

Chapter

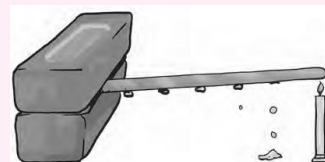
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Heat



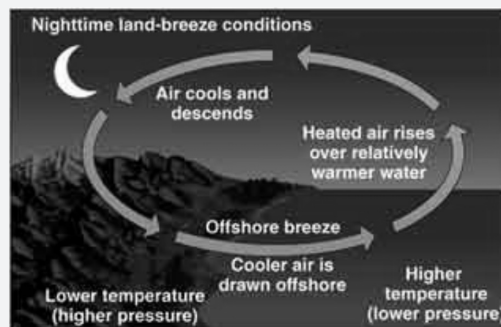
Learning Objectives

- Hot and Cold
- Effects of Heat Energy
- Sources of Heat Energy
- Measuring Temperature
- Temperature Measuring Instruments - Thermometers
- Transfer of Heat
- Conductors & Insulators



Critical Concepts

- ✦ Thermal Expansion
- ✦ Land Breeze and Sea Breeze



INTRODUCTION

Common Misconception	Fact
1. Heat and temperature are same.	1. Heat is a form of energy. Temperature is a measure of degree of hotness or coldness of a body.
2. Transfer of heat from one body to another needs a medium.	2. Radiation of heat does not require any physical medium. (Example : Heat from sun reaches earth through vacuum)
3. Boiling water can cause more damage.	3. Steam causes more damage due to latent heat as compared to boiling water.

Heat is a form of energy which produces a sensation in our body by way of which we make out whether a body is cold, warm or hot. Hence it has the ability to do work. For example, the steam engine pulls a train converting heat into mechanical energy. Heat can also be converted to other forms of energy. For example, the heat in a fire cracker produces both sound and light.

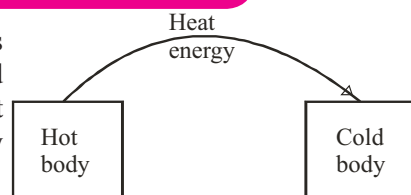
HOT AND COLD

Sun is the Earth's main source of heat energy. Other sources of heat include burning of fuels, e.g., wood, coal, kerosene and liquefied petroleum gas (LPG), rubbing of two surfaces against each other, or from electricity. Heat always flows from a body of higher temperature to the body at lower temperature.

A body which is losing heat is feeling the other body to be cold, and a body which is gaining heat is feeling the other

body to be hot. S.I unit of heat is joule (J). Another commonly used unit of heat is calorie (cal). One calorie is the quantity of heat energy required to raise the temperature of 1g of water through 1°C.

$$1 \text{ cal} = 4.2 \text{ J}, \quad 1 \text{ kcal} = 1000 \text{ calories}$$



DID YOU KNOW?

1. As heat is a form of energy. So, its unit is same as energy.
2. It is a scalar quantity.



Let's Do Activity

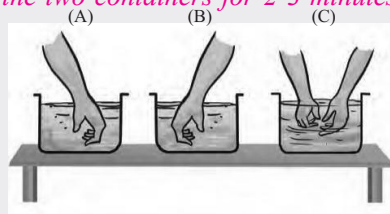
Aim:- Observing feeling of hot and cold objects.

Requirement:- Three small tubs/containers A, B, C, some amount of hot and cold water.

Procedure:- Take three small tubs/containers A, B, C. Put cold water in container A and hot water in container B. Mix some cold and hot water in container C. Now, dip your left hand in container A and right hand in container B. After keeping the hands in the two containers for 2-3 minutes, put both the hands simultaneously in container C as shown in figure below.

Observation:- We observe that both the hands get different feeling. Left hand tells that water in container C is hot, while the right hand tells that the same water is cold.

Conclusion:- From the above observations, we conclude that a reliable measure of the hotness and coldness of an object is its temperature.

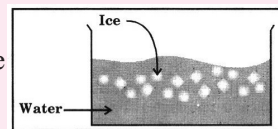


**Illustration 1 :**

When ice is added to water in a glass, why do we feel cold to touch the glass?

Solution :

Heat flows from a hot body to cold body. Heat flows out of the glass into the ice. Thus the glass loses heat and hence we feel it cold.

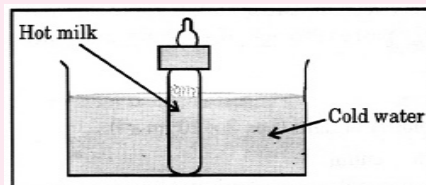
**Illustration 2 :**

A bottle of hot milk is placed in cold water for a long time. What will happen?

Solution :

Heat transfer between two bodies at different temperature and stops when thermal equilibrium is achieved.

Heat from the hot milk will flow to cold water. The milk cools down as it loses heat to the water. This process of heat transfer continues till both milk and water reaches same temperature.

**EFFECTS OF HEAT ENERGY**

- (a) Heat energy brings about change in temperature conversely, if a hot body gives out heat energy, its temperature falls.
- (b) Heat energy brings about change in dimensions when a material body is heated, its length, area and volume increases.
- (c) Heat energy brings about change in state. When heat supplied to the solid, at a particular constant temperature it changes into the liquid state. Similarly liquid changes into gaseous state. During the change of state, the temperature of the body remains constant.
- (d) Heat energy affects the living things.
- (e) Heat energy brings about chemical change when calcium carbonate is heated strongly, it changes into calcium oxide and carbon dioxide.

MEASURING TEMPERATURE

The device used for measuring the temperature of a substance is called Thermometer. ("Thermo" is a latin word which means heat and "matter" means a measuring device). Thermometer works on the principle that *matter expand* when heated and contract when cooled. There are different thermometric substances like mercury, alcohol etc., used in thermometers for different range of temperatures to be measured. Mercury is used in thermometers as thermometric substance because of the following advantages.

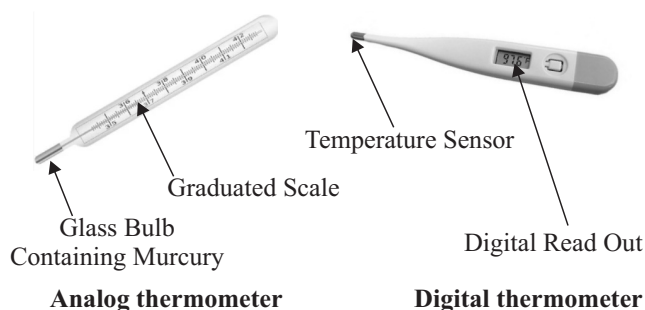
- (a) It expands evenly as the temperature rises.
- (b) It is a good conductor of heat.

- (c) Its density is higher.
- (d) It is very sensitive in expansion.
- (e) It does not stick on the wall of a glass tube.
- (f) It has very low freezing point and a very high boiling point.

The calibration of thermometer involves fixing of two points on it one lower fixed point (L.F.P) and other upper fixed point. The melting point of pure ice at normal atmospheric pressure is taken as lower fixed point (L.F.P). The boiling point of pure water at normal atmospheric pressure is taken as upper fixed point (U.F.P). The constant temperature at which, the solid substance changes into liquid is called its melting point. The constant temperature at which, a liquid changes into gaseous state is called boiling point.

● TEMPERATURE MEASURING INSTRUMENT – THERMOMETERS ●

Two types of thermometers are there in use. These are, **laboratory thermometer and clinical thermometer.**



Clinical thermometer is used for the measurement of body temperature. The body temperature varies slightly. Therefore the range of clinical thermometer is between 35°C to 42°C . Clinical thermometer has graduated scale, on which scale is mentioned in degree celsius and in fahrenheit. Small division on the body of the clinical thermometer represents the temperate of 0.1°C or $\frac{1}{10}$ degree C. The range in terms of fahrenheit on the body of the thermometer is between 94°C to

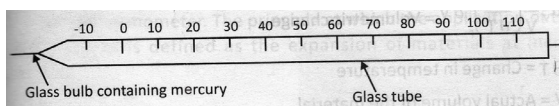
108°C . Human body temperature on the fahrenheit scale is 98.4°F and in the celsius scale it is 37°C . Clinical thermometer is made up of glass tube and a liquid (**mercury or alcohol or hydrocarbon based fluid**) is filled inside it. As the temperature increases, volume of the mercury expands. Division on the body of the thermometer shows the increase in temperature.

DID YOU KNOW?

Galileo was the first scientist to construct a thermometer based on the thermal expansion and he called his thermometer the thermoscope.



Digital thermometers are widely used because of their accuracy. A digital display on it shows temperature. It requires battery for function.



