

CONTENTS

- Introduction
- Different Scales of Temperature
- Role of Temperature in Transfer of Heat Energy
- Unit of Heat Energy
- Effects of Heat
- Transfer of Heat

➤ INTRODUCTION

Heat : It is a form of energy which causes the sensation of hotness or coldness.

For example, if we dip our finger in hot water we have a sensation of hotness. Similarly, If we touch a block of ice the sensation is that of coldness. In the former case the heat energy has moved into the finger while in the later case it has moved out of the finger. Thus hotness or coldness basically indicates whether heat energy is flowing into our body or out of it.

Temperature : It is the effect of heat energy which determines the thermal state of a given substance. In other words it determines the degree of hotness or coldness of a substance. If a body is at a higher temperature than its surroundings, it means that heat energy will flow out of the body. Similarly, if a body is at a lower temperature than its surroundings, it means that heat energy will flow into the body.

Measurement of temperature

The instrument used for the measurement of temperature is called thermometer.

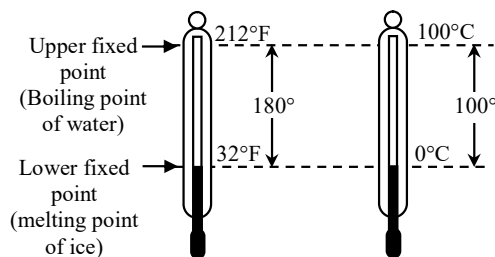
➤ DIFFERENT SCALES OF TEMPERATURE

(A) Celsius or centigrade scale :

As the name suggests, this scale has **100 divisions** between the upper and lower standard points. This scale was introduced by a Swedish astronomer Celsius and is known after his name. On this scale **0°C** represent melting point of ice & **100°C** represent steam point. Each division on this scale is called one degree centigrade or one degree Celsius and is written as °C.

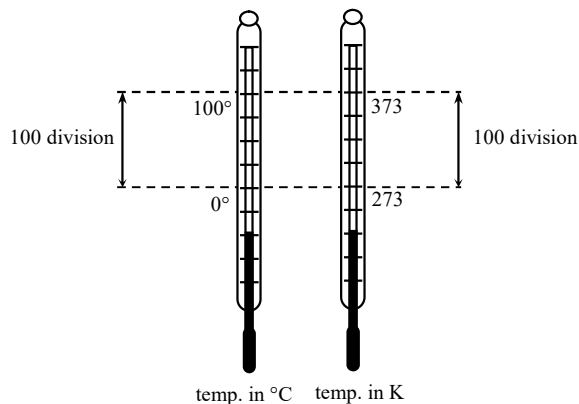
(B) Fahrenheit Scale :

The scale was introduced by Fahrenheit. On this scale **32°F** represents the melting point of ice and **212°F** the steam point . Zero is marked **32°F** below the ice point. The length in between the standard points is divided into 180 equal parts. Each division on this scale is called 1°F. This scale is widely used for meteorological and clinical purposes.



(C) Kelvin Scale

The scale of measurement of temperature, in which lowest temperature is **zero Kelvin** (-273°C) is called **Kelvin scale**. This is also called S.I. scale of temperature.



Characteristics of Kelvin scale

- (i) There cannot be any temperature below zero Kelvin
- (ii) Rise in temperature in Kelvin = Rise in temperature in degree Celsius.

➤ ROLE OF TEMPERATURE IN TRANSFER OF HEAT ENERGY

When two bodies at different temperature are brought in contact with each other, the heat energy always flows from a body at higher temperature to a body at lower temperature, till the temperature equalise. Thus, it is the temperature of body which determines the direction of flow of heat energy.

➤ UNIT OF HEAT ENERGY

Heat energy is measured in calories.

The quantity of heat energy required to raise the temperature of 1 g of pure water through 1°C (14.5°C to 15.5°C) is called one calories .

➤ EFFECTS OF HEAT

◆ Temperature rises with heat

When you heat something, or supply it with heat, its temperature rises. You would have noticed this

in the activity in which you measured the temperature of boiling water. The converse is also true. When you cool something, its temperature falls. Cooling something is the same as taking away heat from it.

