

Unit III Heat

3.1 HEAT AND TEMPERATURE

Heat may be defined as energy in transit from a high temperature region to a lower temperature region.

An object does not possess "heat" the appropriate term for microscopic energy in an object is internal energy.

The internal energy may be increased by transferring energy to the object from a higher temperature object- this is properly called heating.

- Heat can be felt in terms of physical changes like hotness, coldness or change of state of matter.
- Heat transfer is conduction, convection or radiation.
- Heat can cause a change in body's temperature by changing the internal energy of the body. Internal energy of a body is the total energy (Kinetic and potential) of its molecules.
- Heat energy is produced at the expense of mechanical energy and vice versa.
Ex: - Rub your palms vigorously, palm becomes warmer.
- Heat is measurable quantity it is expressed in calorie or Joule.
1 calorie = 4.2 joule
1 calorie = The quantity of heat required to raise the temperature of one gram of water by one degree centigrade.

➤ Sources of heat

- The Sun , hot object
- Burning fire wood & other fuels.

Temperature: -

Take three pans, one containing hot water the second Luke warm and the third t cold. Suppose you place your one hand in hot and the other in cold water for some time. Then place both your hands in lukewarm water you will observe that the hand which was previously in contact with hot water will now feel cold, whereas the other feels hot.

It thus shows that the sensation of degree of hotness is just relative to our body.

So temperature is the property of a body that determines the sensation of hotness or coldness when we touch the body.

NOTE: -

- 1) The average kinetic energy of molecules of a body is an indicator of its temperature.
- 2) Heat is the cause , Temperature is the effect

Activity 01 : -

Suppose the two pans, one containing a small and other a large amount of water are placed over identical gas burners and heated for length of time. The temperature of the small amount of water will have risen higher than that of the large amount. In this instance the increase in temperature are not equal.

Activity 02: -

On the other hand suppose the two pans are both initially at 30°C temperature and that both are to be heated to 60°C. It is evident that more heat to be supplied to the pan containing larger amount of water. The temperature change is same for both the quantities of heat supplied are very different.

Thermal equilibrium

We all know that hot water or milk when left on a table begins to cool gradually. Ultimately, it attains the temperature of the surroundings. Similarly, a glass of ice-cooled water when left on a table for some time will no longer remain cold and finally tends to attain the

temperature of the surroundings. This shows that when two bodies at different temperatures come in contact with each other the hotter body becomes cooler and the colder becomes warmer.

Finally a state is reached when no heat is flow from one body to other.

The state when no heat is exchanged between the two bodies in contact with each other is known as the state of thermal equilibrium.

At this stage two bodies are said to be at the same temperature.

Measurement of temperature :-

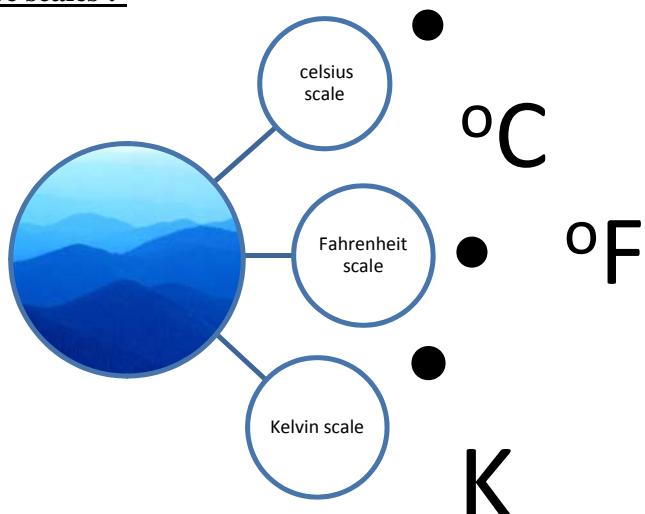
Measurement of temperature is based on the effect on the change of physical property of the matter due to transference of heat.

Ex: -

1. Expansion of solids and liquids
2. Increase of volume/ pressure at constant pressure/volume of a gas
3. Change in electrical resistance of a piece of metallic wire
4. Setting up of electromotive force at the junction of two dissimilar metals
5. Change in vapour pressure
6. Change of chemical phase of a system etc.

An instrument based on any of the above thermometric property is called a thermometer.

Temperature scales :-



Some specific temperature on different scales of temperature under normal conditions

Boiling point of pure water	100°C	373 K	212°F
Freezing point of pure water	0°C Celsius scale	273 K Kelvin scale	32°F Fahrenheit scale

Types of thermometers

- a) **Liquid thermometers:-** It works on the principle of change in volume of liquid with change in temperature.
- b) **Gas thermometers :-** It works on the principle of change in the pressure with change in temperature.
- c) **Platinum resistance thermometer :-** It works on the principle of change of resistance with change of temperature.
- d) **Thermoelectric thermometer : -** It works on the principle of change of Thermo emf with change in temperature.
- e) **Radiation pyrometers:-** It works on the principle of amount of radiation falls .
- f) **Bimetallic strip thermometer:** - It works on the principle of linear expansion of solid with temperature.

Questions

- 1) Write the differences between heat and temperature
- 2) A thermometer is kept in direct sun light what does it measure temperature of air or temperature of sun.
- 3) What is the temperature of vacuum?
- 4) Why a thick glass tumbler does break when a hot liquid is poured in it?
- 5) A thin rod and a thick rod of the same material are allowed to expand by giving the same amount of heat which expands more?
- 6) What does the temperature scale on the thermometer measure?
- 7) Imagine you put a thermometer in your mouth. How does the heat flowing from your mouth affect the atoms in the thermometer?

Answers

1)

Sl No	Heat	Temperature
1	It is a form of energy	It is a measure of degree of hotness of a body
2	Heat is responsible for temperature	It is one of the effects of heat
3	It is the sum of energies of all molecules	It is the average kinetic energy of the molecules
4	S I unit is joule	S I unit is Kelvin

2) Temperature of air

3) No.

If you have a perfect vacuum, it has no temperature. Temperature is a measure of how fast the molecules of the medium are moving, and with no molecules to measure, temperature is meaningless.

4) The inside of the glass expands faster because the heat comes to it faster than the outside so it cracks under pressure.

5) Thin rod

6) It measures the average Kinetic Energy of a substance. In other words, it measures the average motion of the molecules in a substance.

7) Heat flows from warm places to cooler places. Thus, heat is conducted into the cooler thermometer. The heat causes the molecules in the thermometer to vibrate more quickly. The increased kinetic energy of the atoms causes them to spread out and rise up the tube. The end result is that you can read your body temperature.