

Lesson at a Glance

- **Heat:** Heat is a form of energy which causes the sensation of hotness and coldness. Heat energy can be used to do work. For example, on heating, water converts into steam which makes a steam engine move, and it pulls a train.
- On heating an object becomes hotter. If an object loses heat, it becomes cool.
- A reliable measure of the hotness of an object is its *temperature*. Temperature is measured by a device called *thermometer*. The temperature is a measure of the degree of hotness of an object.
- The thermometer that measures our body temperature is called a *clinical thermometer*.
- A clinical thermometer consists of a long narrow, uniform glass tube which has a capillary tube in which mercury runs. It has a bulb at one end and is connected with the capillary tube. The bulb contains mercury which can rise into capillary tube. There is a scale on the thermometer. The scale we use is the celsius scale indicated by $^{\circ}\text{C}$.

In a clinical thermometer, the range of temperature is from 35°C to 42°C , and there is a small constriction or bend or a kink at the bottom of the capillary tube. Kink prevents mercury level from falling on its own.



Fig. 4.1 A clinical thermometer.

In a *laboratory thermometer*, the range is from -10°C to 110°C and there is no kink.

- **Celsius Scale:** The *celsius scale* to measure temperature was designed by *Anders Celsius* (1701-1744). On this scale, temperature is described in degree celsius ($^{\circ}\text{C}$). It is a metric

scale of temperature. The other scale with the range 94–108 degrees is the *Fahrenheit Scale* ($^{\circ}\text{F}$). It was in use earlier.

- The temperature should always be stated with its unit, $^{\circ}\text{C}$ (where $^{\circ}$ stands for degree and C for celsius).
- The normal temperature of human body is 37°C . Note that how the temperature of a body is stated.

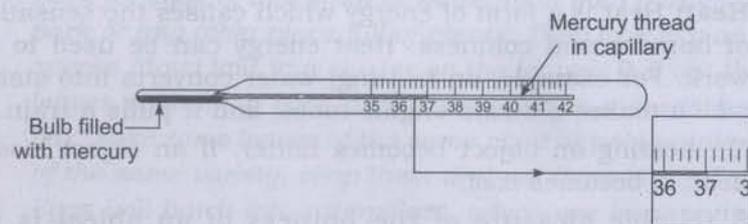


Fig. 4.2 A clinical thermometer showing normal temperature of human body (37°C).

• Different Types of Thermometers

- (i) *Maximum-minimum thermometer*: This thermometer is used to report maximum and minimum temperatures of previous day reported in weather reports (see Fig. 4.3).

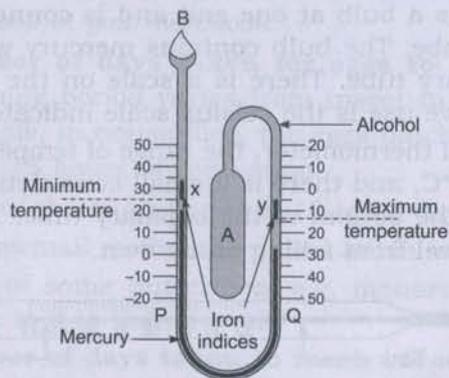


Fig. 4.3 A type of maximum and minimum thermometer.

- (ii) *Digital thermometers*: Mercury is a toxic substance and is very difficult to dispose off if a thermometer breaks. These days digital thermometers are available which do not use mercury.



Fig. 4.4 Digital thermometer.

- The heat flows from a hotter object to a colder object. There are three ways in which heat can flow from one object to another. These are: *conduction*, *convection* and *radiation*.
- **Conduction**: The process by which heat is transferred from the hotter end to the colder end of an object is known as *conduction*. This phenomenon, generally, is involved in transfer of heat energy through solids.
- **Conductor**: The materials that allow heat to pass through them easily are called *conductors*. For example, metals like aluminium, iron and copper.
- **Insulators**: The materials that do not allow heat to pass through them easily are poor conductors of heat. Such poor conductors are called as *insulators*. For example, plastic and wood are insulators.
- **Convection**: *Convection* is the process of transmission of heat in fluids (liquid and gases) in which the molecules move in definite currents carrying heat with them. In other words, the process of hotter liquid or gases transferring heat to the colder surroundings is known as *convection*. The water and air are poor conductors of heat but due to convection heat transfer takes place in these substances. In convection, the molecules themselves move from one place to another, carrying heat energy with them.
- **Radiation**: The process of transmission of heat in which heat energy travels in straight lines from hotter to cooler areas without having any intervening medium is called *radiation*. It means, the process of transfer of heat in which no medium is required is known as *radiation*.