Laboratory thermometer is generally available in the range of -10°C to 110°C . The graduated laboratory thermometer is used in the laboratory for the measurement of the temperature of chemicals and for other purposes.

Difference between Heat and Temperature

	Heat		Temperature
1.	Heat is a form energy.	1.	Temperature indicate the thermal condition of a body i.e., how much hot (or) how much cold the body is:
2.	Heat is the cause.	2.	Temperature is the effect.
3.	Heat contents of a body do not decide the direction of heat flow from the body.	3.	Temperature of a body decides the direction of heat flow from the body.
4.	S.I. unit of heat is joule (J)	4.	S.I. unit of temperature is kelvin (K).



Let's Do Activity

Aim:- Observing correct method of reading a clinical thermometer.

Requirement:- A clinical thermometer.

Procedure:- First, note the temperature difference indicated between the two bigger marks on the clinical thermometer. Also note down the number of divisions between these marks. Now, wash the thermometer, preferably with an antiseptic solution. Hold it firmly and give it a few jerks. Ensure that the jerks will bring the level of mercury down below 35°C . Now place the bulb of thermometer under your tongue. After one minute, take the thermometer out and note the reading as shown in figure below.



Observation:- We observe that the temperature recorded by the clinical thermometer is the normal temperature of human body which is 37°C .

Conclusion:- From above observations, we conclude that the clinical thermometer is designed to measure the temperature of human body only. The temperature of human body does not go below 35°C or above 42°C .

**CONNECTING TOPIC****Thermal Expansion**

The increase in size of an object on heating is called thermal expansion. Thermal expansion takes place in all bodies and in all three states of matter.

Expansion of solids

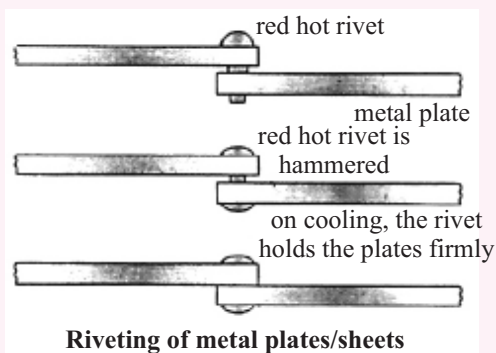
A solid has a definite shape, so it shows all three types of expansions i.e., on heating solids show an increase in length (linear expansion), in area (superficial expansion) and in volume (cubical expansion).

Applications of Thermal Expansion of Solids**1. An iron rim is heated before being fitted onto wooden wheels**

The iron rim is made slightly smaller than the diameter of the wooden wheel. The rim is heated and this hot iron rim is then placed on wooden wheel and cooled by pouring water over it. On cooling, the iron rim contracts and holds the wheel firmly.

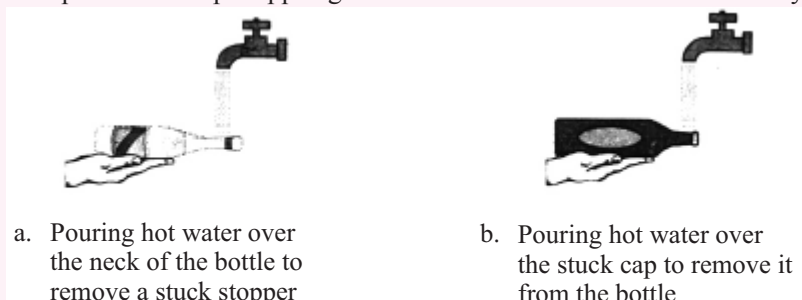
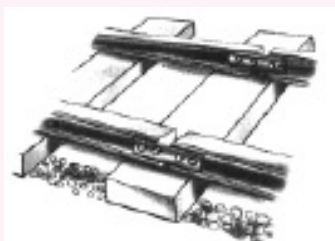
**2. Riveting of Metal plates**

A red-hot rivet is passed through the holes in the two plates/sheets. While still red hot it is hammered nearly flat. When the rivet cools down, it contracts, and pulls the two plates together very firmly.



3. To remove a stuck stopper or cap from a bottle

A metal cap stuck on a glass bottle/stuck stopper can be removed from bottle by pouring hot water on cap/neck of the bottle. When hot water is poured over the cap/neck of the bottle, it expands and cap/stopper gets loosened and can be removed easily.

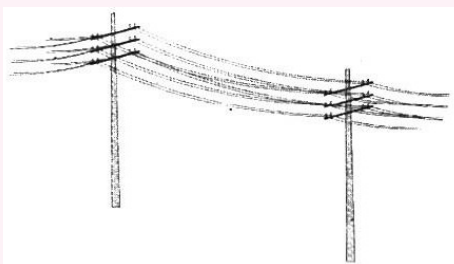
**4. Laying of rail tracks**

Gaps for expansion between two sections of rail tracks

If rails are fixed tightly, leaving no space for expansion or contraction, these will bend outward in summer. It will result in the derailment of train. To avoid such a situation, small gaps are left in between the rails.

5. Laying of telephone and electric transmission wires

When the telephone or telegraph wires are laid in summer they are kept slightly loose so as to allow for contraction in winter. Similarly, if they are laid in winter they are kept very tight so as to allow expansion during summer.



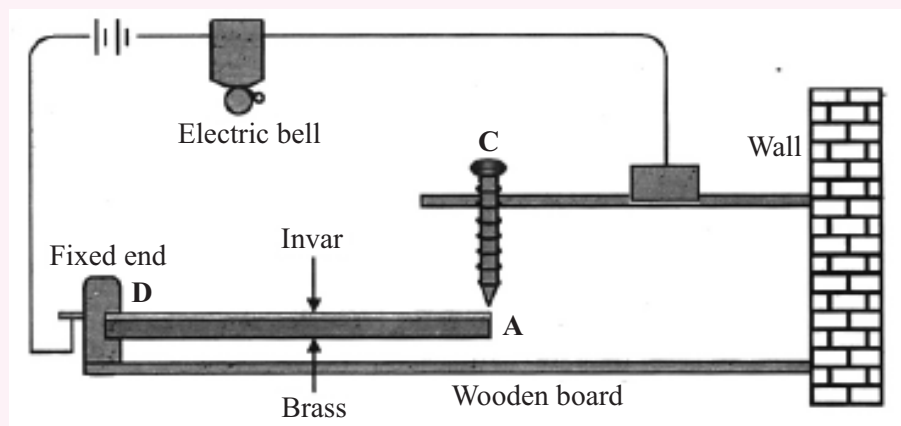
Sagging of telephone wires during summer

6. Laying of cement floor

Cement floor is laid in small blocks leaving a very small space in between the blocks to allow the expansion and do not crack the floor during the expansion in summer.

7. A bimetallic strip used in automatic fire alarm

In case of fire, as the bimetallic strip gets heated, it bends. This means that end A will rise up as brass expands more than invar. When end A touches the contact screw C, an electrical contact is established, and hence, the electric bell starts ringing.



Expansion of fluids

Liquids have no definite length or area, but have definite volume. Thus, the only expansion in liquids is volume expansion (or) cubical expansion. Different liquids have different rates of expansion, for the same rise in temperature. Gases have no definite shape, but have a definite volume in an enclosed vessel. When gases are heated they expand, i.e., they have cubical expansion. Expansion in gases is very large as compared to the solids or the liquids.

Let's Connect

- Superficial expansion is related to
 - Length
 - Area
 - Volume
 - Breadth
- A small gap is left between the rails, because
 - these will bend outwards in summer
 - they look attractive
 - these are fixed at some height
 - they are very long

Solutions:

- (b) Superficial expansion of a solid is related to area of the solid.
- (a) If rails are fixed lightly, leaving no space for expansion or contraction, these will bend outward in summer. It will result in the derailment of train. To avoid such situation, a small gap is left in between the rails.

**CHECK POINT-1**

1. **Column I** **Column II**
- | | |
|-------------------------------------|--|
| (A) Range of clinical thermometer | (p) 35°C to 42°C |
| (B) Range of Laboratory thermometer | (q) -10°C to 110°C |
| (C) Normal body temperature | (r) 37°C |
| (D) A liquid metal | (s) Mercury |
2. Which of the following devices is used for measurement of temperature of human body?
- (a) Thermometer
 - (b) Clinical thermometer
 - (c) Laboratory thermometer
 - (d) None of these

Solutions:

1. $A \rightarrow (p); B \rightarrow (q); C \rightarrow (r); D \rightarrow (s)$
2. (b) The measure temperature of human body we use clinical thermometer or doctor's thermometer.

