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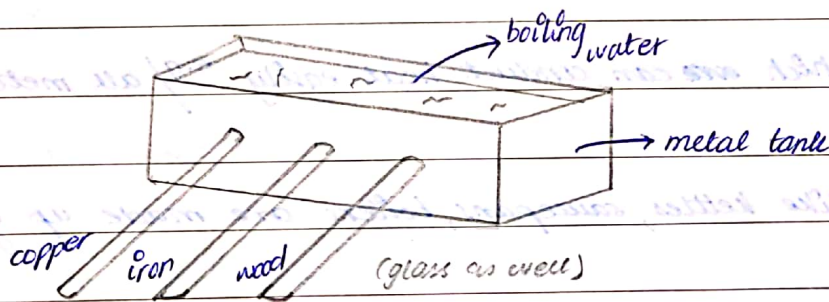
## TRANSFER OF THERMAL ENERGY

- thermal energy is produced when a rise in temperature causes atoms and molecules to move faster and collide with each other
- the energy that comes from the temperature of a heated substance is also thermal energy

### CONDUCTION

- the transfer of heat mainly through solids
- when heat is supplied to one end of the solid, the molecules of that side gain energy and vibrate vigorously
- the kinetic energy of the vibrating molecules is passed on to the neighboring molecules and so on
- this way, heat is transferred throughout the solid by vibration of molecules from one end to the other

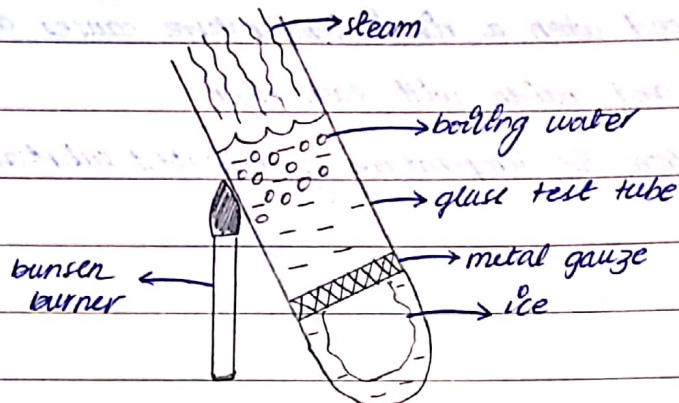
### Experiment to determine thermal conduction through different solids



- four rods of different material but the same size, coated with wax are inserted in a metal tank
- pour boiling water into the tank so that the ends are submerged
- the level to which wax melts on different rods determines the conduction rates of solid



## Experiment to demonstrate water is a poor conductor electricity



- place the ice cube at the bottom of the test tube which is filled with water
- cover the ice cube <sup>with a</sup> wire gauze so that the cube may not float
- to heat the test tube at the upper end
- it will be observed that the water boils at the top but the ice does not melt at the bottom
- this shows that water is a poor conductor of heat

### Application of Conduction:

#### (i). Good conductors

- the substances which can conduct heat easily e.g/ all metals are good conductors
- \* → cooking utensils like kettles, saucepans, boilers are made up of stainless steel
- \* → mercury, a good conductor, is used in thermometers
- \* → soldering iron rods are made of iron, with tip made of copper as copper is a much better conductor than iron

(ii). Bad Conductors

→ the substances which do not conduct heat are called bad conductors or insulators e.g/ glass, wood, plastic, rubber and materials containing trapped air like wool, fiber glass etc.

\* → handles of cooking utensils

\* → fiber glass and polystyrene foam which air are used in the walls of houses and refrigerators

\* → birds have feathers and animals like cats & polar bears have fur to trap air, which act as an insulator

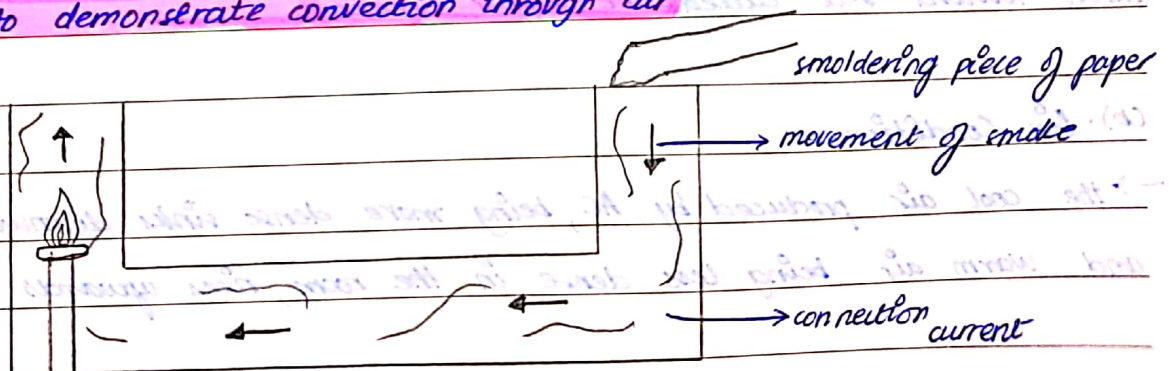
**CONVECTION**

→ transfer of heat through fluids (liquids and gases)

