Thermal expansion subtopics:-

1)specific heat capacity
2) Calorimetry
3)Change of state
4)Latent heat
5)Heat transfer
i)Conduction ii)convection iii)Radiation

Specific Heat Capacity

- Specific heat of a substance is defined as the quantity of heat required to raise the temperature of unit mass of a substance through 1◦C(1 K).
- The amount of heat required to change the temperature of a substance is directly proportional to the mass of the substance and change in the temperature θ.

FORMULA OF SPECIFIC HEAT CAPACITY

$$Q = mc\theta$$

m = mass	(kg)
c = specific heat capacity	(J kg^{-1} $°C^{-1}$)
θ = temperature change	(°C)

Specific heat of a gas

- At constant volume

The quantity of heat required to raise the temperature of unit mass of a gas through 1K when its volume is kept constant.

- At constant pressure

The quantity of heat required to raise the temperature of unit mass of a gas through 1K when its pressure is kept constant.

Molar specific heat of gas

- At constant volume
- The quantity of heat required to raise the temperature of one mole of the gas through 1K(1°C).when its volume is kept constant.

- At constant pressure
- The quantity of heat required to raise the temperature of one mole of the gas though 1K(1°C) .when its pressure is kept constant.

The number of molecules in one mole of a gas is given by Avogadro's number

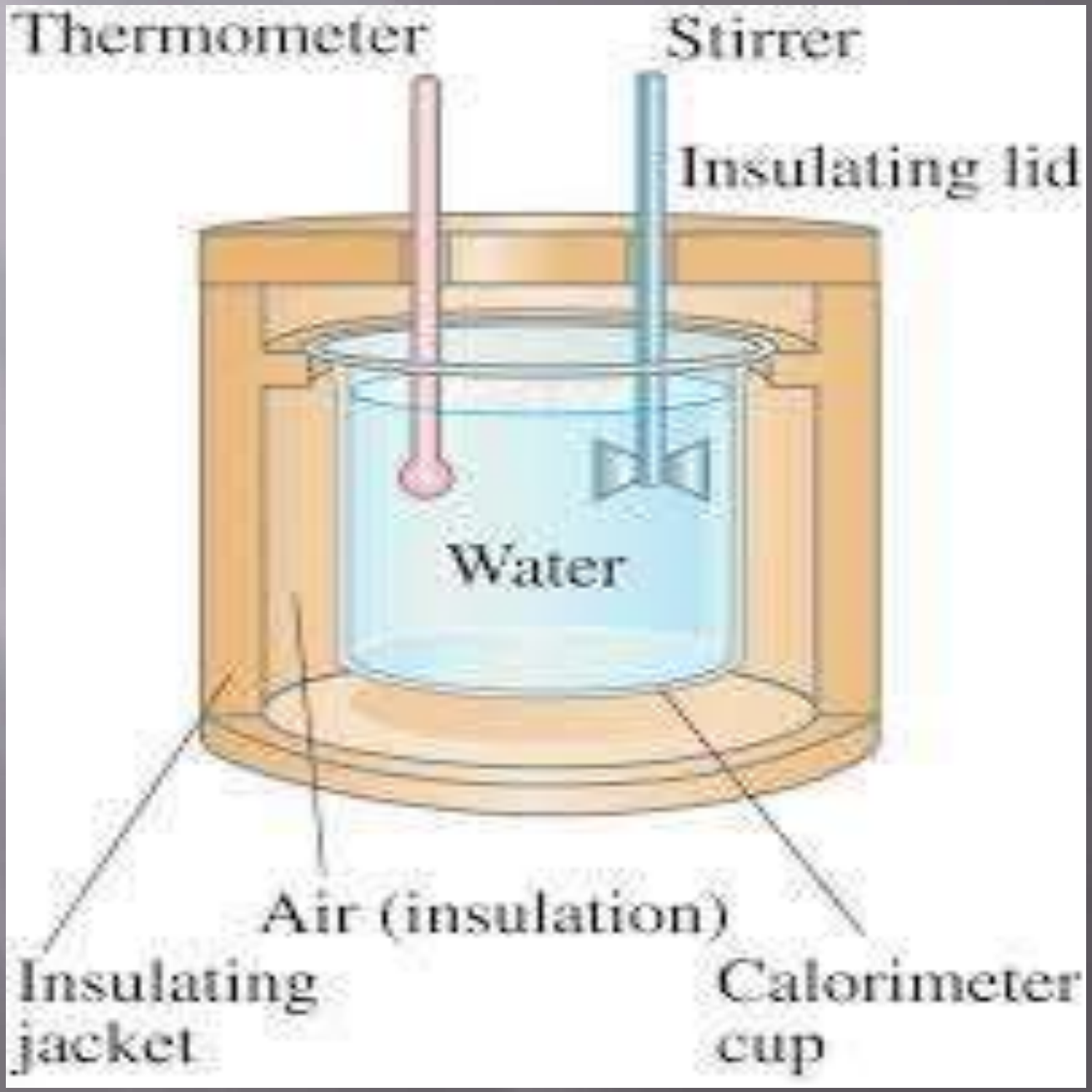
23

N=6.023×10^ molecules per mole=6.023×10^26 molecules per kilomole .

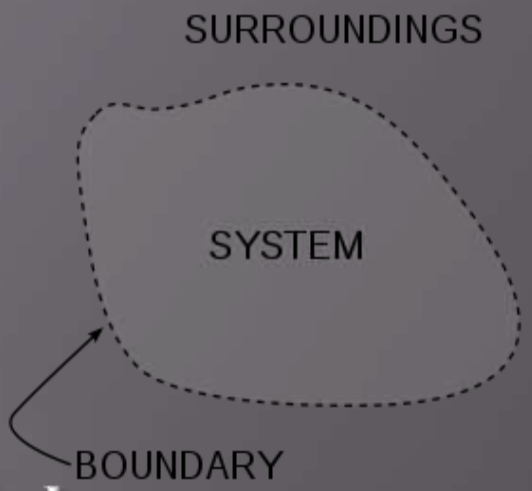
The SI unit of molar specific heat is J/K and mole K.
The molar specific heat = molecular weight ×principal specific heat.
Cp =M × cp and Cv= M × cv

Calorimetry

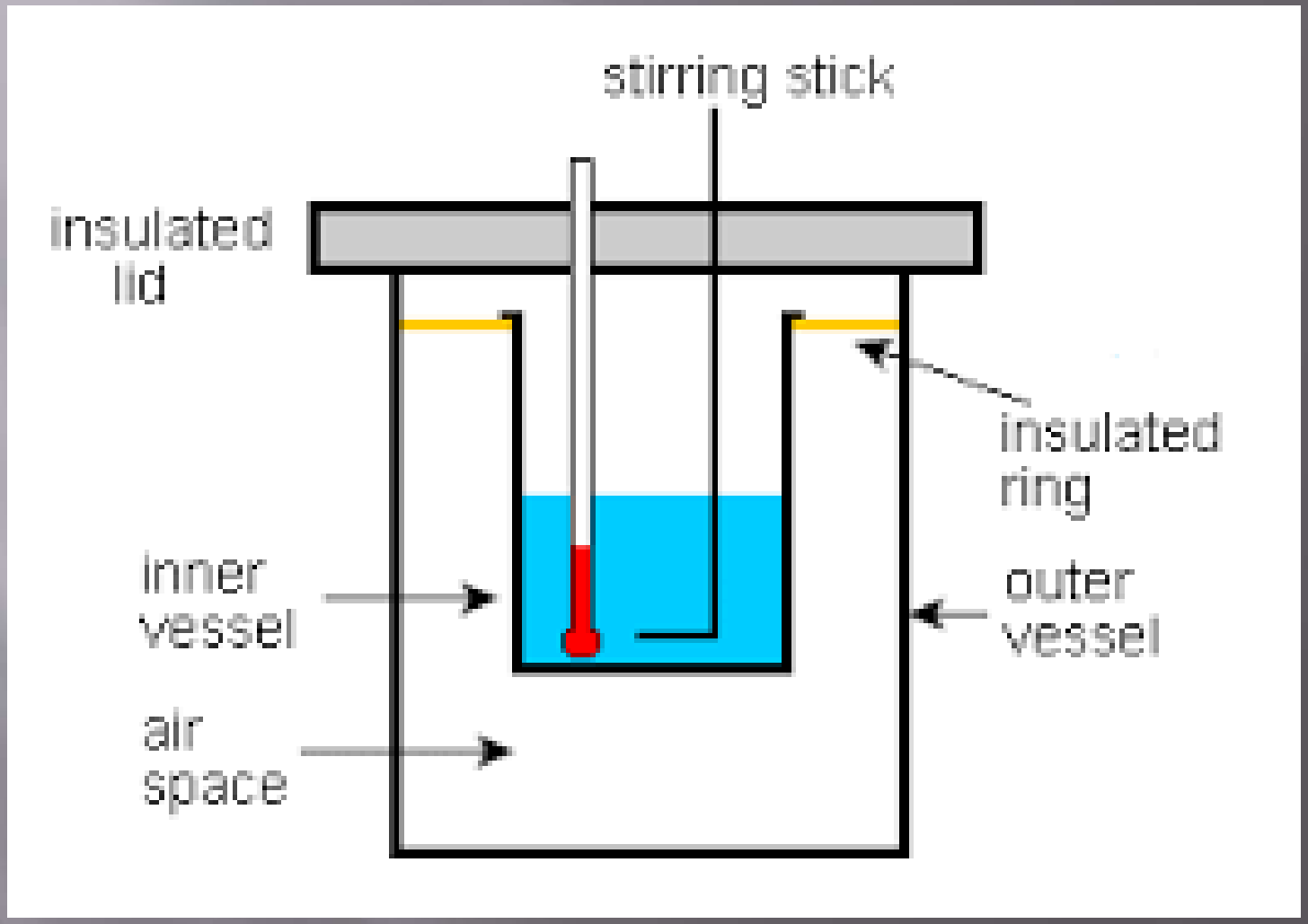
- Calorimetry means measurement of heat.
- A device in which heat measurement can be made is called calorimeter.