TRANSFER OF HEAT

Since heat is a form of energy, it can be transferred from one part of a body to another part or from one body to another body. This transfer of heat depends upon the difference of temperatures between the two bodies.

The transfer of heat can take place by the following three modes:

- (1) Conduction (2) Convection (3) Radiation
- (1) **Conduction:** It is a mode of heat transfer from particle to particle without any actual movement of the particles.

E.g., if we heat one end of a metal rod the other end of the rod also becomes hot. Here the heat has travelled from the hot end to the cold end by the process of conduction.

All solids generally get heated by conduction.

Touching a hot object and being burnt, cooling down of your hand on holding ice are also examples of conduction of heat.

DID YOU KNOW?

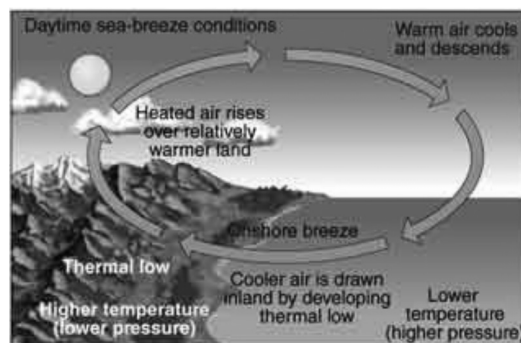
Mercury though a liquid is heated by conduction and not by convection.



- (2) **Convection:** It is a mode of heat transfer from one part of a medium to another part by the actual movement of the heated particles of the medium.

Generally all fluids (liquids and gases) get heated up by convection. The phenomena of sea breeze during the day and land breeze during the night are based on natural convection.

- (i) **Sea breeze:** During the day, the heat from the sun reaches the land and sea water on earth. But land gets heated up faster than the sea water, so the air in contact with the land is heated up and becomes lighter. As a result it rises up. The cooler air from above the sea moves down to fill the space. This creates a sea breeze.

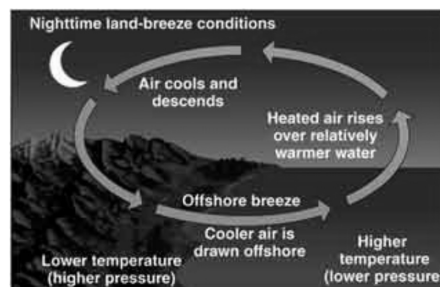


DID YOU KNOW?

If liquids and gases are heated from the top they transfer heat by conduction not by convection.



- (ii) **Land breeze:** At night the land loses its heat faster than the sea water. So the air above the sea water is warmer and it rises up. Therefore the cooler air above the land blows towards the sea and fills the space. As a result, the land breeze is set up.



- (iii) **Radiation :** Radiation is a mode of heat transfer from the source to the receiver without any actual movement of the source or the receiver and also without heating the intervening medium. Transfer of heat through radiation does not require any medium. We feel warm when we receive heat from the sun. This heat is transferred to us by the mode of radiation. Heat from fire is also an example of radiation. The greenhouse works on radiation. Heating up of a room through an electric heater happens because of radiation.

DID YOU KNOW?

Heat radiation travels with a velocity of light i.e. 3×10^8 m/s.



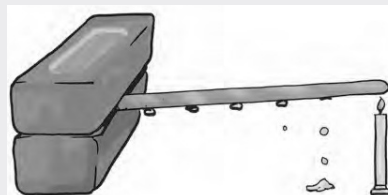


Let's Do Activity

Aim:- Observing the flow of heat through a metal strip.

Requirement:- A rod or flat strip of metal (aluminium or iron), a few small wax pieces, a stand or two bricks.

Procedure:- Take a rod or flat strip of metal, say of aluminium or iron. Fix a few small wax pieces on the rod at nearly equal distances as shown in figure below. Clamp the rod to the stand or you can put one end of the rod in between two bricks. Now, heat the other end of the rod.



Observation:- We observe that heat is transferred from the end nearest to the flame to the other end of the rod. This mode of heat transfer in solids is known as **conduction**.

Conclusion:- From the above observations, we conclude that conduction of heat by different materials like metallic rod, plastics is performed with different rates.



Let's Do Activity

Aim:- Observing the flow of heat through water.

Requirement:- A round bottom flask, a tripod, a candle, some amount of water, a crystal of potassium permanganate.

Procedure:- Take a round bottom flask. Fill it two-thirds with water. Place it on a tripod in such a way that you can heat it by placing a candle below it. Wait till the water in the flask is still. Place a crystal of potassium permanganate at the bottom of the flask gently using a straw. Now, heat the water by placing the candle just below the crystal as shown in figure below.

Observation:- We observe that when water is heated, the water near the flame gets hot and it rises up. The cold water from the sides moves down towards the source of heat. This water also gets hot and rises. This process continues till the whole water gets heated. This mode of heat transfer is known as **convection**.

Conclusion:- From the above observations, we conclude that the mode of flow of heat through a liquid is different from that through a solid.





CHECK POINT-2

1. Column I
(Transfer of heat)

- (A) Conduction
(B) Convection
(C) Radiation
(D) Absorption

Column II
(Medium)

- (p) Black surface
(q) Vacuum
(r) Air
(s) A solid medium

2. The flow of heat by conduction is generally observed in case of
(a) solids (b) liquids (c) gases (d) All of these

Solutions:

1. A → (s); B → (r); C → (q); D → (p)
2. (a) In solids heat flows from one part of the solid to another part by conduction.

CONDUCTORS AND INSULATORS

Conductors

Materials that allow heat energy to pass through them easily are called **conductors**. Metals are good conductors of heat.

Applications of Conductors

- The cooking utensils are made up of metals because they are conductors of heat, so they will allow the heat of flame to pass through them required to cook the food.
- Mercury is used as thermometric liquid because it is a good conductor of heat.
- Automobile radiators use tubes made of copper as it is a good conductor of heat. Being a good conductor, it absorbs the heat from the hot water in the engine and transmits it to the surroundings. For the same reason, air conditioners and refrigerators use copper tubes.
- The heat is passed onto the solder through the tip of soldering iron which is made of copper as copper is a good conductor of heat.

Insulators

Materials that do not allow heat energy to pass through them easily are called **insulators**. Substances like glass, wood, plastic, rubber and non-metals are generally insulators.

DID YOU KNOW?

Silver is the best conductor of heat followed by copper and aluminium.



Applications of Insulators

- Handles of cooking utensils are made up of insulators so that we can hold them through the insulated handle which do not become hot even when the utensil is very hot.
- We wear woollen clothes and use blankets in winter as they contain large amount of trapped air which is a bad conductor of heat and therefore does not allow heat energy to flow outward from our body. Thus, our body stops losing heat and we feel warm.
- The gap between double walls of an ice box is filled with glass, wool, which is a bad conductor of heat. It prevents the heat from flowing in so that ice does not melt.

**Let's Do Activity**

Aim:- Observing dark surfaces absorb more heat than light surfaces.

Requirement:- Two identical tin cans painted their outer surfaces with one black and other white, some amount of water.

Procedure:- Take two identical tin cans. Paint the outer surface of one black and of the other white as shown in figure below. Pour equal amounts of water in each and leave them in the mid-day sun for about an hour. Measure the temperature of water in both the cans.



Observation:- We observe that the temperature of both the cans are different. The temperature of water in black painted can is more than that of water in white painted can.

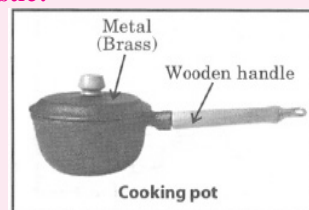
Conclusion:- From the above observation, we conclude that dark surfaces absorb more heat. We feel comfortable with dark coloured clothes in winter. Light coloured clothes reflect most of the heat that falls on them, and therefore, we feel more comfortable wearing them in summer.

**Illustration 3 :**

Why cooking pot is made of metal but its handle is made of wood or plastic?

Solution :

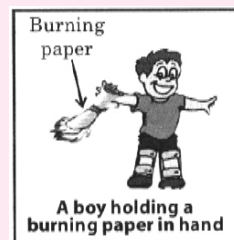
A cooking pot is made of metal because metals are good conductors of heat and heat is needed to cook the food. Heat does not pass through bad conductors of heat. So the knob of the lid and the handle of the pot are made of it (plastic/wood) will NOT get hot so we can hold them to lift the lid or to carry the pot.

**Illustration 4 :**

A boy is holding a paper rolled in the shape of a cone with one end burning what will happen?