→ when heat is supplied to a liquid, the liquid expands and becomes less dense

→ the less dense liquid rises upwards and more dense liquid at the top sinks downwards

→ therefore, a cyclic process of liquid movement takes place due to density difference and heat is transferred throughout the liquid

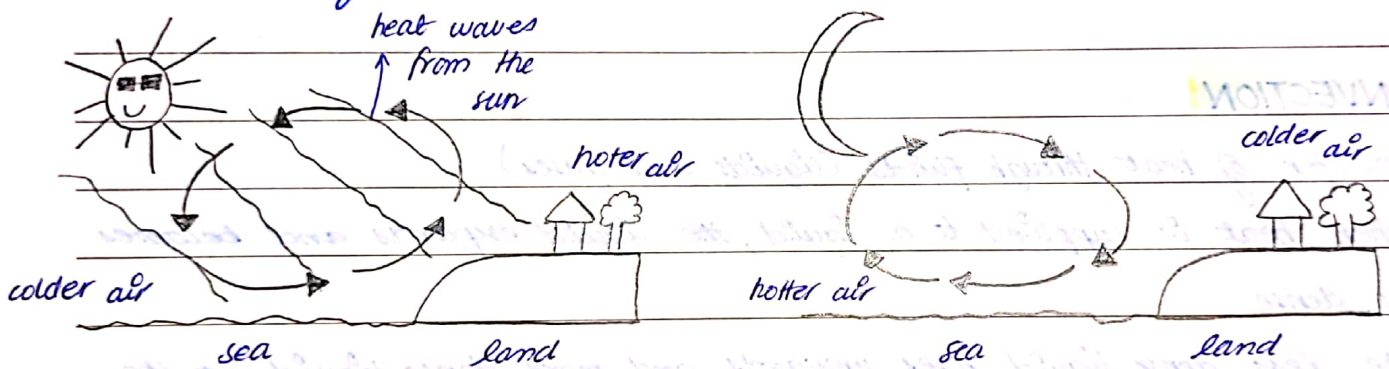
**Experiment to demonstrate convection through air**

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- keep the burning candle at the bottom of chimney A and smoldering paper at the top of chimney B
- the hot air above candle rises upwards and more dense air along with smoke enters from chimney B and travels towards chimney A
- the path of the smoke indicates presence of convection current

### Application of Convection:

#### (i). Formation of sea and land breeze



- during the day, hot air above the land expands and becomes less dense and rises upwards
- the cool air from the sea being more dense moves towards land, called the sea breeze
- at night reverse process occurs i.e. more dense air from land moves toward sea called the land breeze

#### (b). Air Conditioners

- the cool air produced by AC, being more dense sinks downwards and warm air being less dense in the room, rises upwards



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→ the warm air is cooled by AC and re-circulated producing convection current

### (c). Kettle

→ the heating coil of an electric kettle is placed at the bottom of the kettle

→ the water at the bottom is heated and becomes less dense, rises upwards

→ the cool water at the top sinks downwards, producing convection current

### Experiment to demonstrate convection through liquids

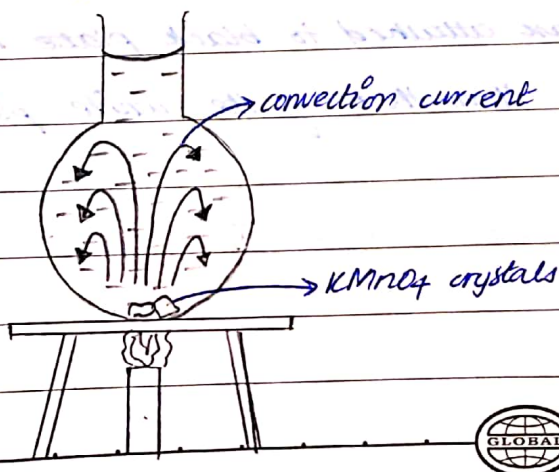
→ fill the flask with water

→ keep few crystals of potassium permanganate ( $KMnO_4$ ) at the bottom of the flask