Thermometer
Stirrer
Insulating lid
Water
Air (insulation)
Insulating jacket
Calorimeter cup

Isolated system-



Isolated system means if no exchange or transfer of heat occurs between the system and its surroundings.


stirring stick
insulated lid
insulated ring
inner vessel
outer vessel
air space

Structure of Calorimetry

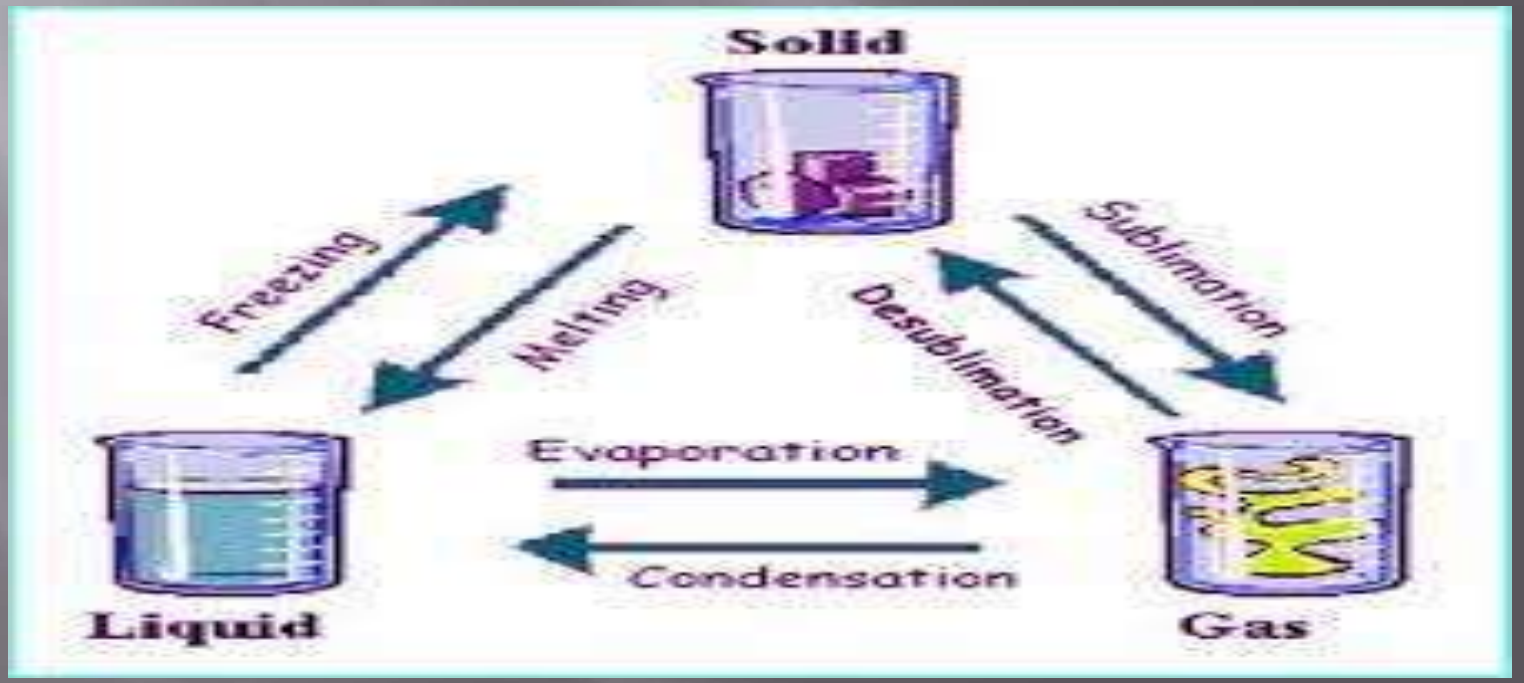
- It consist of metallic vessel and stirrer Of the same material like copper or aluminium .
- The vessel is kept inside a wooden jacket which contains heat insulating materials like glass ,wool etc.
- The outer jacket acts as a heat reduce the heat loss from the inner vessel
- There is opening in the outer jacket through which a mercury thermometer can be inserted into the calorimeter.
- It is used to determine specific heat of a substance.