Heat energy from the sun comes to us, though there is a vacuum (and no medium) between the sun and the earth over a large distance.

• **Sea breeze:** The flow of cool air from the sea towards the land to replace the hot air on land, is called *sea breeze*. This happens in the coastal regions during the day.

• **Land breeze:** In coastal regions, the currents of air flow from the cooler land towards the warmer sea. This happens during the night.

A. *Sea breeze*, during day the cooler air from the sea rushes in towards the land and warm air from the land moves towards the sea to complete the cycle.

B. *Land breeze*, at night the cooler air from the land moves towards the sea and warm air from the sea moves towards land.

Reason: In coastal areas, the land gets heated faster than the water during the day. 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 known as sea breeze.

Land breeze: The water cools down more slowly at night than the land. Therefore, the cooler air from the land moves towards the sea. The air from the land is known as *land breeze*.

- All hot bodies radiate heat.
- Dark coloured objects absorb heat radiation better than the light-coloured objects. That is why we feel more comfortable in light-coloured clothes in the summer.
- Woollen clothes are used in winter to keep us warm. Sometime, people refer woollen clothes as warm clothes. Actually, woollen clothes are not warm but they keep us warm because wool is a poor conductor of heat and it also has air trapped in between the fibres. The trapped air prevents the flow of heat from our body to the cold surroundings. So, we feel warm after wearing woollen clothes.

TEXTBOOK QUESTIONS SOLVED

Q.1. State similarities and differences between the laboratory thermometer and the clinical thermometer.

Ans. Similarities:

- (i) Both thermometers consist of long narrow uniform glass tubes.
- (ii) Both have a bulb at one end.
- (iii) Both contain mercury in bulb.
- (iv) Both use celsius scale on the glass tube.

Differences:

- (i) A clinical thermometer reads temperature 35°C to 45°C while the range of laboratory thermometer is -10°C to 110°C .
- (ii) Clinical thermometer has a kink near the bulb while there is no kink in the laboratory thermometer.

Due to kink mercury does not fall down on its own in clinical thermometer.

Q.2. Give two examples each of conductors and insulators of heat.

Ans. Conductors—aluminium, iron

Insulators—plastic, wood.

Q.3. Fill in the blanks:

- (a) The hotness of an object is determined by its _____.
- (b) Temperature of boiling water cannot be measured by a _____ thermometer.
- (c) Temperature is measured in degree _____.
- (d) No medium is required for transfer of heat by the process of _____.
- (e) A cold steel spoon is dipped in a cup of hot milk. It transfers heat to its other end by the process of _____.
- (f) Clothes of _____ colours absorb heat better than clothes of light colours.

Ans. (a) temperature (b) clinical
(c) celsius (d) radiation
(e) conduction (f) dark.

Q.4. Match the following:

- (i) Land breeze blows during (a) summer

- (ii) Sea breeze blows during (b) winter
 (iii) Dark coloured clothes are preferred during (c) day
 (iv) Light coloured clothes are preferred during (d) night

- Ans.** (i) Land breeze blows during (d) night
 (ii) Sea breeze blows during (c) day
 (iii) Dark coloured clothes are preferred during (a) winter
 (iv) Light coloured clothes are preferred during (b) summer

Q.5. Discuss why wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece of clothing?

Ans. More layers of clothing keep us warm in winters as they have a lot of space between them. This space gets filled up with air. Air is a bad conductor, it does not allow the body heat to escape out.

Q.6. Look at figure 4.5. Mark where the heat is being transferred by conduction, by convection and by radiation.

Ans.

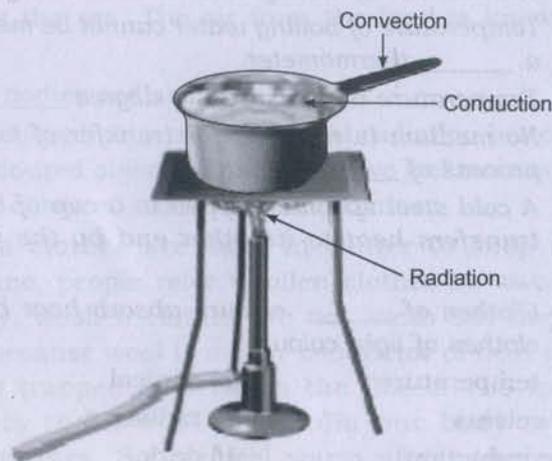


Fig. 4.5

Q.7. In places of hot climate it is advised that the outer walls of houses be painted white. Explain.