→ heat the flask from the bottom

→ the water at the bottom being less dense rises upwards along with crystals of  $KMnO_4$

→ the purple streaks moving upwards and then downward are observed in the flask, which shows the presence of convection current

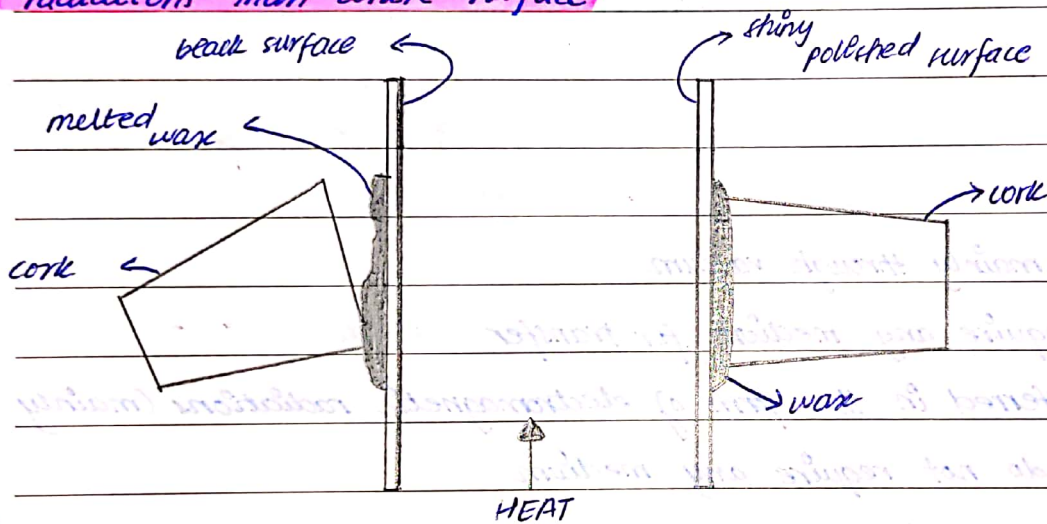


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## RADIATION

- the transfer of heat mainly through vacuum
- does not require any medium for heat transfer
- heat is transferred in the form of electromagnetic radiations (mainly infra red) which do not require any medium
- e.g/ heat energy from the sun reaches the earth by process of radiation

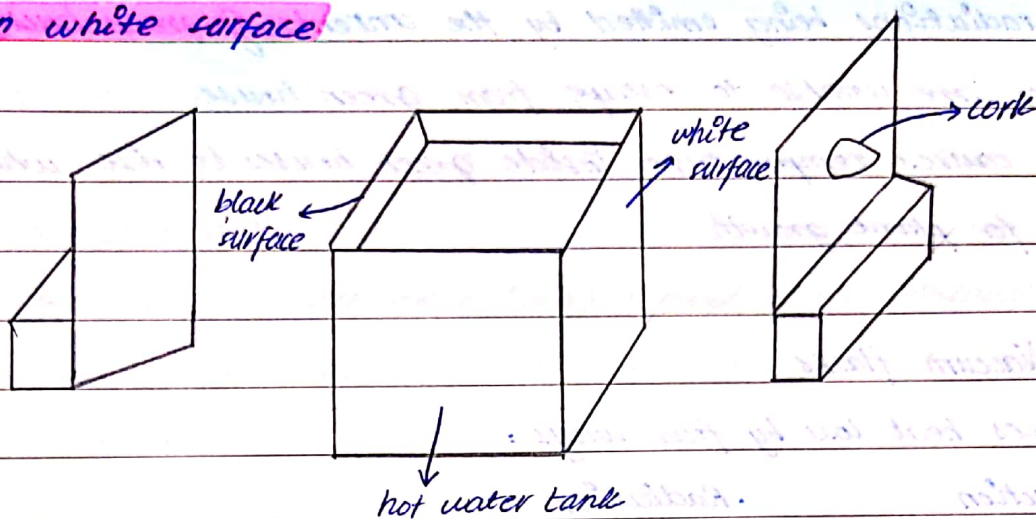
Experiment to demonstrate that black surface absorbs more infra red radiations than white surface



- two metal plates of same size, one is dull black and one smooth shiny
- sticks corks with wax on opposite sides of the plates
- heat the plates equally
- it will be observed that the wax attached to black plate melts and the cork falls down earlier than that of the white plate

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Experiment to demonstrate that black surface emits more infra-red radiations than white surface



- take a metal tank and fill it with hot water
- make one side of the container dull black and other shiny white
- keep two metal plates holding wax and cork at equal distances on both sides of the tank
- it will be observed that wax melts earlier and cork falls down from the plate facing black side of the tank

