JSR IAS ACADEMY

GENERAL SCIENCE

PHYSICS

HEAT - 2

Transfer of Heat

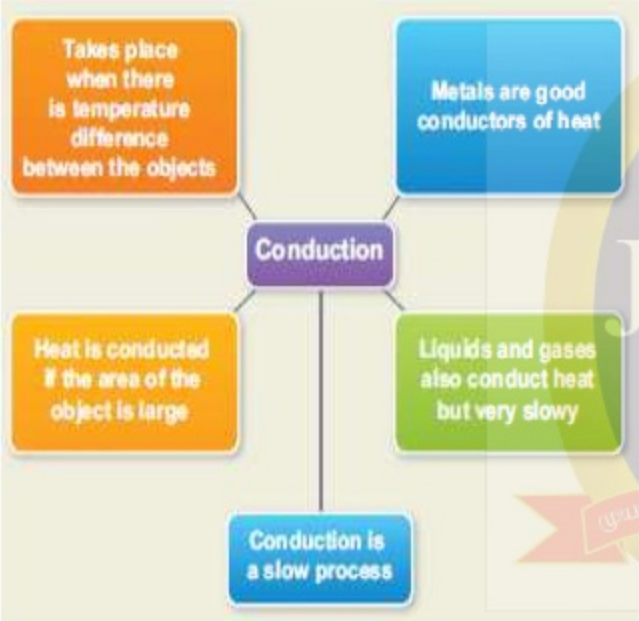
If heat energy is supplied to any substance, it will be transferred from one part of the substance to another part.

Three ways of heat transfer are:

a. Conduction
b. Convection
c. Radiation

Conduction

we can define conduction as the process of heat transfer in solids from the region of higher temperature to the region of lower temperature without the actual movement of atoms or molecules.



How did the other end of the spoon become hot?

- It is because heat in the hot water is transferred from one end to other end of the spoon.
- In solid substances such as silver spoon, atoms are arranged very closely.
- Hot water molecules which are vibrating transfer the heat energy to the atoms in the spoon and make them vibrate.
- Those atoms make other atoms to vibrate and thus heat is transferred to the other end of the spoon.
- In conduction heat transfer takes place between two ends of the same solid or through two solid substances that are at different temperatures but in contact with one another.

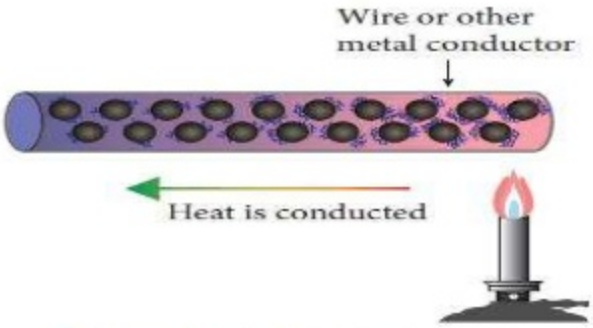


Figure 1.4 Conduction in Solids

Convection

- heat transfer from places of high temperature to places of low temperature by the actual movement of molecules is called convection.
- When water in the vessel is heated, water molecules at the bottom receive heat energy and move upward.
- Then the molecules at the top comes down and get heated.
- This kind of heat transfer is known as convection.
- This is how air in the atmosphere is also heated.
- Convection takes place in liquids and gases.

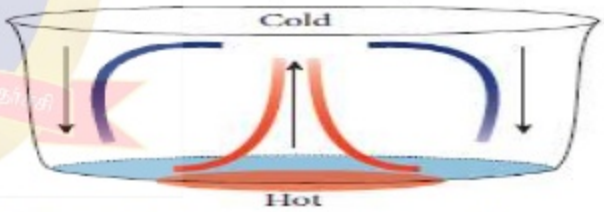


Figure 1.5 Convection in liquid

- When air is heated, the air molecules gain heat energy allowing them to move further apart. Warm air being less dense than cold air will rise.
- Cooler air moves down to replace the air that has risen. It heats up, rises and is again replaced by cooler air, creating a circular flow.

