learnkwniy

Class 7th

Chapter – 3

Heat

Heat

Heat is a form of energy. It makes a substance hotter. When heat is given to a substance, its temperature increases and it becomes hotter. For example, when a utensil is kept on a gas burner, it gets heat, its temperature increases and it becomes hot.

On the other hand, when heat is removed from a substance, then its temperature decreases and it becomes cold. For example, when water is kept in a refrigerator, then heat gets removed from water, its temperature decreases and it becomes cold.

TEMPERATURE

The temperature of an object is the degree of hotness (or coldness) of the object. The temperature of an object tells us how hot or cold the object is.

A high temperature of an object tells us that it is very hot whereas a low temperature of the object tells us that it is quite cold.

For example, the temperature of boiling water is hundred degrees Celsius' (100°C), which is quite high. So, boiling water feels to be very hot. On the other hand, the temperature of melting ice is 'zero degree Celsius'(0°C), which is quite low.

Temperature is measured by using a device (or instrument) called thermometer. A thermometer has a scale marked on it which is used to read the temperature.

The most common temperature scale marked on thermometers for measuring temperatures is the 'Celsius scale'. So, the temperature is expressed in the unit of 'degree Celsius' (which is written in short form as °C).

MEASURING TEMPERATURE: THERMOMETERS

A thermometer is a device for measuring the temperature of an object.

There are two common types of thermometers:

Laboratory thermometer and

Clinical thermometer.

Both these thermometers are based on the Celsius scale of temperature.

Laboratory Thermometer

- **A laboratory thermometer is used for measuring the temperature in a science laboratory.**
- **A laboratory thermometer is made up of a long glass tube T having a thin bore in it.**
- **There is a glass bulb B containing mercury which is joined at the lower end of the glass tube.**
- **The top end of glass tube is sealed (after removing air). The whole length of thermometer glass tube is graduated (or calibrated) in degrees Celsius.**
- **The graduations marked on the tube of a commonly thermometer are from, -10°C to 110°C (minus ten degree C to hundred ten decree C). This is called the range of thermometer.**
- **The range of a laboratory thermometer is generally from, -10°C to 110°C. This means that a common laboratory thermometer can measure a lowest temperature of, –10°C and a highest temperature of 110°C.**
- **A thin silvery thread of mercury in the narrow glass tube of the thermometer. The upper end of this mercury thread (or column) tells us the temperature of the object in which the thermometer bulb is placed.**

Precautions in Using a Laboratory Thermometer

1. The laboratory thermometer should be held vertically (or upright) while measuring temperature. It should not be tilted.

2. The thermometer bulb should be surrounded from all sides by the substance whose temperature is to be measured.

3. The thermometer bulb should not touch the sides or bottom of the container in which the substance is taken.

4. Read the thermometer while its bulb is still in touch with the substance whose temperature is being measured.

5. Read the thermometer by keeping the level of mercury along the line of sight.

6. Do not hold the thermometer by the bulb.

7. Handle the thermometer with care. It can break if hit against any hard object.

CLINICAL THERMOMETER

- **A clinical thermometer is used to measure our body temperature by a doctor (or at home).**
- **A clinical thermometer consists of a long glass tube having a thin and uniform bore.**
- **There is a glass bulb at one end of the glass tube. This glass bulb contains mercury. Outside the glass bulb, a small, shining thread of mercury can be seen in the thermometer tube.**
- **The other end of glass tube is sealed (after removing air). A temperature scale is marked on the glass tube of the clinical thermometer.**
- **The clinical thermometer has a temperature scale marked from 35°C to 42°C.**

A clinical thermometer has two special features which make it different from the laboratory thermometer.

(i) A clinical thermometer has a very short range of temperature from 35°C to 42°C.

(ii) A clinical thermometer has a kink (or constriction) in its glass tube just above the bulb containing mercury. The kink is to prevent the back flow of mercury into the thermometer bulb when the thermometer bulb is removed from the mouth of a patient.

The kink prevents the mercury level in the thermometer tube from falling on its own. So, even when the thermometer bulb is removed from the mouth of a patient, the mercury thread will keep standing at the maximum level reached.

Precautions in Using a Clinical Thermometer

1. The clinical thermometer should be washed before and after use.

2. Before using the clinical thermometer, we should ensure that the mercury level in its tube is below 35°C mark.

3. Read the clinical thermometer by keeping the level of mercury along the line of sight

4. The clinical thermometer should never be held by the bulb while reading it.

A clinical thermometer has usually two temperature scales marked on its glass tube on the two sides of the mercury thread:

Celsius scale of temperature and Fahrenheit scale of temperature

The Fahrenheit scale of temperature marked on the clinical thermometer has a range of 94°F to 108°F (°F means degree Fahrenheit).

The normal temperature of human body on Fahrenheit scale is 98.6°F. Fahrenheit scale of temperature was used in earlier days.

The normal temperature of human body is 37°C.

Comparison between Clinical Thermometer and Laboratory Thermometer

(i) The clinical thermometer has a very short temperature range (35°C to 42°C) whereas a laboratory thermometer has a large temperature range (usually from, -10°C to 110°C).

