficient kinetic energy to do work against the force of attraction on them due to other molecules inside the liquid (with less K.E.) escape out from the surface to the space forming vapour of the liquid. Thus 'evaporation is a surface phenomenon'.

8) Cooling is produced when a liquid evaporates. The reason for cooling in evaporation is that when a liquid changes into vapour, it requires heat.

This heat is supplied by the surroundings of the liquid. This results in fall in temperature (or cooling) in the surrounding.

a) a) When air is blown above the surface of liquid, the rate of evaporation increases. The reason is that blowing air takes away with it the molecules of liquid escaping out of the surface. To take their place, other molecules escape out from the surface of liquid.

b) On increasing the area of surface exposed to air, the rate of evaporation increases. The reason being that on increasing the area of surface, no. of molecules escaping out from the surface increases.

c) The rate of evaporation increases with the increase in temperature of liquid. The reason is that the energy of the molecules increases with increase in temperature. So more and more molecules come to the surface of liquid hence increasing the rate of evaporation.

10) The change from the liquid state to the gaseous (or vapour state), on heating at a constant temperature is called boiling.

## Molecular basis of boiling:-

Heating of the liquid increases the average kinetic energy of the liquid molecules when the molecules acquire sufficient kinetic energy to do work against the force of attraction of other molecules. These molecules start leaving the liquid, not only at the surface but also near the walls of the containing vessel producing bubbles. The bubbles grow in size with further evaporation and move to the surface which causes agitation in whole of the liquid. Thus boiling occurs without further increase in temperature.

11) Heating of the liquid increases the average K.E of the liquid molecules which does work against the force of attraction by other molecules. These agitated molecules start leaving the liquid not only at the surface but also near the walls of the containing vessel, thus forming bubbles.

12) At boiling point we know that the temperature normally remains constant. Even though the temperature remains constant, the average kinetic energy of the molecules normally increases.

13) During boiling the heat energy supplied is used in increasing the energy of water molecules and hence the change of phase takes place.

On receiving sufficient amount of heat, the water molecules get converted into the gaseous state.

- 14) Two ways of changing liquid state to the vapour state are evaporation and boiling.

### Evaporation

- i) It takes place at all temperatures
- ii) Evaporation occurs only from the surface of liquid.
- iii) Evaporation is a slow process.

### Boiling

- i) Boiling takes place at a fixed temperature.
- ii) It takes place throughout the mass of liquid at the same time.
- iii) It is a rapid process.

- 15) The expansion of a substance when heated is called thermal expansion.

- 16) Two substances which expand on heating are iron and copper.

- 17) Experiment → No. - 1 (page - 109)

- 18) Three factors on which the linear expansion of a metal rod on heating depends are - i) Original length of the rod ii) Increase in temperature iii) Material of the rod.

- 19) When two identical rods are heated at same rise in temperature, the rod which is longer (10m) ∴ expands more than the shorter (5m) as expansion depends upon the original length of the rod.

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**Question 20.**

Two identical rods of copper are heated to different temperatures — one by 5°C and the other by 10°C. Which rod will expand more ?

**Answer:**

Two rods with same length and material are heated to different temperature.

But,  $L - L_0 \propto \Delta t$

∴ Rod with higher change in temperature i. e. 10°C will expand more.

**Question 21.**

One rod of copper and another identical rod of iron are heated to the same rise in temperature. Which rod will expand more? Give reason.

**Answer:**

When two identical rods (same length) are of different material and heated to same rise in temperature, the copper rod will expand more than iron, since expansion depends on nature of material.

(Coefficient of linear expansion of copper  $17 \times 10^{-6}/^{\circ}\text{C}$  > iron  $13 \times 10^{-6}/^{\circ}\text{C}$ )

**Question 22.**

Two identical rods—one hollow and the other solid, are heated to the same rise in temperature. Which will expand more ?

**Answer:**

When two identical rods are heated to the same rise in temperature, solid rod will expand more.

As more number of molecules are present in the solid rod so, more heat energy is present in solid rod.

**Question 23.**

In the ball and ring experiment, if the ball after heating is left to cool on the ring for some time, the ball again passes through the ring. Explain the reason.

**Answer:**

On heating the ball expands and increases in size and cannot pass the ring when left on it. As the ball cools, it contracts, size becomes less than ring and passes the ring.

**Question 24.**

Explain the following:

- (a) The telephone wires break in winter.
- (b) Iron rims are heated before they are fixed on the wooden wheels.
- (c) The gaps are left between the successive rails on a railway track.
- (d) A glass stopper stuck in the neck of a bottle can be removed by pouring hot water on the neck of the bottle.
- (e) A cement floor is laid in small pieces with gaps in between.

**Answer:**

(a) Metals expand on heating (in summer) and contract on cooling (in winter). Therefore while putting up the wires between two poles, care is taken that they are kept tight while laying them in winter as they sag in summer due to expansion.