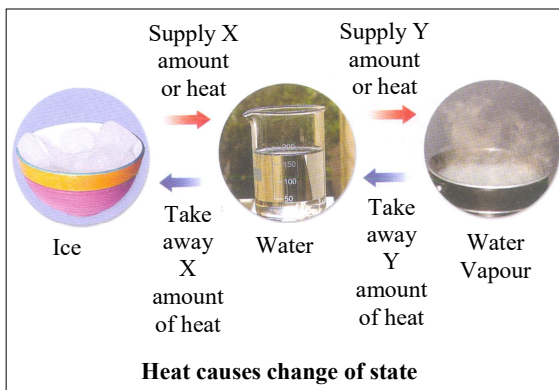
◆ Heat causes expansion

All substances, whether solid, liquid or gaseous, expand when they are heated and contract when they are cooled. However, the extent to which they expand is different. **Expansion is the greatest in gases, less in liquids, and the least in solid.**

Ex. Fit a balloon to the mouth of a glass bottle. Place the bottle in a pan of water and heat it. The balloon will get inflated as the air inside the bottle becomes warm and expands. Take the bottle out of the pan and allow it to cool. The balloon will get deflated as the air inside the bottle contracts.

◆ Heat causes change of state

When you heat a solid, it melts. And when you heat a liquid, it ultimately boils and changes into vapour. Conversely, when you cool a vapour, or take away heat from it, it changes into a liquid. And when you cool a liquid, or take away heat from it, it changes into a solid.



➤ TRANSFER OF HEAT

Heat can be transferred by three methods-

- (a) conduction
- (b) Convection
- (c) Radiation

(a) Conduction ;

Heat is transferred by the process of conduction when bodies at different temperatures are in direct or indirect physical contact

Conduction is a process of transfer of heat from the hotter end to the colder end from particle to particle of the medium. Conduction is the process of transmission of heat in solids, in which the molecules of the solid do not move from their position (only oscillate back and forth about their fixed positions) but merely transfer the heat energy in the form of kinetic energy from one molecule to the next.

Thus, medium is required for the transfer of heat by conduction, therefore, conduction is not possible in vacuum. In solids heat is transferred mainly by the process of conduction.

◆ Types of conductors

(i) Good conductors

The substances through which heat energy can easily flow by conduction are called good conductors.

Ex. Metals in general are good conductors. Amongst the metals, silver is considered best conductors. Amongst non-metal graphite is a good conductor. Metals are good conductor of heat

(ii) Bad conductors

The substances which do not allow the heat energy to flow through them easily are called poor conductors or bad conductors.

Ex. Amongst the solid, glass, wood, clay, asbestos, rubber, plastics, wax etc, are poor conductors, All liquids except mercury are poor conductors. All gases without any exception are poor conductors.

◆ Practical Application of good conductors

- ◆ Cooper tubing is used in the automobile radiators, as it readily takes up heat from the hot water coming from the side of engine

- ◆ Cooking vessels are made out of metals, so that they can readily absorb heat energy and transfer it to the food.
- ◆ Mercury is used as a thermometric liquid, as it is a good conductor of heat
- ◆ Cooling coils of an air conditioner and the refrigerator are made of copper as they readily conduct heat.

◆ Practical Application of bad conductors

We wear woolen clothes in the winter, because the woolen clothes contains a large amount of the trapped air. Since air is a bad conductor of heat, it does not allow the body heat to flow outward, As our body stops losing heat, we feel warm.

(b) Convection :

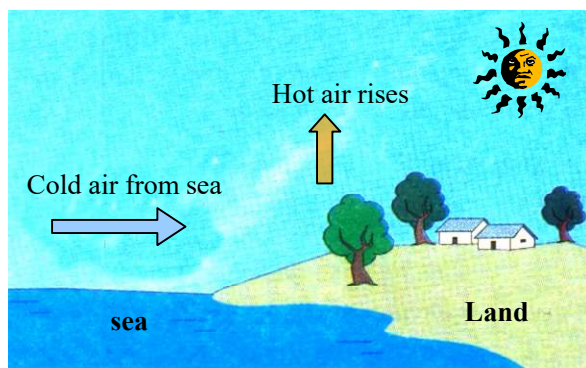
Convection is a process of transfer of heat by the actual movement of the medium particles. Liquids and gases are the bad conductor of heat. they are heated mainly by the process of convection. In a solid, the atoms cannot move, leaving their positions, So solids are not heated by convection. A medium is required for the transfer of heat by convection. Heat cannot be transferred by convection in vacuum.

◆ Consequence of convection :

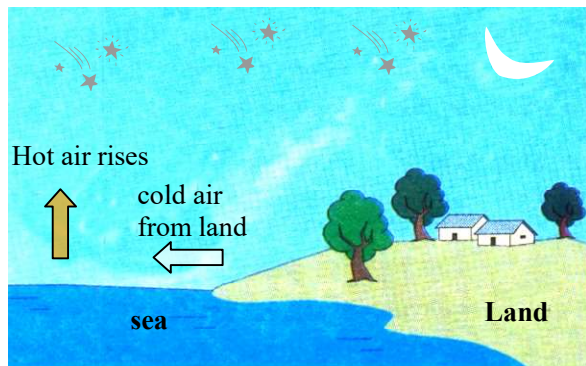
Land and sea breeze

In the coastal regions, during summer it is noticed that a breeze generally blows from land towards the sea during the night (or early morning) which is called the land breeze.