Solution :

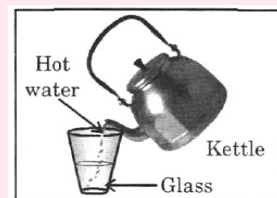
Heat does not pass through a bad conductor/insulator. Paper is a bad conductor of heat. Thus the heat, due to burning at one end will not pass to the other end, held by the boy. He will not feel the heat. He can hold the burning paper till the flames reach near his hand, or comes in direct contact with his hand.

**Illustration 5 :**

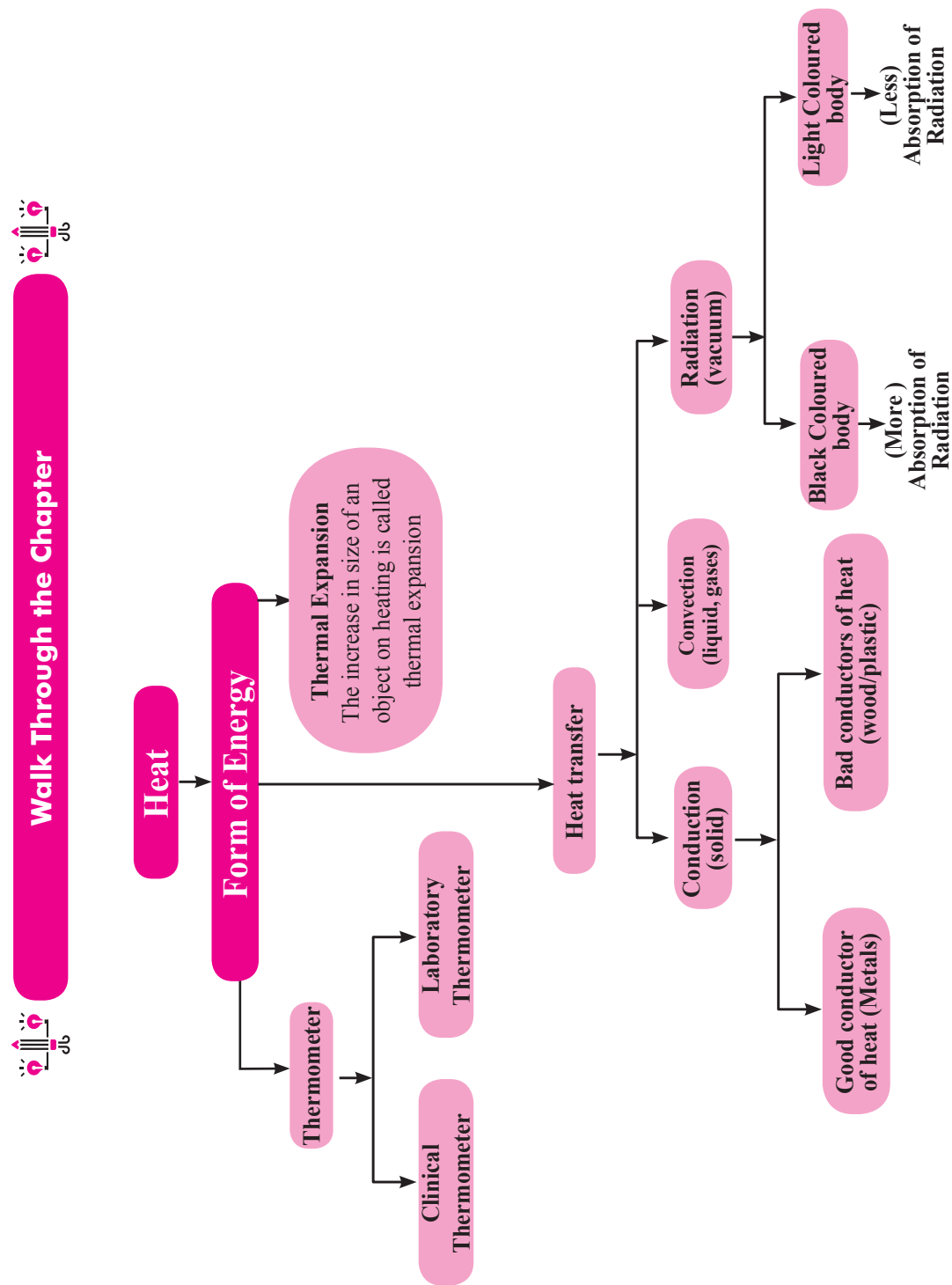
Boiling hot water is poured into a glass with thick bottom. What is likely to happen

Solution :

The glass cracks because the inside of the glass gets very hot and start to expand. The outside of the glass, however is cooler and doesn't expand as the inside. This happens because glass is bad conductor of heat. This uneven expansion results in cracking of glass.



Walk Through the Chapter





Let's Revise Through FIB & T/F

1. When we come out in the sun we feel _____. (T/F)
2. The hot bodies radiate _____. (T/F)
3. Temperature is measure of _____ of an object. (T/F)
4. The temperature of boiling water cannot be measured by a _____ thermometer. (T/F)
5. Heat flows from a _____ surface to _____ surface. (T/F)
6. Normal temperature of human body is 37°F . (T/F)
7. The maximum and minimum temperature of the day is measured by doctor's thermometer. (T/F)
8. The thermometer has a shining thread of water. (T/F)
9. Heat can be seen with a special device. (T/F)
10. Our sense of touch about hotness or coldness is not always reliable. (T/F)
11. Normal temperature of human body is 98.6°C . (T/F)
12. In all cases heat flows from a hotter object to a colder object. (T/F)
13. Marking on clinical thermometer is from 0°C to 100°C . (T/F)
14. Shining thread in thermometer is the column of mercury. (T/F)
15. The maximum and minimum temperature of the day is measured by a laboratory thermometer. (T/F)
16. No medium is required for transfer of heat by the process of _____. (T/F)
17. All hot bodies _____ heat. (T/F)
18. The three modes of heat transfer are radiation, _____ and conduction. (T/F)
19. Water at higher temperature feels more hot. (T/F)
20. Wool is a _____ conductor of heat. (T/F)
21. The water and air are _____ conductor of heat. (T/F)
22. Clothes of _____ colours absorb heat better than clothes of _____ colours. (T/F)
23. Wood is an insulator. (T/F)
24. Liquids conduct heat. (T/F)
25. The materials which allow heat to pass through them easily are called conductors. (T/F)
26. Water and air are good conductors of heat. (T/F)
27. Woollen clothes keep us warm in winter. (T/F)
28. Woollen clothes keep us warm during winter. (T/F)

EXERCISE -1

Master Board

Multiple Choice Questions

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. The reliable measure of hotness of an object is
 - (a) its heat content
 - (b) its temperature
 - (c) its contact with other objects
 - (d) None of these
2. The direction of flow of heat is
 - (a) always from hotter body to a cooler body
 - (b) always from cooler body to a hotter body
 - (c) always from a body at a lower temperature to a body at higher temperature
 - (d) All the above are correct
3. The normal temperature of human body is
 - (a) 35°C
 - (b) 37°C
 - (c) 39°C
 - (d) None of these
4. For a clinical thermometer we use a solid and a liquid. The liquid used in a clinical thermometer is
 - (a) a metal
 - (b) a non-metal
 - (c) neither a metal nor a non-metal
 - (d) None of the above is correct
5. In which mode of heat transfer does the transfer of heat occur as a wave?
 - (a) Conduction
 - (b) Convection
 - (c) Radiation
 - (d) All of these
6. Substances through which radiant heat can pass are called
 - (a) transparent
 - (b) diathermal
 - (c) athermal
 - (d) translucent
7. One feels sensation of heat when exposed to
 - (a) ultra violet rays
 - (b) infra-red rays
 - (c) X-rays
 - (d) gamma rays
8. In case of thermos flask the loss or gain of heat is prevented by
 - (a) conduction only
 - (b) convection only
 - (c) radiation only
 - (d) All of these
9. Which of the following is a good conductor of heat?
 - (a) Wood
 - (b) Plastic
 - (c) Aluminium
 - (d) None of these
10. Which of the following is an insulator?
 - (a) Wood
 - (b) Plastic
 - (c) Both of these
 - (d) None of these
11. Two laboratory thermometers are marked as 'A' and 'B'. The bulb of thermometer 'A' is wrapped in a white cloth and that of thermometer 'B' in black cloth. Both the thermometers are placed in sunlight for an hour. After one hour:
 - (a) Both the thermometers will read the same temperature.
 - (b) Thermometer 'A' will show higher temperature than 'B'
 - (c) Thermometer 'B' will show higher temperature than 'A'
 - (d) None of the above is correct.
12. Which one of the following will not help to cool down a cup of hot tea?
 - (a) Stirring the contents of cup continuously
 - (b) Adding a piece of ice to the cup of hot tea
 - (c) Pouring the hot tea in a saucer
 - (d) Adding more sugar to the cup of tea.
13. Suppose we take two identical size rods (one wooden rod and another iron rod) and wrap each one of them in a piece of paper, and heat, these rods with a candle flame. On being heated, the paper around the iron rod does not burn but the one around wooden rod catches fire. Which of the following is the possible reason for this?
 - (a) Iron being a good conductor, conducts away heat given to paper.
 - (b) Wood being an insulator, takes away all the heat.
 - (c) In case of iron rod, the candle is near the paper.
 - (d) Paper around iron rod is thicker.