(b) Iron rims are made slightly smaller in diameter than the wooden wheel and on heating wheel expands

and can easily slip over the wooden wheel and on cooling the rim contracts and makes a tight fit over the wooden wheel.

(c) In summer due to considerable rise in temperature, the gaps allow for the expansion of rails, otherwise the rail will bend sideways.

(d) By pouring hot water on the neck of the bottle, the neck expands and stuck glass stopper can easily be removed.

(e) In summer when temperature rises small pieces of cement expand and to allow expansion gaps are left between small pieces.

**Question 25.**

**Why is one end of a steel girder in a bridge kept on rollers instead of fixing it in pillar?**

**Answer:**

In summer when temperature increases considerably the bridge made of metal expands and rollers slide to allow for expansion otherwise the bridge may break the pillar.

**Question 26.**

**A metal plate is heated. State three factors on which the increase in its area will depend.**

**Answer:**

Three factors are:

- (i) Original area of plate  $A_0$ .
- (ii) Rise in temperature  $t$ .
- (iii) Nature of material of plate.

**Question 27.**

**A cubical metal solid block is heated. How will its volume change ?**

**Answer:**

When a solid is heated, it expands in all directions. The volume of a cube also increases.

Let  $V_0$  be the volume of cube of side  $L_0$  at  $0^\circ\text{C}$ . i.e.  $V_0 = L_0^3$

When temperature increases to  $t^\circ\text{C}$ , each side increases to

$$V_t = L_t^3$$

$$\text{Increase in volume} = (V_t - V_0) [L_t^3 - L_0^3]$$

$$\text{Increase in temperature} = (t - 0)^\circ\text{C} = t^\circ\text{C}$$

**Question 28.**

**Describe an experiment to show that liquids expand on heating.**

**Answer:**

Experiment. Take round bottomed flask filled with water. Close its mouth with air-tight cork having delivery tube through it. Mark the level of water. Let it be at A. Now heat the flask. As water gets heated in flask, the level of water in the tube rises from A to B. This proves that liquids expand on heating.

**OR**

Experiment :Take a laboratory Celsius thermometer Suspend it with the help of a stand. Note the level of mercury thread in it. Let it be at A. Now take hot water in a beaker and as shown, set up the arrangement. The mercury thread rises to B by gaining temperature.

This shows that liquids expand on heating.

**Question 29.**

**State one application of thermal expansion of liquids.**

**Answer:**

Application of thermal expansion of liquids: An important application is mercury thermometer or alcohol thermometer.

When the bulb of the thermometer is kept in contact with a hot body the mercury expands and the level of mercury rises in the capillary tube.

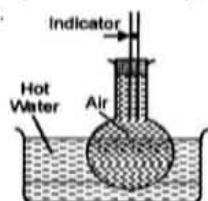


**Question 30.**

**Describe an experiment to show that air expands on heating.**

**Answer:**

Take a glass flat bottomed flask. Close its mouth with a cork having capillary tube containing indicator visible in the tube as shown. Make it air tight. Place the flask in hot water. After few minutes, we see the indicator moving up. This happens because air inside the flask expands with rise in temperature. This proves that gases expand on heating.



**Question 31.**

**An empty glass bottle is fitted with a narrow tube at its mouth. The open end of the tube is kept in a beaker containing water. When the bottle is heated, bubbles of air are seen escaping into water. Explain the reason.**

**Answer:**

When the bottle is heated, air in it expands and the solubility of gases in it decreases which escapes from water in the form of bubbles.

**Question 32.**

**Which of the following will expand more, when heated to the same temperature : (a) solid (b) liquid and (c) gas ?**

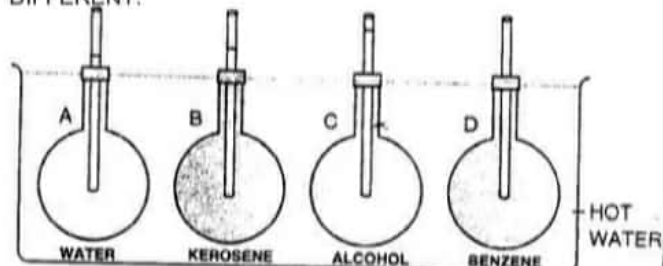
**Answer:** Gas will expand more as the inter-molecular force of attraction in gas molecules is least and K.E. is maximum.

**Question 33.**

**Describe an experiment to show that same volume of different liquids heated to same rise in temperature expand by different amounts.**

**Answer:**

**CUBICAL EXPANSION OF DIFFERENT LIQUIDS IS DIFFERENT:**



Experiment: Take four identical glass flasks each fitted with a narrow glass tube through a cork at its mouth. Fill flask A with water, B with kerosene, C with alcohol and D with Benzene. So that volume of each is same i.e. to the same level and their levels are visible above hot water bath. Put enough hot water in hot-water-bath. So that each flask is in the hot water. After some time we will see that different liquids rise to different levels. Water expands the least and benzene the most. This shows that different liquids of same volume expand by different amount.

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