Land is a better absorber of heat than water. During the day, the land gets hotter, the air above it rises and cooler air from over the sea flows in to take its place. This gives rise to a sea breeze that cools the land.



Land breeze



Sea breeze

During night, the land radiates the heat it had absorbed during the day cools down faster than the sea. Above the sea, the air is warmer. It rises and cooler air from the land moves towards the sea to take its place. This gives rise to a land breeze. Thus, we have a sea breeze during day time and a land breeze at night.

(c) Radiation :

Radiation is the process of heat transfer in which heat directly passes from one body to the other body without affecting the medium. Thus, no medium is required for the heat transfer by the process of radiation. In vacuum, heat transfer takes place only by the process of radiation.

The heat energy transferred by the process of radiation is called the radiant heat or the thermal radiation.

◆ **Nature of radiant heat :** Heat energy is transferred by radiation in the form of electromagnetic waves. These waves can travel even in vacuum. They travel in all direction in straight line with a speed equal to the speed of light ($= 3 \times 10^8 \text{ ms}^{-1}$). They do not heat the medium through which they pass. They are reflected by a polished and white surface. When radiant heat falls on an object, it is partially absorbed and partially reflected. Dull, black or coloured surfaces are good absorber and good radiators of heat.

◆ Properties of heat radiations

- (A) Heat radiations travel with the speed of light.
- (B) Heat radiations can travel through vacuum
- (C) Heat radiations travels in straight lines

➤ POINTS TO REMEMBER

- ◆ Heat is a form of energy. We use this energy to generate electricity, among other things.
- ◆ The hotness or coldness of a body is relative.
- ◆ The temperature of a body is a measure of the degree of hotness of the body. We measure it by comparing it with a universal standard.
- ◆ The Celsius and Fahrenheit scales are commonly used to measure temperature. Ice melts at 0°C or 32°F . and water boils at 100°C or 212°F .
- ◆ Heat causes a rise in temperature. It also causes expansion and change in the state of matter.
- ◆ Heat flows or travels in three ways – conduction, convection and radiation.
- ◆ Conduction is the process by which heat flows through a substance without the movement of the substance itself.
- ◆ Convection is the process of transfer of heat in a liquid or gas by the movement of the liquid or gas.

- ◆ Radiation is the process by which heat travels without the help of a material medium. Radiant heat travels in straight lines, in all direction from a hot body.
- ◆ Every body emits (gives out) radiant heat. The emission of radiant heat from a body depends upon its temperature and colour.
- ◆ When radiant heat falls on a body, a part of it is absorbed and the rest is reflected. How much radiant heat a body absorbs and how much it reflects depend on its colour and the nature of its surface. Shiny white bodies are the best reflectors, while rough black bodies are the best absorbers of radiant heat. Black bodies absorb and emit radiant heat the best.

EXERCISE-1

A. Very Short Answer Type Questions

- Q.1** Give one example to show that heat is a form of energy.
- Q.2** What is temperature? Name the scales used to measure it.
- Q.3** If the hotness or coldness of a body is relative, how do we measure its degree of hotness?
- Q.4** Mention three changes that heat causes in substances.
- Q.5** A steel spoon dipped in a pot of boiling soup for a few minutes becomes too hot to touch. How does heat travel through the spoon?
- Q.6** How is it that we can hold a match while it is burning?
- Q.7** How does turning on a heater in a room make the whole room warm?
- Q.8** How does heat from the sun reach the earth?
- Q.9** Mention one similarity between heat and light.
- Q.10** When two bodies are in contact, heat flows from the hotter to the colder body. When does heat stop flowing?

B. Short Answer Type Question

- Q.11** Distinguish between the Celsius and Fahrenheit scales.
- Q.12** When a pan of water is heated on a gas stove, all the water turns hot in a while. How does heat travel through the water?
- Q.13** What happens to radiant heat when it falls on a body? What does the absorption of radiant heat by a body depend on?

- Q.14** (a) Mention one difference between the transfer of heat by conduction and that by radiation.
(b) Mention one difference between the transfer of heat by conduction and that by convection.

C. Long Answer Type Questions

- Q.15** Explain how land and sea breezes originate.
- Q.16** How would you demonstrate to a friend that gases expand when heated?
- Q.17** Explain why -
(a) It is better to wear lighter shades in summer.
(b) Two thin sweaters feel warmer than one thick sweater.
(c) Utensils are made of metal, while their handles are made of plastic.