14. In sea breeze
(a) cold air moves from sea towards land during day time.
(b) hot air moves from sea towards land during day time.
(c) cold air moves from land towards sea during day time.
(d) None of the above is correct
15. In land breeze
(a) cold air moves from sea towards land during night.
(b) hot air moves from sea towards land during night.
(c) cold air moves from land towards sea during night.
(d) None of the above is correct

Assertion & Reason Questions

DIRECTIONS : The questions on this segment consists of two statements, one labelled as "Assertion A" and the other labelled as "Reason R". You are to examine these two statements carefully and decide if the Assertion A and Reason R are individually true and if so, whether the reason is a correct explanation of the assertion. Select your answers to these items using codes given below.

- (a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (A) :** Radiation is a method of transfer of heat.
Reason (R) : The process of heat transfer that does not require any medium is called convection.
2. **Assertion (A) :** Temperature is a measure of degree of hotness of our body.
Reason (R) : We use a clinical thermometer to measure the degree of hotness of our body.
3. **Assertion (A) :** Heat always flows from a larger object to a smaller object.
Reason (R) : Various modes by which heat can flow are conduction, convection and radiation.

4. **Assertion (A) :** A clinical thermometer has a scale in the range of 37°C to 45°C
Reason (R) : The normal temperature of human body is 37°C .
5. **Assertion (A) :** Sea breeze refers to the movement of cold air from sea towards sea during time.
Reason (R) : Land breeze refers to the movement of cold air from land towards sea during night time.
6. **Assertion (A) :** Temperature is a measure of degree of hotness of our body.
Reason (R) : We use a clinical thermometer to measure the degree of hotness of our body.
7. **Assertion (A) :** A clinical thermometer has a scale in the range of 37°C to 45°C .
Reason (R) : The normal temperature of human body is 37°C .
8. **Assertion (A) :** Glass tumbler breaks in winter when hot water is poured to it.
Reason (R) : When hot water is poured, the outer surface of glass expands.

Very Short Answer Questions

DIRECTIONS : Give answer in one word or one sentence.

1. What is heat?
2. What is temperature?
3. Name the device which is used to measure temperature of an object.
4. What is clinical thermometer?
5. Name an other type of thermometer.
6. Which metal is used in the bulb of a thermometer?
7. What is the S.I unit of temperature?
8. What is the range of clinical thermometer?
9. What is the normal temperature of our body?
10. Is the body temperature of every person 37°C ?
11. What is laboratory thermometer?
12. What is the range of laboratory thermometer?
13. What is the use of kink in clinical thermometer?
14. What do you mean by the transfer of heat?
15. What are the various methods of transfer of heat?

16. What are conductors? Give two examples of good conductors of heat.
17. What are insulators? Give two examples of insulators.
8. Why do we use mercury in the thermometer in place of water?
9. What are the various modes of transfer of heat?
10. What do you mean by conduction mode of transfer of heat energy?
11. What is convection?
12. Why is the handle of a metallic kettle covered with strips of cane?

Short Answer Questions

DIRECTIONS : Give answer in 2-3 sentences.

1. What are the effects of heat?
2. What is clinical thermometer? Explain with diagram.
3. What is the limitation of clinical thermometer?
4. What is maximum and minimum thermometers?
5. What is laboratory thermometer?
6. What are the precautions needed while reading a laboratory thermometer?
7. Explain an activity to show the measuring temperature of water with laboratory thermometer.

Long Answer Questions

DIRECTIONS : Give answer in 4-5 sentences.

1. Explain the sea breeze and land breeze.
2. Difference between heat and temperature.
3. Write a short note on radiation.
4. Explain the working of a thermo flask.
5. What are conductors of heat and insulators? Discuss their practical application.

EXERCISE -2

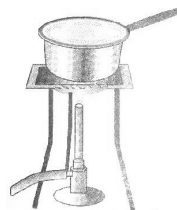
NCERT Questions

Text Book Questions

1. State similarities and differences between the laboratory thermometer and the clinical thermometer.
2. Give two examples each of conductors and insulators of heat.
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.

4. Match the following:

(A) Land breeze blows during	(p) summer
(B) Sea breeze blows during	(q) winter
(C) Dark-coloured clothes are preferred during	(r) day
(D) Light-coloured clothes are preferred during	(s) night
5. Discuss why wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece of clothing.
6. Look at Fig. mark where the heat is being transferred by conduction, by convection and by radiation.

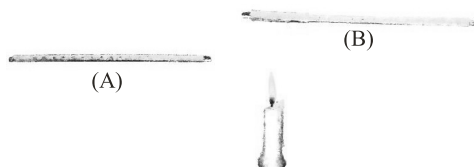


Heat transferred by conduction
by convection and by radiation

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

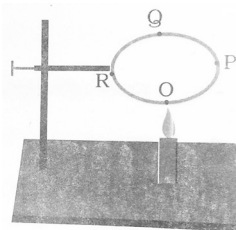
Exemplar Questions

1. Shopkeepers selling ice blocks usually cover them with jute sacks. Explain why.
2. A laboratory thermometer A is kept 7 cm away on the side of the flame while a similar thermometer B is kept 7 cm above the flame of a candle as shown in Figure.

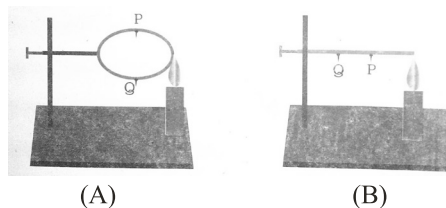


Which of the thermometers, A or B, will show a greater rise in temperature? Give reason for your answer.

3. To keep her soup warm Paheli wrapped the container in which it was kept with a woollen cloth. Can she apply the same method to keep a glass of cold drink cool? Give reason for your answer.
4. In a mercury thermometer, the level of mercury rises when its bulb comes in contact with a hot object. What is the reason for this rise in the level of mercury?
5. A circular metal loop is heated at point O as shown in Fig.



- (i) In which direction would heat flow in the loop?
- (ii) In which order the pins at points P, Q and R fixed with the help of wax fall if points O, P, Q and R equidistant from each other?
6. In the arrangements A and B shown in Figure, pins P and Q are fixed to a metal loop and an iron rod with the help of wax. In which case are both the pins likely to fall at different times? Explain.



7. For setting curd, a small amount of curd is added to warm milk. The microbes present in the curd help in setting if the temperature of the mixture remains approximately between 35°C to 40°C . At places, where room temperature remains much below the range, setting of curd becomes difficult. Suggest a way to set curd in such a situation.

8. You may have noticed that a few sharp jerks are given to clinical thermometer before using it. Why is it done so?
9. Why is it advised not to hold the thermometer by its bulb while reading it?
10. At a camp site there are tents of two shades – one made with black fabric and the other with white fabric. Which one will you prefer for resting on a hot summer afternoon? Give reason for your choice. Would you like to prefer the same tent during winter?
3. Which is greater 1° rise in the Celsius scale or a 1° rise in the Fahrenheit scale?
4. Can a clinical thermometer be used to measure the temperature of boiling water? Why?
5. Why is a laboratory thermometer not used to measure body temperature?
6. You have seen that an ordinary glass tumbler can crack if very hot or very cold water is poured into it. You have two glass tumblers made of ordinary glass one with thick walls and the other with very thin walls. Which one is more likely to crack when very hot or very cool water is poured into them?

HOTS Questions

1. Clinical thermometer have such a narrow range. Explain.
2. You are planning to go to a very cold place where the night temperature drops to 50°C .