Figure 7.3 Convection in air

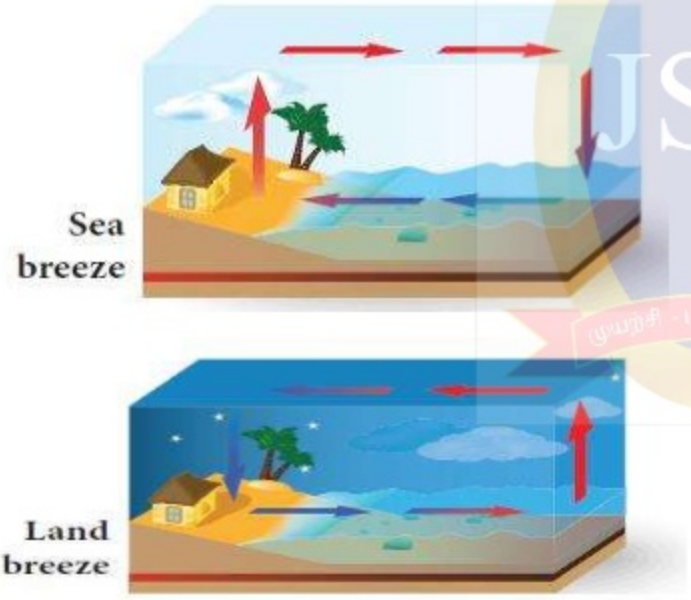
Convection in daily life

Hot air balloons:

- Air molecules at the bottom of the balloon get heated by a heat source and rise.
- As the warm air rises, cold air is pushed downward and it is also heated.
- When the hot air is trapped inside the balloon, it rises.

Breezes:

- During day time, the air in contact with the land becomes hot and rises.
- Now the cool air over the surface of the sea replaces it. It is called sea breeze.
- During night time, air above the sea is warmer.
- As the warmer air over the surface of the sea rises, cooler air above the land moves towards the sea. It is called land breeze.



Winds:

- Air flows from area of high pressure to area of low pressure.
- The warm air molecules over hot surface rise and create low pressure.
- So, cooler air with high pressure flows towards low pressure area. This causes wind flow.

Chimneys:

- As the hot gases and smoke are lighter, they rise up in the atmosphere.

Radiation

- Radiation is the third form of heat transfer.
- By conduction, heat is transferred through solids, by convection heat is transferred through liquids and gases, but by radiation heat can be transferred through empty space even through vacuum.
- Heat energy from the Sun reaches the Earth by this form of heat transfer.
- Radiation is defined as the way of heat transfer from one place to another in the form of electromagnetic waves.

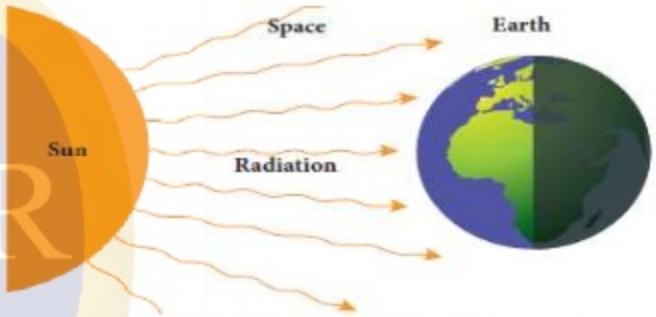


Figure 1.6 Heat transfer by radiation

Radiation is emitted by all bodies above 0 K.

Radiation in daily life

- Base of cooking utensils is blackened because black surface absorbs more heat from the surrounding.
- Surface of airplane is highly polished because it helps to reflect most of the heat radiation from the sun.
- While standing near fire we feel the heat which is transferred as radiation.
- White colour reflects heat radiation. That's why we are advised to wear white cloth during summer.

DO YOU KNOW?