Change Of State

Example : water (Solid ,liquid ,Gas)

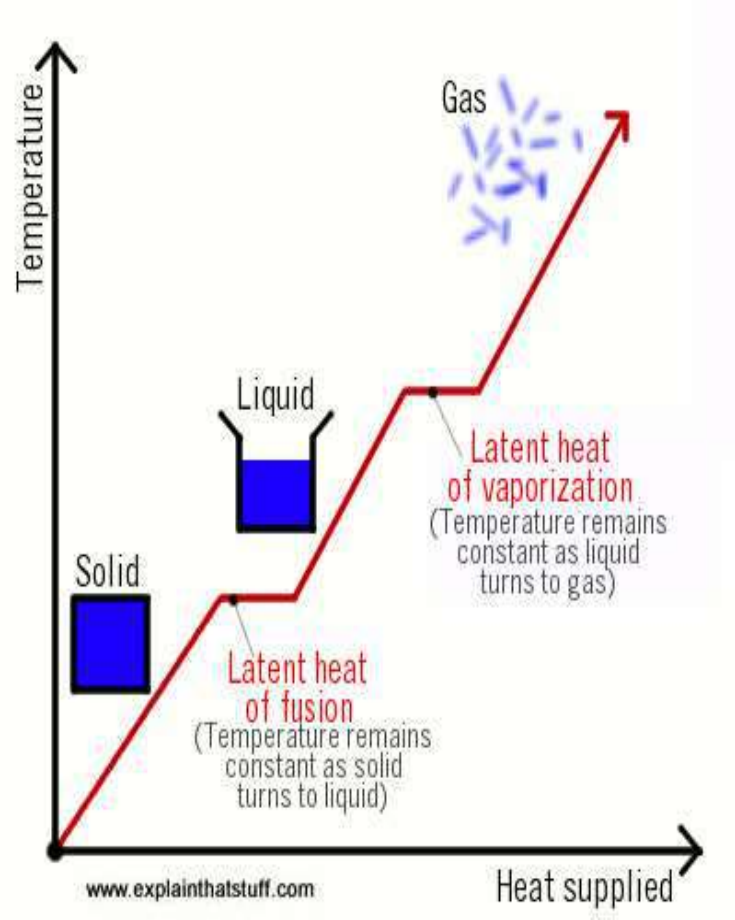
Three states

1. Solid (Ice)
2. Liquid (Water)
3. Gas (Steam)



- At standard pressure the temperature at which a substance changes its state from solid to liquid is called melting point. Melting point of water is 0°C.
- At standard pressure the temperature at which a substance changes its state from liquid to gas is called boiling point. boiling point of water is 100°C.

Latent heat



Latent heat of a substance is the quantity of heat required to change the state of unit mass of the substance without changing its temperature.