EXERCISE -3

Foundation Builder

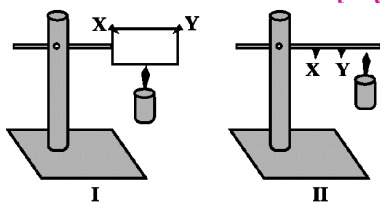
Multiple Choice Questions

DIRECTIONS : This section contains multiple choice questions. Each questions has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. The clinical thermometers presently in use in India are marked with a temperature scale. This scale corresponds to which of the following?
 - (a) Celsius (b) Farenheit
 - (c) Both (a) and (b) (d) None of these
2. A clinical thermometer can read temperatures between
 - (a) 30°C to 40°C (b) 35°C to 42°C
 - (c) 0°C to 100°C (d) -10°C to 110°C
3. The range of laboratory thermometers is generally.
 - (a) 0°C to 100°C (b) 0°C to 110°C
 - (c) -10°C to 100°C (d) -10°C to 110°C
4. The glass tube used for construction of a thermometer should be
 - (a) long (b) narrow
 - (c) uniform (d) All of these
5. Which of the following thermometers does not use mercury?
 - (a) Clinical thermometers
 - (b) Laboratory thermometers
 - (c) Digital thermometers
 - (d) All of these use mercury
6. In which of the following ways can heat flow from one body to another?
 - (a) By conduction (b) By convection
 - (c) By radiation (d) By all of these
7. In the process of flow of heat by conduction
 - (a) there is no movement of the substance
 - (b) the heat transfer takes place from higher temperature part of body to lower temperature part of body
 - (c) occurs when one end of an iron rod is heated on a burner
 - (d) All the above are correct
8. When a liquid in a beaker is heated on a gas burner
 - (a) heated molecules becomes less dense and rise
 - (b) colder molecules from above move down and get heated

- (c) the heat is transferred by convection
(d) All of these are correct
9. The process of transfer of heat by convection generally occurs in
(a) solids and liquids
(b) liquids and gases
(c) liquids only (d) gases only
10. Which of the following is a poor conductor of heat?
(a) Air (b) Wool
(c) Both of these (d) None of these
11. Which of the following is a good conductor of heat?
(a) Water (b) Air
(c) Both of these (d) None of these
12. 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
13. In the arrangements shown in the figures I and II, pin X and pin Y are fixed to a metal loop and a thin iron rod with the help of wax. The pins will fall at different times in arrangement

[Olympiad]



- (a) I (b) II
(c) In both I and II (d) Cannot say anything
14. Which is not a unit of measuring temperature?
(a) Kelvin (b) Celsius
(c) Pascal (d) Fahrenheit
15. Sagging of electric wires in summer is because of
(a) contraction of wires on heating.
(b) expansion of wires on heating.
(c) unchanging nature of wires.
(d) None of these

More than One Option Correct

DIRECTIONS : This section contains multiple choice question. Each question has 4 choices (a), (b), (c) and (d) out of which ONE OR MORE may be correct.

1. Why mercury is used in thermometer?
(a) It is cheap
(b) It does not stick to the walls of glass
(c) It expands uniformly when heated
(d) It is a good conductor of heat
2. Which of the following statements about the expansion of matter is not true?
(a) Expansion of matter is used in construction of thermometers.
(b) Expansion of matter has both advantages and disadvantages.
(c) Expansion varies with amount of heating.
(d) Expansion of matter leads to decrease in mass of substance.
3. Which of the following things is good conductor(s) of heat?
(a) Copper (b) Steel
(c) Silver (d) Aluminium
4. Which of the following effect heat energy brings?
(a) Change in temperature
(b) Change in state
(c) Change in mass
(d) Chemical change

Passage/Case Based Questions

DIRECTIONS : Read the passage(s) given below and answer the questions that follow.

Passage - I

A clinical thermometer is used to measure the body temperature of human beings. It consists of a long, narrow, uniform glass tube. It has a bulb at one end. The bulb contains mercury. This thermometer reads temperatures from 35°C to 42°C .

1. A clinical thermometer can be used to measure the body temperature of human beings. A person suffering with fever is likely to show which of the following readings on this thermometer?

- (a) 35°C (b) 36°C
(c) 37°C (d) 39°C
2. What for is a clinical thermometer provided with a kink?
- (a) To keep the mercury within the range of 35°C – 42°C.
(b) To allow the temperature reading to remain unchanged after the use of temperature until a jerk is given.
(c) To make the thermometer size smaller.
(d) All of the above are correct
3. Which of the following precautions should be used while using a clinical thermometer?
- (a) It should be washed before use.
(b) It should be washed after use.
(c) It should be washed preferably with some antiseptic.
(d) All the above.

Passage - II

Take a rod or flat strip of a metal such as iron or aluminium. Fix a few small wax pieces on the rod. Fix these pieces at equal distances and clamp the rod to stand in a horizontal position. Now, heat the farther end (away from clamped position) of the rod with the help of a burner. Observe the changes in wax pieces.

4. The wax piece that melts first is one
- (a) that is farthest away from the clamped end of the rod.
(b) that is nearest to the clamped end of the rod.
(c) that is in the middle of the rod.
(d) any one of the wax pieces may melt first.
5. In this activity the heat travels from one end of the rod to the other end of the rod by
- (a) Conduction (b) Convection
(c) radiation (d) All of these
6. In this activity heat travels from
- (a) higher temperature to lower temperature.
(b) lower temperature to higher temperature.
(c) Both ends to the middle of rod.
(d) None of these is correct.

Passage - III

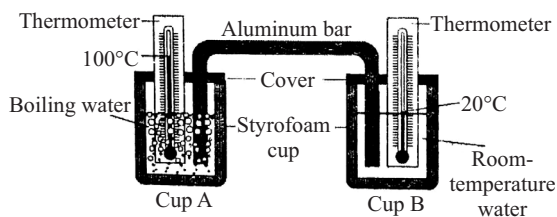
Light a candle, Keep one hand above the candle

flame and one hand on the side of the flame. Do you feel any difference in degree of hotness felt by two hands?

7. Which hand feels more hot?
- (a) The hand that was kept above the flame.
(b) The hand that was kept on the side of the flame.
(c) Both hands feel equally hot.
(d) None of these is correct.
8. In this activity the mode of transfer of heat is
- (a) conduction (b) convection
(c) radiation (d) None of these
9. How does the heat travel in air?
- (a) The air near the heat source gets hot and rises.
(b) The air from sides come to take its place.
(c) In this way air gets heated.
(d) All the above are correct.

Passage - IV

The thermometers below shows the temperature of the water in cup A and cup B at the beginning of a heat-flow experiment.



10. Over the next 15 minutes, which changes would most likely occur?
- (a) The temperature in cup A will decrease and the temperature in cup B will increase.
(b) The temperature in cup A will decrease and the temperature in cup B will decrease.
(c) The temperature in cup A will increase and the temperature in cup B will increase.
(d) The temperature in cup A will increase and the temperature in cup B will decrease.

- ### Passage - VI

Anomalous expansion of water. If some water is taken at 0°C and heated, it will be found that in the temperature range 0° to 4°C , it contracts instead of expanding. On heating if further above 4°C , its volume increases. Similarly, if water which is initially at a temperature above 4°C is cooled, it contracts till the temperature of water reaches 4°C . On further cooling it below 4°C its volume would increase instead of decreasing.

(a) expands
(b) contracts
(c) remains same
(d) may expand or contract

- (a) nature of the substance
(b) rise in temperature
(c) both A and B
(d) colour of the substance

Assertion & Reason Questions

DIRECTIONS : The questions in this segment consists of two statements, one labelled as “Assertion A” and the other labelled as “Reason R”. You are to examine these two statements carefully and decide if the Assertion A and Reason R are individually true and if so, whether the reason is a correct explanation of the assertion. Select your answers to these items using the codes given below.

- Both A and R are true and R is the correct explanation of A.
- Both A and R are true but R is not the correct explanation of A.
- A is true but R is false.
- A is false but R is true.

1. **Assertion (A) :** Telephone wires sag more in summer.

Reason (R) : They expand due to summer heat.

2. **Assertion (A) :** Glass tumbler breaks in winter when hot water is water to it.

Reason (R) : When hot water is poured, the outer surface of glass expands.

3. **Assertion (A) :** When metallic objects are touched in winter, they give a colder sensation as compared to wooden objects.

Reason (R) : Metals conduct heat faster than wood.

4. **Assertion (A) :** Temperature decreases with increasing height above sea level.

Reason (R) : Atmosphere is mainly heated by conduction from the earth.

5. **Assertion (A) :** Cloudy days are cooler than clear days.

Reason (R) : Clouds do not permit the radiation of the sun to reach the earth.

6. **Assertion (A) :** Heat always flows from a larger object to a smaller object.

Reason (R) : Various modes by which heat can flow are conduction, convection and radiation.

7. **Assertion (A) :** When a body A at temperature 50°C is brought in contact with a body B at temperature 30°C , heat flows from the body A to the body B.

Reason (R) : Heat always flows from a body at a low temperature to a body at a high temperature.