Heat transfer by radiation is visible to our eyes. When a substance is heated to 500°C the radiation begins to become visible to the eye as a dull red glow, and it is sensed as warmth by the skin. Further heating rapidly increases the amount of radiation, and its perceived colour becomes orange, yellow and finally white.

DO YOU KNOW?

While firing wood, we can observe all the three ways of heat transfer. Heat in one end of the wood will be transfered to other end due to conduction. The air near the wood will become warm and replace the air above. This is convection. Our hands will be warm because heat reaches us in the form of radiation.

Effect of Heat

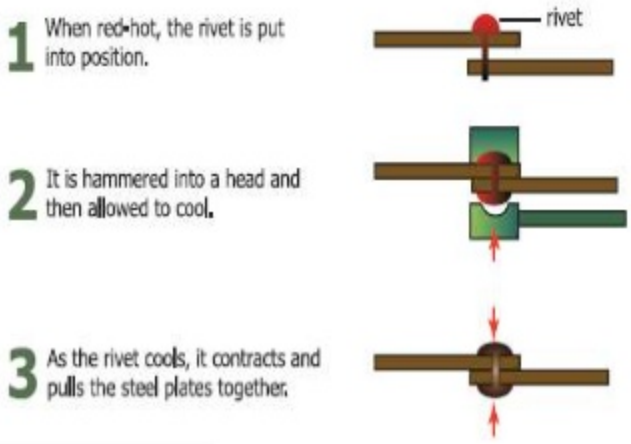
linear expansion and cubical expansion

The expansion in length is **called linear expansion** and the expansion in volume is called **cubical expansion.**

- Uses of Thermal Expansion Fitting the iron rim on the wooden wheel
- The diameter of the iron ring is slightly less than that of the wooden wheel. Therefore, it cannot be easily slipped on from the rim of wooden wheel.
- The iron ring is, therefore, first heated to a higher temperature so that it expands in side and the hot ring is then easily slipped over to the rim of the wooden wheel.
- Cold water is now poured on the iron ring so that it contracts in side and holds the wooden wheel tightly.

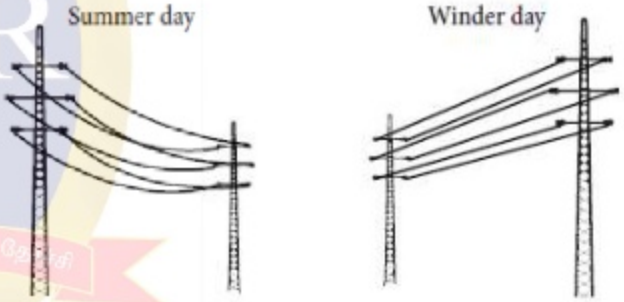
Rivetting

- Rivets are used to join two steel plates together.
- Hot rivet is driven through the hole in the plates.
- One end of the rivet is hammered to form a new rivet head.
- When cooled, the rivet will contract and hold the two plates tightly together.



Electric wires

- Electric wires between electric posts contract on cold days and sag in summers.
- To solve this problem, we leave wires slack so that they are free to change length.



DO YOU KNOW?

Glassware used in kitchen and laboratory are generally made up of Borosilicate glass (pyrex glass). The reason is that the Borosilicate glass do not expand much on being heated and therefore they do not crack.

DO YOU KNOW?

One day in 1922, the air temperature was measured at 59°C in the shade in Libya, Africa. The coldest temperature in the world was measured in the Antarctic continent. It was approximately – 89°C. The minus sign (–) is used when the temperature falls below the freezing point of water, which is 0°C. If water becomes ice at 0°C, you can imagine how cold – 89° C would be. Our normal body temperature is 37°C. Our body feels cool if the air temperature is around 15 to 20 degree Celsius.

Can you estimate the night temperature in your village or city during winter?

DO YOU KNOW?

You would have noticed some space being left in railway tracks. Why? It is because railway tracks which are made up of iron metal expand during summer. When there is a gap, there will not be any damage in the track due to expansion of the metal rod.

- Expansion is greater for liquids than solids and it is maximum in gases.