Chapter – 4

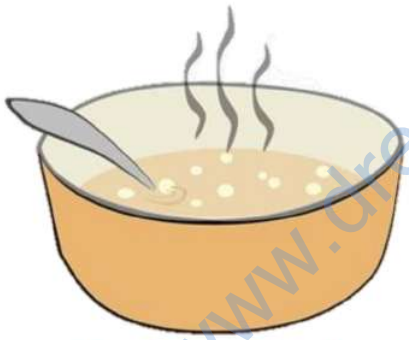
Heat

HOT AND COLD

Hot and Cold: The hotness and coldness of an object/body is determined by its temperature.

Temperature is defined as a measure of the degree of hotness of an object. Any object with a high temperature will feel hot and the object with a low temperature will feel cold.

Example: Hot Objects.



Hot Soup Bowl

Fire

Example: Cold objects.

Ice

Sea Water

MEASURING TEMPERATURE

Thermometer: The device used to measure the temperature of a body is called the thermometer.

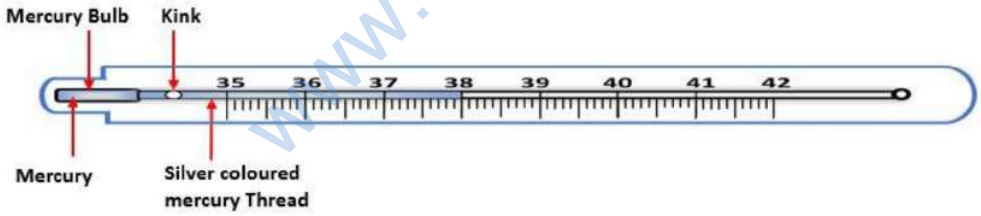
There are various types of thermometers that we use in our daily life such as 1) Clinical thermometer, 2) Laboratory thermometer, 3) maximum-minimum thermometer

Clinical Thermometer: A thermometer that measures the temperature of the human body is called the clinical thermometer.

The bulb of the clinical thermometer contains mercury which can be seen as a silver colour substance, as shown in the diagram below. The movement of Mercury in the thermometer indicates the temperature of the body in contact.

In a clinical thermometer, the kink near the bulb is placed which prevents the mercury to fall back into the bulb.

Most clinical thermometers have two scales marked on them. On one scale, we have markings indicating the Celsius scale denoted by ^{o}C. A clinical thermometer has a range from $35^{o}C$ to $42^{o}C$. This is because of the reason that we use this thermometer to measure the human body temperature and the temperature of the human body normally ranges from $35^{o}C$ to above $42^{o}C$.



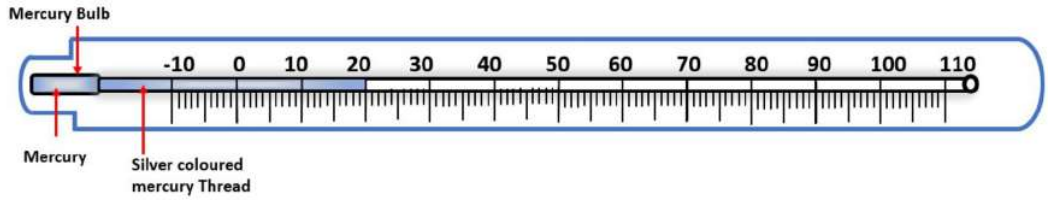
The other scale is the Fahrenheit scale denoted by ^{o}F and having a range from $94^{o}F$ to $108^{o}F$.

The normal human body temperature in these scales is taken as $37^{o}C$ or $98.4^{o}F$.

LABORATORY THERMOMETER

Laboratory Thermometer: A laboratory thermometer is used in laboratories to measure temperatures with high accuracy. To measure the temperature of a

substance, it is usually immersed partially or fully immersed in the substance. Mercury expands as the temperature increases while decreasing temperature indicates the contraction of mercury level. The range of a laboratory thermometer is generally from $-10^{o}C$ to $110^{o}C$. The temperature of some substances may go below $0^{o}C$ or above $100^{o}C$. That is why this thermometer has a range of $-10^{o}C$ to $110^{o}C$.



Example: Why a clinical thermometer cannot be used to measure the boiling point of water?

Solution: A clinical thermometer cannot be used to measure the boiling point of water because the boiling point of water is 100°C. This is a high temperature for a clinical thermometer which is designed to measure only human body temperature. A human body temperature varies over a short range from 35°C to 42°C.

To measure the temperatures above this range (i.e. 35°C to 42°C or 94°F to 108°F), we need a laboratory thermometer. The range of a laboratory thermometer is generally from –10°C to 110°C. The temperature of some substances may go below 0°C.

Maximum - Minimum Thermometer: The maximum-minimum thermometer is used to measure the maximum and minimum temperatures of the previous day reported in weather reports.