8. **Assertion (A) :** Sea breeze blows during daytime.

Reason (R) : The air above the sea is hot and moves toward land.

9. **Assertion (A) :** Two bodies at the same temperature may contain different amounts of heat.

Reason (R) : Two bodies may require different amounts of heat to maintain or acquire same temperature.

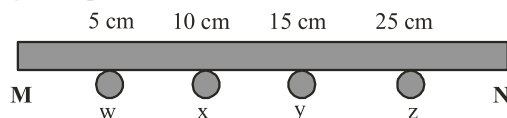
10. **Assertion (A) :** The flow of heat energy from one body to the other depends upon the amount of heat energy in them.

Reason (R) : Heat flows from lower temperature of the body to higher temperature of the body.

Integer Type Question

DIRECTIONS : Following are integer based questions, each questions when worked out will result in on integer from 0 to 9 (both inclusive)

1. Look at the diagram carefully and answer the given question.



Given above is a metal rod of length 50 cm. 4 drops of wax, w, x, y and z are placed at the distance of 5 cm, 10 cm, 15 cm and 25 cm respectively from the end M.

(a) When heated from the end M, drop w comes off first in 2 minutes time. What will be the time taken for the drops x and y to fall?

SOLUTIONS

Brief Explanations of Selected Questions

Let's Revise Through FIB and T/F

- | | |
|-------------------|-------------|
| 1. Warm | 2. Heat |
| 3. Hotness | 4. Clinical |
| 5. Hotter, colder | 6. False |
| 7. False | 8. False |
| 10. True | 11. False |
| 13. False | 14. True |
| 16. Radiation | 17. Radiate |
| 19. True | 20. Poor |
| 22. Dark, white | 23. True |
| 25. True | 26. False |
| 28. True | |

EXERCISE-1

Master Board

Multiple Choice Questions

- (b) The reliable measure of hotness of an object is its temperature.
- (a)
- (b) Normal temperature of human body is 37°C .
- (a) Mercury (liquid) used in clinical thermometer is a metal.
- (c) In radiation heat is transferred as a wave.
- (b)
- (b)
- (d)
- (c) Aluminium is a good conductor of heat.
- (c)
- (c)
- (d)
- (a)
- (a)
- (c)

Assertion & Reason Questions

- | | | | |
|--------|--------|--------|--------|
| 1. (c) | 2. (b) | 3. (d) | 4. (d) |
| 5. (b) | 6. (b) | 7. (d) | 8. (c) |

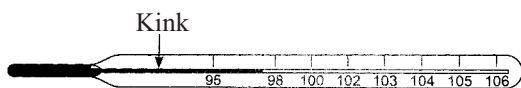
Very Short Answer Questions

- Heat is a form of energy. It helps us to feel hotness and coolness.
- The measure of hotness or coldness is called temperature.
- Thermometer.
- The thermometer which is used to measure our body temperature is called clinical thermometer.

- The other type of thermometer is called celsius thermometer.
- Mercury.
- The S.I unit of temperature is kelvin.
- 35°C to 42°C
- 37°C
- No, the temperature of every person may not be 37°C .
- The thermometer used to measure the temperature of various objects is called laboratory thermometer.
- -10°C to 110°C
- It prevents mercury level from falling on its own.
- The heat flows from a hotter object to a colder object. This process is called transfer of heat.
- There are three methods of transfer of heat:
(i) Conduction (ii) Convection
(iii) Radiation
- The substances which allow heat to pass through them are called conductors. Copper and iron.
- The materials which do not allow heat to pass through them are called insulators. Plastic and wood.

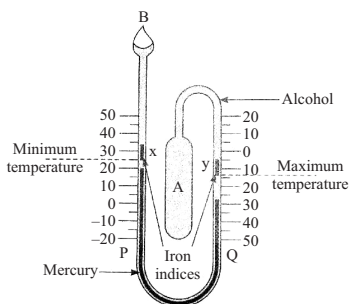
Short Answer Questions

- Effects of heat :** Heat energy can cause many changes in an object. On heating objects become hotter, they may expand. Heat may change state of the body. For example, ice changes into water. Heat can also increase the speed of chemical reactions. Heat even kills harmful bacteria. That is why boiled water is generally given to a patient suffering from water borne disease.
- The most common thermometer used almost in every house in clinical thermometer. We use it to measure the temperature of human body, when some one has fever. The normal temperature of body in clinical thermometer is 37°C or 98.4°F .



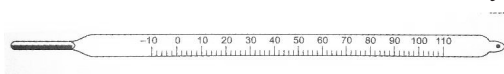
Clinical thermometer

3. We can not use clinical thermometer for measuring the temperature of any object more than 42°C (more than body temperature). It may break in keeping in the sun or near a flame.
4. A thermometer used to measure the maximum and minimum temperature of previous day is called Maximum-Minimum thermometer. It is used by the weather department to report/predict the weather.



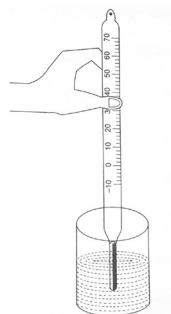
Maximum and minimum thermometer

5. The thermometer which is used to measure the temperature of other objects is called laboratory thermometer. The range is -10°C to 110°C . It also contains a thread of mercury.

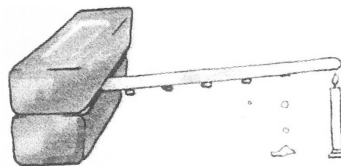


Laboratory thermometer

6. (i) The thermometer should be kept upright not tilted.
(ii) Bulb should be surrounded from all the substance of which the temperature is to be measured.
(iii) The bulb should not touch the surface of the container.
7. Take some hot water in a beaker. Dip the thermometer in water as shown in the figure. Keep it for some time in the water till the mercury thread becomes steady. Note the temperature of hot water.

Measuring temperature of water
With an laboratory thermometer

8. (i) Mercury expands more than water.
(ii) Mercury do not stick on the walls of the thermometer like water.
(iii) Mercury can be easily collected when thermometer breaks.
9. The heat energy flows from a point at higher temperature to a point of lower temperature. When the temperature of two points become equal the flow of heat energy is stopped. There are following three modes of transfer of heat energy: (i) Conduction (ii) Convection (iii) Radiation.
10. The process by which heat is transferred from hotter end to colder end of an object is called conduction. In this process, molecules of the substance do not move but heat energy is transferred. In solids generally, the heat is transferred by the process of conduction.



11. The mode of heat transfer in which molecules of a fluid actually move after taking heat is called convection. Mostly is liquids and gases (including air) heat is transmitted by the process of convection.
12. Handle of metallic kettle is covered with strips of cane because when kettle is heated, the heat does not pass through strips of cane. The strips of cane are bad conductor of heat and we may hold the handle with our bare hands.

Long Answer Questions

1. At sea-shore during the day cold air from the sea moves towards the beach because the land gets more heated than the the sea water. Hot air above the land rise up, and cold air from the sea moves towards the land beach. This is called sea breeze as shown in Fig (a). During the night cold air from the land moves towards the sea because the land cools more quickly than the sea water. So hot air above the sea rises up and cold air from the land moves towards the sea. This is called and breeze as shown in Fig (b).

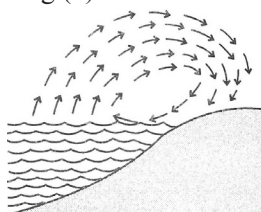


Fig (a) Sea breeze

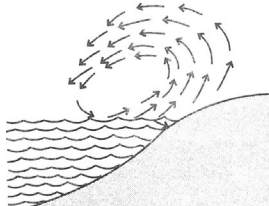


Fig (b) Land breeze

2. Difference between heat and temperature:

Heat	Temperature
(a) It is a form of energy	(a) It is a thermal condition of body.
(b) It flows from one object to other when object when there is a difference in temperature.	(b) It is a quantity that indicates whether or not and in which direction heat will flow.
(c) It is the total amount of internal energy of a body.	(c) It is proportional to average kinetic energy of the molecules of a body.
(d) In the transmission of heat, total amount of heat remains same.	(d) In the transmission of heat, temperature does not remain same.
(e) It is a cause.	(e) It is an effect
(f) Its S.I. Unit is Joule.	(f) Its S.I. Unit is Kelvin (K).

3. The solar energy cannot reach to us by the process of conduction or convection as there is no medium such as air, in most part of the space between the earth and the sun. This process of heat transfer is called radiation. The transfer of heat by radiation does not require any medium. When you sit in front of a room heater or bonfire you feel warm. We get heat by radiation because air is a poor conductor of heat, heat is not transferred through conduction. Convection is also not possible in this case as convection current rise upwards and not sideways. Further if we put an insulating material like a cardboard between the fire and ourselves, we no longer feel hot. This shows air around us remains cold and is not involved in transferring heat to us from the heat source. Further heat is transferred to us by radiation only in the straight path.