Two types

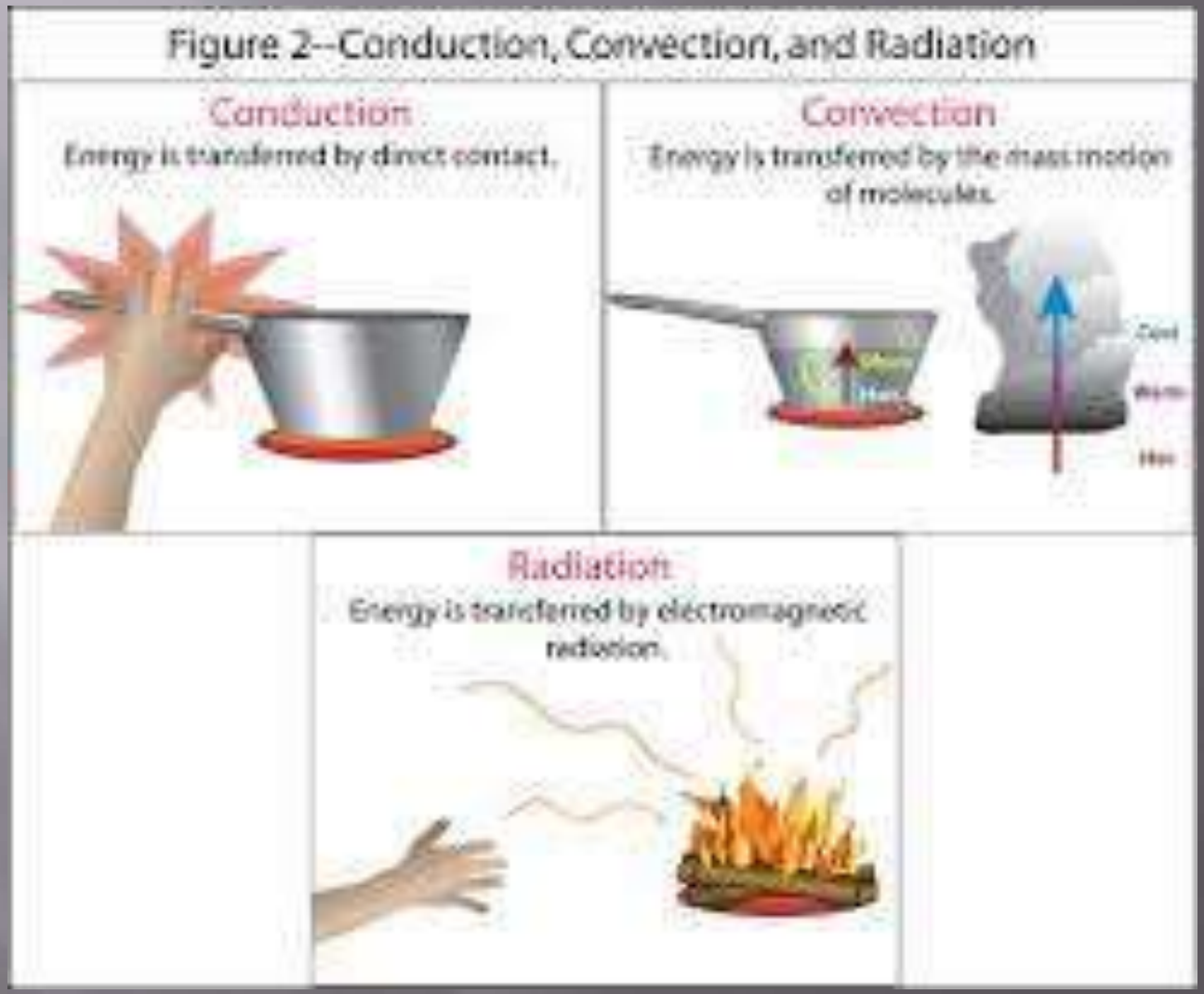
- **Heat of fusion**

The quantity of heat required to convert unit mass of a substance from its solid state to the liquid state , at its melting point , without any change in its temperature .