(ii) The clinical thermometer has a kink (or constriction) in its, tube to prevent the back flow of mercury into the bulb whereas a laboratory thermometer has no kink.

(iii) The clinical thermometer measures temperature more accurately (up to 0.1°C) than a laboratory thermometer.

TRANSFER OF HEAT

To carry heat from one part of an object to its other part, or from one object to another object is called transfer of heat.

Heat flows from a hot object to a cold object. In other words, heat flows from an object at higher temperature to another object at lower temperature.

Heat can be transferred from a hot object to a cold object in three different ways:

(i) By conduction,

(ii) By convection,

(iii) By radiation.

In solids, heat is transferred by conduction. In liquids and gases, heat is transferred by convection. And in empty space or vacuum (having no medium like solid, liquid or gas), heat is transferred by radiation.

Conduction

Conduction is the transfer of heat from the hotter part of a material to its colder part (or from a hot material to a cold material in contact with it) without the movement of material as a whole.

In all the solids, heat is transferred by the process of conduction.

The transfer of heat by the process of conduction takes place only in solids because: In solids, the particles are closely packed together. During conduction, heat is transferred from particle to particle by means of back and forth vibrations of the particles (caused by the heat energy). The particles of a solid remain at their fixed positions.

There is no actual movement of the particles of the solid from its hotter end to the colder end during the conduction of heat through it.

Good Conductors of Heat and Poor Conductors of Heat

Some materials conduct heat easily whereas other materials do not conduct heat easily. So, on the basis of conduction of heat, all the materials are classified into two groups:

1. Good conductors of heat,

2. Poor conductors of heat.

Those materials which allow heat to pass through them easily are called good conductors of heat (or just 'conductors' of heat). All the metals are good conductors of heat.

For example, the metals such as silver, copper, aluminium, iron and mercury are all good conductors of heat.

Metals and their alloys are good conductors of heat, Stone (marble, etc.) and tiles are also quite good conductors of heat.

Those materials which do not allow heat to pass through them easily heat. The materials which are poor conductors of heat are called insulators.

Examples of poor conductors of heat (or insulators of heat) are plastic, wood, paper, cloth, leather, cotton, wool, thermocol, rubber, asbestos, clay, bricks, cork, cane, bamboo, straw, saw-dust, glass, fiberglass, water and air.

CONVECTION

The transfer of heat in liquids and gases, however, takes place by the process of convection.

Convection is the transfer of heat from the hotter parts of a liquid (or gas) to its colder parts by the movement of the liquid (or gas) itself.

The transfer of heat by convection can take place only in liquids and gases because the particles in liquids and gases can move about freely.

The transfer of heat by convection also cannot take place in empty space (called vacuum) because there are no particles of any kind in empty space which can move and transfer heat.

CONVECTION IN WATER

Water is a poor conductor of heat, so it cannot transfer heat by conduction. Water transfers heat by the process of convection. In

order to heat water, we keep the vessel containing water over a gas burner now, though the burner is kept at the bottom of the vessel but it still heats all the water in the vessel. Actually, when water is heated in a vessel, it transfers heat from its hotter parts (just above the flame of burner) to its colder parts by the process of convection.

CONVECTION IN AIR

Air is a very poor conductor of heat, so air cannot transfer heat by the process of conduction. Air transfers heat from its hotter parts to colder parts by the process of convection.

In order to heat air in a room during winter, we keep the heater on the floor. Now, though the heater is placed on the floor at the bottom of the room but it still heats all the air in the room.

Actually, when air is heated by the heater in one part of the room, it transfers heat by convection.

RADIATION

When we switch on an electric bulb, it becomes hot and gives out heat and light. Now, if we keep our hand a short distance below the glowing bulb, we can feel its heat on the hand.

This means that the hot, glowing bulb is transferring some of its heat to our hand held below it. It is by the process called 'radiation'.

Hot bulb hot object emits (gives out) invisible heat rays in all directions. These heat rays carry heat energy.

These heat rays carry heat energy. When these heat rays fall on a cold object, the cold object receives heat energy and gets heated.

The best example of radiation is the transfer of heat energy of the sun to the earth. When we come out in the sunshine, we feel hot. This means that the heat from the sun is being transferred to us which makes us feel hot.

Absorbers of Heat Radiations

The amount of heat which an object can absorb by radiation depends on the colour of the object. The objects having dark colours absorb more heat radiations than the objects having light colours.

Emitters of Heat Radiations

The amount of heat which a hot object can emit by radiation also depends on the colour of the object.

The hot objects having dark colours emit more heat radiations than the hot objects having light colours.

The people living in the coastal areas experience an interesting phenomenon.

During the day, the land gets heated faster than the water. The air over the land becomes hotter and rises up. The cooler air from the sea rushes in towards the land to take its place. The warm air from the land moves towards the sea to complete the cycle.

The air from the sea is called the sea breeze. To receive the cooler sea breeze, the windows of the houses in coastal areas are made to face the sea. At night it is exactly the reverse. The water cools down more slowly than the land. So, the cool air from the land moves towards the sea. This is called the land breeze.