Ans. In places of hot climate it is advised that the outer wall of houses be painted white because white colour reflects heat and the houses do not heat up too much.

Q.8. One litre of water at 30°C is mixed with one litre of water at 50°C . The temperature of the mixture will be:

- (a) 80°C
 (b) More than 50°C but less than 80°C
 (c) 20°C
 (d) Between 30°C and 50°C

Ans. (d) Between 30°C and 50°C .

Q.9. An iron ball at 40°C is dropped in a mug containing water at 40°C . The heat will:

- (a) flow from iron ball to water.
 (b) not flow from iron ball to water or from water to iron ball.
 (c) flow from water to iron ball.
 (d) increase the temperature of both.

Ans. (b) not flow from iron ball to water or from water to iron ball.

Q.10. A wooden spoon is dipped in a cup of ice-cream. Its other end:

- (a) becomes cold by the process of conduction
 (b) becomes cold by the process of convection
 (c) becomes cold by the process of radiation
 (d) does not become cold

Ans. (d) does not become cold.

Q.11. Stainless steel pans are usually provided with copper bottoms. The reason for this could be that:

- (a) copper bottom makes the pan more durable
 (b) such pans appear colourful
 (c) copper is a better conductor of heat than the stainless steel
 (d) copper is easier to clean than the stainless steel

Ans. (c) copper is better conductor of heat than the stainless steel.

EXTENDED LEARNING — ACTIVITIES AND PROJECTS

Q.1. Go to a doctor or your nearest health centre. Observe the doctor taking temperature of patients. Enquire:

- why she dips the thermometer in a liquid before use.
- why the thermometer is kept under the tongue.
- whether the body temperature can be measured by keeping the thermometer at some place other than the mouth.
- whether the temperature of different parts of the body is the same or different.

You can add more questions which come to your mind.

- Ans.**
- The doctor dips the thermometer in liquid before use to disinfect it.
 - The thermometer is kept under the tongue because this part of body gives accurate body temperature.
 - We can measure the thermometer of the body by keeping thermometer at some place other than mouth like arm pit.
 - The temperature of different parts of the body is not exactly same but it differs slightly.

Q.2. Go to a veterinary doctor (a doctor who treats animals). Discuss and find out the normal temperature of domestic animals and birds.

- Ans.** Normal temperature of domestic animals is 37°C to 40°C (goat) and 28°C (dog). The normal temperature of birds is about 40°C to 45°C .

Q.3. Wrap a thin paper strip tightly around an iron rod. Try to burn the paper with candle while rotating the iron rod continuously. Does it burn? Explain your observation.

- Ans.** No, the paper strip does not burn. The paper does not attain ignition temperature. The iron takes away the heat because iron is good conductor of heat.

Q.4. Take a sheet of paper. Draw a spiral on it as shown in the Fig. 4.6. Cut out the paper along the line. Suspend the paper as shown in Fig. 4.6 above a lighted candle. Observe what happens. Think of an explanation.

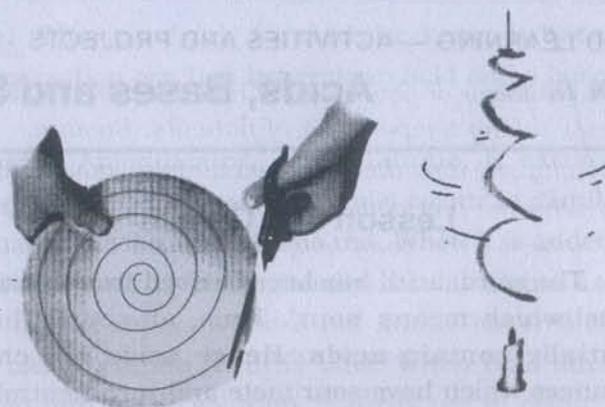


Fig. 4.6

- Ans.** The paper spiral keeps moving because the hot air above the flame moves up due to convection.

Q.5. Take two similar transparent glass bottles having wide mouths. Put a few crystals of potassium permanganate or pour a few drops of ink in one bottle. Fill this bottle with hot water. Fill the other bottle with cold water. Cover the cold water bottle with a thick piece of paper such as a postcard. Press the postcard firmly with one hand and hold the bottle with the other hand. Invert the bottle and place it on top of the hot water bottle. Hold both the bottles firmly. Ask some other person to pull the postcard. Observe what happens. Explain.

- Ans.** Do it yourself.