All hot bodies radiate heat when the heat falls on some object, it divides into three parts:

- a part of it is reflected.
- a part of it gets absorbed.
- a part of it may be transmitted.

The temperature of the object rises due to the absorbed part of the heat.

4. Thermo flask is a special kind of flask for keeping liquids. It prevents loss or gain of heat by any of the three methods. It keeps liquid warm or cold for a long time. It was invented by Sir James Dewar in 1893.

It consists of a double-walled glass-cylinder. A vacuum is created in the space between the double walls. The two inner surfaces of glass walls are silvered. The flask is placed on a spring within a non-conduction cylindrical case to protect it from jerks and breakages. The gaps between flask and outer casing is packed with felt pads. The mouth of the flask is finally closed with a cork.

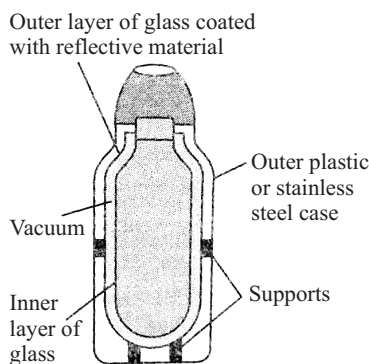


Fig. A thermo flask

Since the container is made of glass which is a bad conductor of heat and therefore, the loss or gain of heat due to conduction is prevented. As there is vacuum between the double walls, it prevents transmission of heat by convection. Due to silvering of the inner surfaces, the heat loss by radiation is prevented. The cork and the felt pads also help to preserve the heat inside the flask. So, the hot liquids like tea, coffee, etc., remain hot and cold liquids like water, juice, etc., remain cold for a long time.

5. Substances that allow heat energy to flow through them are called good conductors of heat, e.g., metals. Substances that do not allow heat energy to flow through them are insulators, e.g., wood, plastic, glass, etc.

(a) Practical applications of good conductors of heat:

- (i) Cooking utensils are made of metals so that heat can easily get transferred to food.
- (ii) Coils of refrigerators and air conditioners are made of copper to conduct away heat.
- (iii) Mercury is used as a thermometric liquid in thermometers.

(b) Practical applications of insulators:

- (i) Handle of cooking utensils are made of insulators like bakelite, wood, etc.
- (ii) Woollen clothes are insulators and keep up warm in winter.
- (iii) Hair and fur in animals are insulators. So they keep them warm during winter.

EXERCISE-2

NCERT Questions

Text Book Questions

1. Similarities:

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

Differences:

- (i) A clinical thermometer shows temperature range from 35°C to 42°C , while a laboratory thermometer shows ranges between -10°C to 110°C .
 - (ii) Clinical thermometer has a kink near the bulb while there is no kink in laboratory thermometer.
2. (i) Conductors of heat : Copper, iron.
(i) Insulators : Plastic, wood (dry).
3. (a) temperature (b) clinical
(c) celsius (d) radiation
(e) conduction (f) dark
4. $A \rightarrow (s)$; $B \rightarrow (r)$; $C \rightarrow (q)$; $D \rightarrow (p)$
5. Wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece clothing because the air trapped between the two layers of clothes. This air prevents the flow of the heat from our body to the cold surroundings.
6. In this figure, the heat is transferred at three points in different ways:
- (i) by radiation : from lower surface to upper surface of the pan.
 - (ii) by conduction : from lower surface to upper surface of the pan.
 - (iii) by convection : from the base to the upper region of pan water.
7. White colour reflects most of the heat that falls on it. When the outer walls of the houses in the places of hot climate are painted white, they reflect the heat falling on them and thus help in keeping the houses cool.

8. (d) Between 30°C and 50°C.
9. (b) Not flow from iron ball to water or from water to iron ball.
10. (d) Does not become cold.
11. (c) Copper is a better conductor of heat than the stainless steel.

Exemplar Questions

1. They must use some insulating material like, sack, saw dust, newspaper, etc. to cover the ice.
2. Thermometer B will show a greater rise in temperature because hot air rises up or air on the top of the candle flame is getting heated by convection.
3. Yes. Wool is poor conductor of heat.
4. Mercury expands when heated. Hence, it rises in the capillary tube.
5. (i) The heat will flow in both the directions i.e. from O to P and O to R.
(ii) At first the pins at R and P will fall simultaneously followed by the pin at Q.
6. In case 'B' the pin P will fall before the pin Q because the heat will reach pin P first. In case 'A', the heat travels in both the directions and pins P and Q will fall simultaneously.
7. (i) In order to maintain the desired temperature of the mixture, the container can be wrapped either by woollen material or any other poor conductor of heat. Alternately, the mixture can be kept in a heat resistant container.
(ii) The container can be kept in the sun or near the gas stove while cooking.
8. The jerk to the thermometer will allow the mercury in or above the kink to flow into the bulb so that the mercury level is below normal temperature.
9. If we hold a thermometer by its bulb, the mercury in the bulb will expand due to our body temperature.
10. (i) On a hot summer afternoon the tent made up of white fabric will be preferred as white colour is a bad absorber and good reflector of heat.
(ii) No, the black fabric tent will be preferred during winter.

HOTS Questions

1. It is because the temperature of a human body cannot fall below 35°C or go above 42°C. It is use to measure only human body temperature not in laboratory.
2. To measure the temperature of cold places where the night temperature drops to -50°C, we will use the alcohol thermometer. This is because alcohol freezes at -115°C, while mercury freezes at -38°C.
3. 1° rise in the Celsius scale is greater than a 1° rise in the Fahrenheit scale.

$$F_2 - F_1 = [(9/5) C_2 + 35] - [(9/5) C_1 + 35]$$

$$\Rightarrow 10F = (9/5)[C_2 - C_1]$$

$$\Rightarrow 10F = 0.56 \text{ times } [C_2 - C_1]$$
 Hence, for the same temperature increase, the increase on the Celsius scale is only by 0.56, while that on the Fahrenheit scale is by 1. Hence, 1° rise in the Celsius scale is greater than the 1° rise on the Fahrenheit scale.
4. A clinical thermometer has the temperature range from 35°C to 42°C. But the boiling point of water is 100°C. Therefore, it is not possible to measure the temperature of boiling water with a clinical thermometer.
5. Laboratory thermometers do not have Kink to prevent back flow of liquid into capillary tube as soon as taken out from our mouth.
6. In thin wall of glass more amount of heat passed per second as compared to thick. Thus, thin tumbler will crack first when same temp difference occurred for same time.

EXERCISE-3

Foundation Builder

Multiple Choice Questions

1. (a) The scale presently used in India for clinical thermometer is celcius scale.
2. (b) 3. (d) 4. (d)
5. (c) Digital thermometer do not use mercury.
6. (d) Heat can flow from one body to another by conduction, convection or radiation.
7. (d) 8. (d) 9. (b)
10. (c) 11. (a)
12. (b) Since the temperature are equal there will be no flow of heat.

13. (b) In the arrangement II, heat would reach to pin Y first, therefore it would fall first and after that pin x would fall.

14. (c) 15. (b)

More than One Option Correct

1. (b, c, d) 2. (a, b, c) 3. (a, c, d)
4. (a, b, d)

Passage/Case Based Questions

1. (d) Normal body temperature is 37°C . A person having fever will show higher temperature.
2. (b) 3. (d)
4. (a) The end that is heated is farthest away from the clamp stand end of the rod.
5. (a)
6. (a) The end that is heated is at a higher temperature.
7. (a) Towards top the air gets heated by convection but there is no convection on sides.
8. (b) 9. (d)
10. (a) Heat flows from body at higher temperature to body at lower temperature.

11. (b) 12. (d) 13. (a)

14. (a) Heat always flows from a hotter region to a colder one. Since iron is a good conductor of heat, more heat will flow from our body into it and we will feel it as cold. As paper is a bad conductor less heat will flow from our body.

15. (a)

16. (d) Gases expand the most upon heating because the intermolecular distance is more than in solids or liquids.

17. (b) Gases expand the most upon heating because of the large intermolecular distances and less intermolecular force between their molecules. Carbon dioxide being a gas will expand the most.

18. (c)

Assertion & Reason Questions

1. (a) 2. (c) 3. (a) 4. (a)
5. (a) 6. (d) 7. (c) 8. (c)
9. (d) 10. (c)

Integer Type Question

1. (a) $x - 4$ min, $y - 6$ min