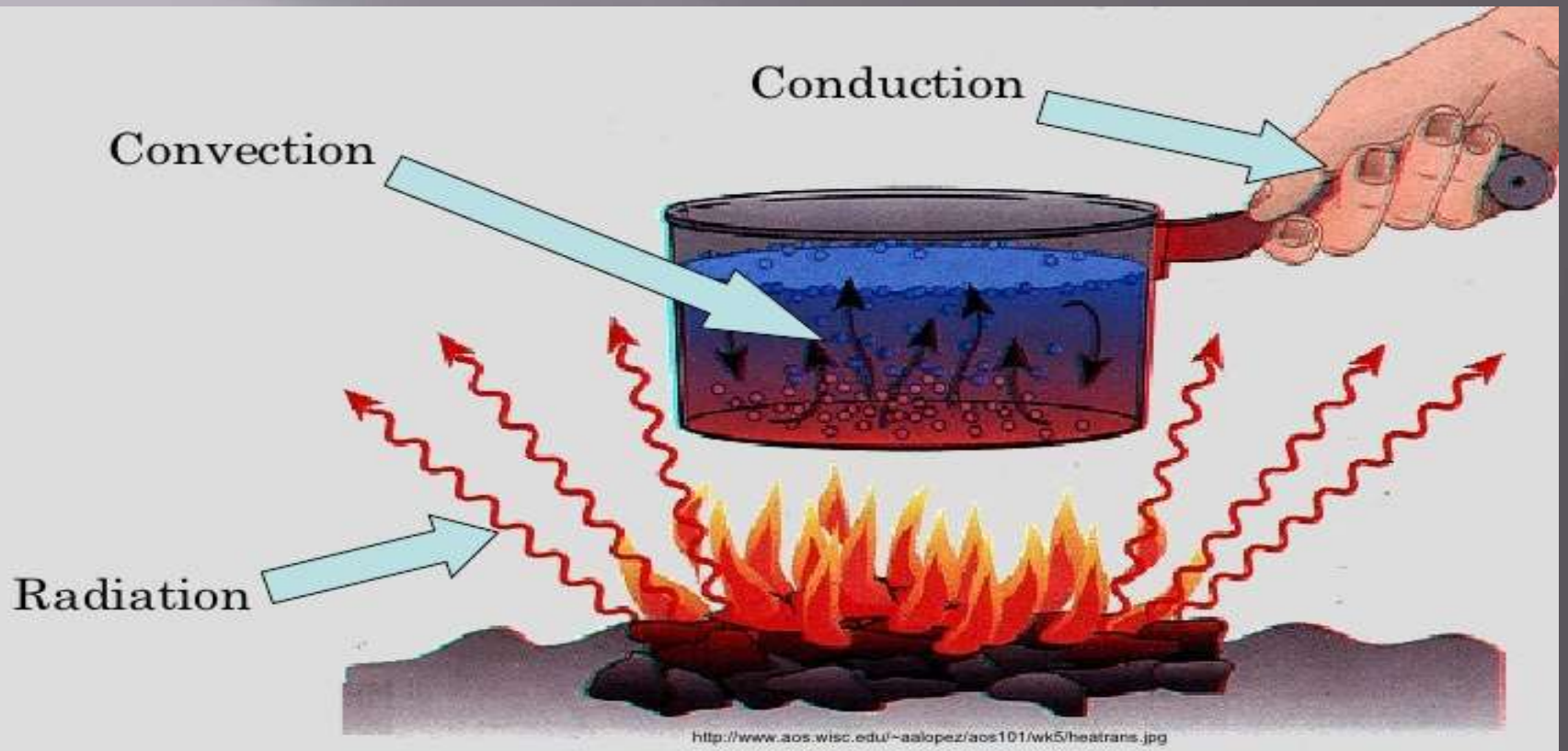
- **Heat of vaporisation**

The quantity of heat required to convert unit mass of a substance from its liquid state to vapor state , at its boiling point ,without any change in its temperature .

Three types of heat transfer



3 types of heat transfer



This picture illustrates all three type of heat transfer.
Can you identify them all?

Conduction

In this case the molecules of the rod do not move from their positions, but the heat travels from the hotter to the colder part . This transmission of heat is called conduction.

For conduction of heat to take place from one point to another following condition must be satisfied-

1) The two points should be at different temperatures.

2)There should be a medium between the two points .

The substances , which conduct heat easily ,are called good conductors. All metals are good conductor of heat.

E.g. steel, silver , aluminium etc.