D. True / False Types Questions

- Q.18** Water boils at 212°F.
- Q.19** A laboratory thermometer has a kink in the capillary tube.
- Q.20** Liquids expand more than solids do when heated.
- Q.21** The heat from the sun reaches us by radiation.
- Q.22** Liquids conduct heat better than metals do.
- Q.23** Transfer of heat in a substance by convection happens by the movement of the substance.
- Q.24** Transfer of heat by radiation needs contact between a hot and a cold body.
- Q.25** Air is a bad conductor of heat.

EXERCISE-2

Single Correct Answer Type Questions

- Q.1** Radiation
(A) does not require a material medium
(B) is the process of the transfer of heat in liquids
(C) is the process of the transfer of heat in which heat travels in one direction
(D) occurs in solids
- Q.2** Which of the following statements is correct?
(A) Metals are bad conductors.
(B) Some metals conduct heat better than others.
(C) Heat can be conducted from one metal to another even if they are not in contact with each other.
(D) When two metal rods are placed in contact with each other, heat can flow from one to the other even if they are at the same temperature.
- Q.3** The capillary tube of a clinical thermometer has a kink
(A) to increase the expansion of mercury
(B) so that the level of mercury does not fall as soon as the thermometer is taken out of the mouth
(C) to use less mercury
(D) to help us see it better
- Q.4** A polished, silvery surface is a
(A) good absorber and good reflector of heat
(B) good absorber and bad radiator of heat
(C) poor absorber and good reflector of heat
(D) poor reflector and good radiator of heat
- Q.5** A black body with a rough surface is a good
(A) reflector and poor absorber of heat
(B) good absorber and good radiator of heat
(C) absorber and poor radiator of heat
(D) reflector and poor radiator of heat
- Q.6** Sweating causes cooling by
(A) conduction (B) radiation
(C) convection (D) evaporation
- Q.7** Air conditioners are placed high up the walls so that-
(A) they create less noise
(B) cold air from them comes down and cools the room while hot air rises up
(C) They are out of the way
(D) all of the above
- Q.8** It is easier to drink hot tea from a porcelain mug than from a steel tumbler as
(A) the porcelain mug has a handle
(B) porcelain is a heat insulator
(C) the tea will cool faster in the steel tumbler
(D) all of the above
- Q.9** The heat energy emitted by sun reaches the earth through-
(A) conduction (B) convection
(C) radiation (D) None of these
- Q.10** Ice blocks are covered with sawdust because-
(A) sawdust lowers the temperature of the ice
(B) the sawdust, together with the air trapped within it, acts as heat insulator and prevents the heat outside from getting to the ice and melting it
(C) the sawdust absorbs excess water from the ice
(D) None of these
- Q.11** Land and sea breezes are based on-
(A) the phenomenon of conduction of heat
(B) the phenomenon of convection of heat
(C) the phenomenon of absorption and radiation of heat
(D) all of the above

- Q.12** 1 calorie equals to-
 (A) 4.2 J (B) 0.42 J
 (C) 420 J (D) 4200 J
- Q.13** Fahrenheit scale divides two fixed point into-
 (A) 180 parts (B) 212 parts
 (C) 100 parts (D) 32 parts
- Q.14** The normal temperature of human body is-
 (A) 37°C (B) 38°C
 (C) 35°C (D) 98.4°C
- Q.15** Convert 293 K into Celsius scale-
 (A) 566°C (B) 293°C
 (C) 20°C (D) 496°C
- Q.16** When in thermal contact, the quantity of heat lost by the hotter body is ----- the amount of heat gained by the colder body.
 (A) equal to (B) greater than
 (C) less than (D) cannot say
- Q.17** Conduction cannot takes place in
 (A) copper (B) iron
 (C) aluminium (D) vacuum
- Q.18** The snow on the mountains does not melt all the at once when it is heated by the sun because it-
 (A) becomes very hard
 (B) reflects most of the heat from the sun
 (C) has a low specific heat capacity
 (D) has a high latent heat of fusion
- Q.19** Conduction is possible-
 (A) When the bodies are apart from each other
 (B) When the bodies have some temperature and in thermal contact
 (C) When they have different temperature maintaining distance between them
 (D) bodies should be in contact and should have different temperatures
- Q.20** It is warmer to have two thin blankets than to have a single thick blanket because-
 (A) thick blanket cannot give more warmth
 (B) two blankets allow more heat to pass through them
 (C) air between the two blankets is a good conductor of heat
 (D) air between the thin blankets does not allow heat to pass through it since it is a bad conductor

22. False

25. True

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	B	B	C	B	D	B	B	C	B	B	A	A	A	C
Ques.	16	17	18	19	20										
Ans.	A	D	D	D	D										