### Applications of Radiation :

(i). Shiny teapots

- shiny teapots can keep warm for longer time than black teapots as shiny surfaces are bad emitters of heat

(ii). Green house

- the radiations from sun pass through glass walls and glass roof of green house



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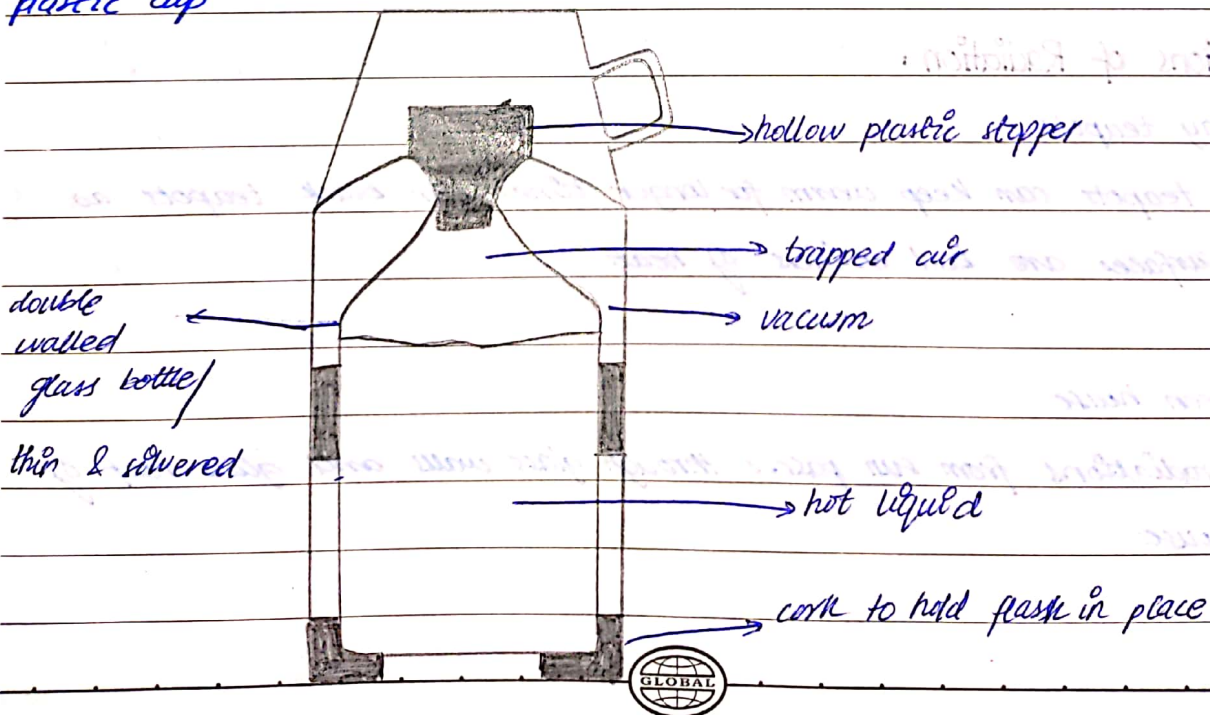
- the radiations are absorbed by the soil and the plants
- the radiations being emitted by the contents of green house being weaker are unable to escape from green house
- this causes temperature inside green houses to rise which is good for plant growth

### (iii). Vacuum flasks

→ reduces heat loss by four ways :

- Conduction
- Radiation
- Convection
- Evaporation

- the heat lost by conduction is minimized by vacuum, trapped air and plastic stopper
- the heat lost by convection is minimized by vacuum and plastic stopper
- the heat lost by radiation is minimized by polishing the walls of silvered glass
- the heat lost by evaporation is minimized by plastic stopper and plastic cup





## Heat Transfer in or from a room or building:

### \* Into building or room

→ by conduction through walls and roof

→ the atoms and molecules of roof gain heat energy and pass it on till heat is conducted inside

→ heat radiations can pass into the building through glass windows

→ the hot roof and walls emit infra-red radiations into the room which keeps it warm

### \* From a building

→ the heat from the building is conducted outside by walls and roof, due to vibration of atoms or molecules which lose energy to surroundings

→ the heat energy from roof is lost by convection i.e. air comes in contact with roof, becomes hot and rises upwards

→ the roof being hotter than the surroundings emit infra-red radiations and loses energy

## Thermal Insulation of a building

→ heat loss can be prevented by

1. Fitting carpets on the floor

2. Insulating the roof

3. Using cavity walls

4. Using wooden ~~floor~~ floors

5. Painting walls and roof white

6. Using double glazed windows

7. Using fiber glass and polystyrene in walls and roof.