The substances , which do not conduct heat easily ,are called bad conductors of heat or insulators.

e.g. glass ,wood , air , paper, cloth etc.

Conduction through metal rod

- Consider a long uniform metal bar AB
- Having number of drilled at equal distances.
- To read temperature , a sensitive thermometer is placed in each of the holes.
- The thermometer T1 which close to the hot end first shows rise in the temperature. Then thermometers T2,T3,T4 respectively show rise in the temperature.
- Consider small portion D, which receives heat from C. It absorbs the part of the heat received, hence there is a rise in the temperature and transfer heat to its neighbouring cooler portion E. During the process , some part of the heat is lost by radiation from its exposed surface .

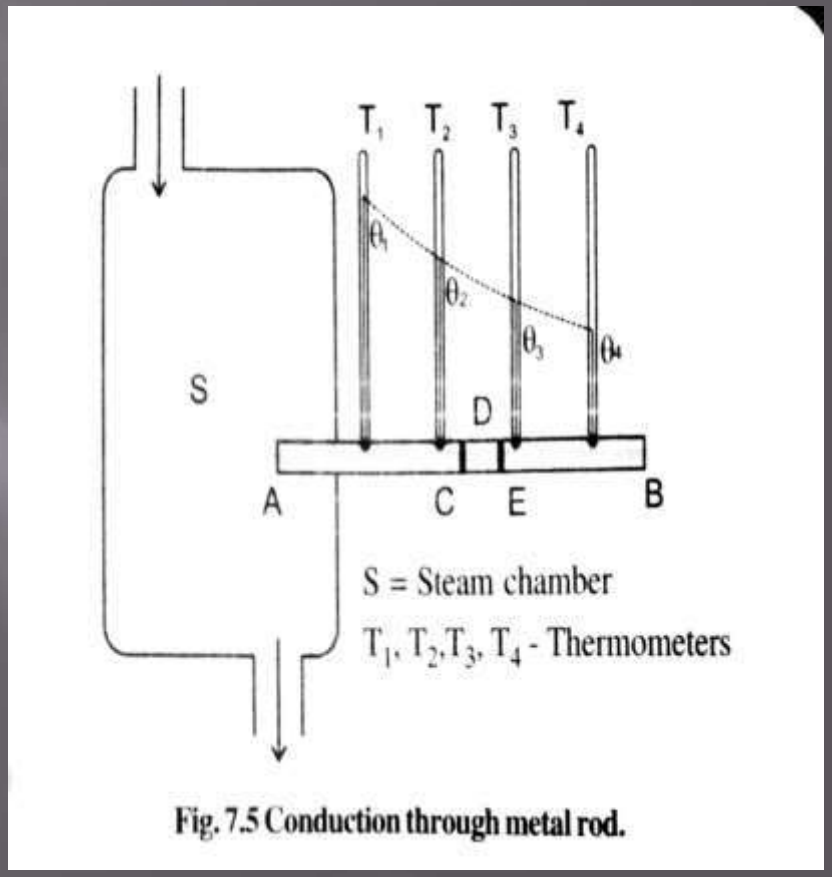


Fig. 7.5 Conduction through metal rod.

- After sufficiently long time ,all the thermometer cease to show any further rise in temperature , this state is called steady state.
- Hence in steady state condition heat received by the segment in one second and heat lost by conduction and radiation in one second becomes equal.
- Uses of good and bad conductors.

1)When hot water is poured in a breaker of thick glass ,the beaker cracks: When hot water is poured in the glass beaker ,the inner surface of the glass is a bad conductor of heat , the heat inside does not reach the outer surface quickly so outer surface doesn't expand and glass cracks.

2)Cooking utensils are made of metals with handles of bad conductor. Here heat can be easily conducted through metals, as metals are good conductors of heat. Bad conductors will not conduct the heat from the utensils to our hand.

3)Mica is bad conductor of electricity but good conductor of heat , so it is used as an electrical insulator . It is coated over a coil of an iron.

Convection of heat

This water is in turn heated ,it expands, its density decreases and it moves upward .This cycle goes on repeating so long as the water is being heated. This process of transfer of heat is called convection of heat.

Radiation of heat

The transfer of heat from the sun to the earth takes place by another process known as radiation of heat.

Radiation of heat is defined as the process of transfer of heat in the form of electromagnetic waves ,for which material medium is not necessary.

Thank you