Following are the precautions we have to take while measuring the temperature:

1. Handle the thermometer with care. If it hits against some hard object, it can break.

2. The thermometer should be kept upright not tilted.

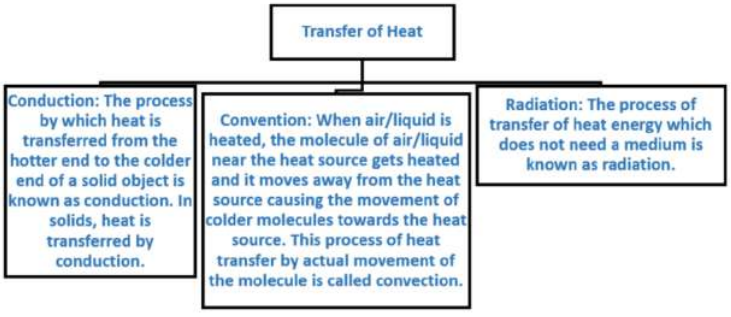
3. The bulb should be surrounded from all sides by the substance of which the temperature is to be measured.

4. The bulb should not touch the surface of the container.

5. Do not move the thermometer while measuring the temperature of the substance.

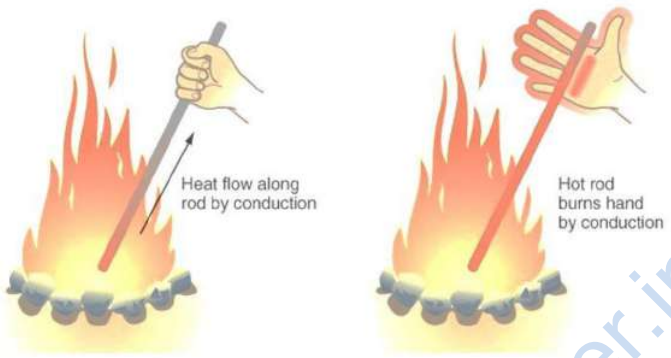
6. Read the temperature of the object when the thermometer is in the substance.

TRANSFER OF HEAT



Tip: The transfer of heat is due to the difference in temperature, from high to low

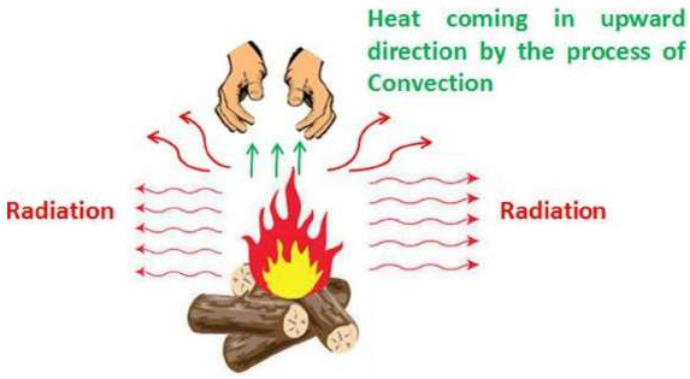
Example: When you hold a metal rod close to the fire, after some time the rod becomes hot and you will feel the burn due to heat transfer by conduction.



Example: When you keep your hand over an open flame, then you feel warm. Why?

Solution: When you keep your hand over an open flame, then you feel warm due to the process of convection as well as radiation.

Because the air directly above the flame gets warmer and lighter in weight, as a result, it rises up and you feel warm as shown in the following figure. Radiation happens in all directions and your hand feels warmer due to radiation and convection both when you keep your hand just above the flame as shown in the figure below.



Heat transfer by the process of convection as well as radiation

Tip: We receive heat energy from the sun through radiation. Radiation is the fastest mode of heat transfer and does not need a medium.

Sea Breeze: During the day land gets heated faster than water. Due to this air over the land expand and rises, while cooler air moves from the sea to take its place. This is called sea breeze.

Sea Breeze

Land Breeze: During the night land cools faster than water. Due to this warmer air over the sea rises and the cooler air moves from land to sea to take its place. This is called land breeze.

Land Breeze

Conductors: The materials which allow heat to pass through them easily are called conductors of heat.

Example: Aluminium, iron, and copper.

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

Example: Plastic, water and air.

Example: A wooden spoon is dipped in a cup of ice cream. What would happen with the temperature of the other end of the spoon?

Solution: When one end of a wooden spoon is dipped in a cup of ice cream, there will be no change in the temperature of its other end because wood is a bad conductor of heat.

So, there will be no flow of heat from one end to the other.

KINDS OF CLOTHES WE WEAR IN SUMMER AND WINTER

The black (Dark) colour is a good absorber and emitter of heat, whereas the white (light) colour reflect the heat.

Example: Four metal cans are identical except for the colours. 100 cm^3 of water at 70°C is poured into each can. Which can cool more rapidly?

Solution: Black colour is a good absorber and good emitter of radiation (heat). Heat lost by radiation will be fastest in the Black coloured container because darker bodies absorb and emit heat radiation better than bodies of lighter colour.

So, Black coloured container loses heat fastest and cools down most rapidly.