Chapter 5. Heat

PAGE NO: 191

Solution 1:
Heat is defined as a form of energy which flows from one point to another on account of temperature difference.

Solution 2:
Yes, heat is a form of energy

Solution 3:
Joule is the SI unit of heat.

Solution 4:
One calorie is defined as the quantity of heat required to raise the temperature of 1 gram of water through 1°C.

Solution 5:
1 calorie = 4.2 joules.

Solution 6:
Temperature is the degree of hotness or coldness of a body compared to other bodies around it.
SI unit of temperature is Kelvin (K).

Solution 7:
We feel cold on touching ice because heat flows from our warm hands to cold ice. Due to this flow of heat from hand to ice, the temperature of our hand falls. This is why we feel cold.

Solution 8:
Difference between heat and temperature

Heat	Temperature
1. It is a form of energy.	The physical state decides the direction of heat flow.
2. Addition of heat causes a change in the temperature of a body.	It is the effect of addition of heat.
3. It is measured in joule or calorie	It is measured in Kelvin or Celsius
Measuring devices are calorimeter	Measuring device is thermometer.

Solution 9:
Heat flows from a body at a higher temperature to a body of lower temperature.

Solution 10:
Yes, heat is the cause of temperature because temperature of a body rises when the heat flows into the body.

Solution 11:
Heat changes the temperature of a body due to flow of heat in or out of the given body.

Solution 12:
Calorie. Because 1 calorie = 4.2 joules.

Solution 13:
No, the exact relation is as given
1 calorie = 4.2 joules.

Solution 14:
Yes, because the heat flow is only due to temperature difference between the temperature of two bodies.

PAGE NO: 229

Solution 1:
Temperature is the degree of hotness or coldness of a body compared to other bodies around it.
SI unit of temperature is Kelvin (K)

Solution 2:
Normal temperature of human body is 37°C.

Solution 3:
To convert 20°c into °F
T°C /100 = (T°f -32)/180
20/100 = (T°f – 32)/180
20 x 180/100 = T°f -32
T°f = 36+32 = 68°F

Solution 4:
Upper fixed point on the Celsius scale is 100°C.

Solution 5:
T_k = 80 K
$T_c = T_k$ -273
T_c = 80 – 273
T_c = -153°C

Solution 6:
SI unit of latent heat is Joule per kg (J/kg).

Solution 7:
Relative humidity is defined as the amount of water vapour in the air compared to the amount needed for saturation.

Solution 8:
Coefficient of Linear expansion is equal to the change in length of a rod of length 1m when its temperature rises by 1°C. Its SI unit is $°C^{-1}$.

Solution 9:
Celsius was the scientist who discovered the first thermometer in 1710.

Solution 10:
According to principle of calorimetry of mixtures,
Heat gained = Heat lost

Solution 11:
SI unit of coefficient of cubical expansion is $°C^{-1}$.

Solution 12:
Two uses of bimetallic strip are

- As thermostat in electric iron
- As balance wheel in watches

Solution 13:
Telephone wires sag in summer because due to heat of the sun, the wire expands and increases in length, thus they sag in summer.

Solution 14:
There are three types of thermal expansior

a. Linear expansion

b. Superficial expansion

c. Cubical expansion

Coefficient of linear expansion be α

Coefficient of cubical expansion be γ

The relation between them is

$$\gamma = 3\alpha$$

Solution 15:
Not all substances expand on heating. Some examples of substances which do not expand on heating are plastics, polythene and rubber.

Solution 16:
Evaporation is the phenomenon of a change of a liquid into vapour without raising the temperature. Evaporation needs energy for phase change from liquid to gases. As water evaporates off your skin, it absorbs energy(heat) from the body to make the phase change to gas thus cooling the body.

Solution 17:
Factors affecting evaporation are

- Humidity- more the humidity less is the evaporation
- surface area- more the surface area more is the evaporation
- wind- more the wind more is the evaporation

- temperature- more the temperature more is the evaporation

Solution 18:
The cold air that blows from land towards sea during night, is called land breeze
The cold air that blows from the sea towards the land during the day is known as the sea breeze. These breezes are the examples of natural convection current.

Solution 19:
No, the conduction is not possible in gases. Gases are bad conductors.

Solution 20:
No, conduction is not possible in vacuum.

Solution 21:
The velocity of thermal radiations is equal to the speed of light i.e. 3×10^8 m/s.

PAGE NO : 230

Solution 22:
We wear woolen clothes in winter because woolen clothes have tiny pores and air is trapped in these pores and being a bad conductor, the trapped air obstructs the flow of body heat to the surroundings.

Solution 23:
A newly made quilt is warmer than an old one because the cotton in the old quilt gets compressed and very little air will remain trapped in it, hence heat insulation is quite poor.

Solution 24:
In cold countries, water pipes are covered with poor conductors because poor conductor prevents water from freezing and thus prevent these pipes from bursting.

Solution 25:
Three devices used to detect heat radiations are

- Blackened bulb thermometer
- Differential air thermo scope
- Thermopile

Solution 26:
The increase in size of a body on heating is called thermal expansion.

Solution 27:
Linear expansion is the increase in length of a solid on heating.

Solution 28:
Coefficient of Linear expansion is equal to the change in length of a rod of length 1m when its temperature rises by 1°C.

Solution 29:
A bimetallic strip consists of two metal strips- one with high coefficient of expansion and the other with low coefficient of expansion.

Solution 30:
SI unit of coefficient of linear expansion is $°C^{-1}$.

Solution 31:
Water is the substance which contracts, when heated from 0°C to 4°C.

Solution 32:
Coefficient of volume expansion is equal to the change in volume of a rod of volume $1m^3$ when its temperature rises by 1°C.

Solution 33:
SI unit of coefficient of volume expansion is $°C^{-1}$.

Solution 34:
Two uses of bimetallic strip are

- As thermostat in electric iron
- As balance wheel in watches

Solution 35:
We should heat the neck of the bottle because due to heating the neck will expand and loosen the stopper stuck in the neck. In this way, we can easily remove the stopper from the bottle.

Solution 36:
When hot water is poured into a thick glass tumbler, it generally cracks because on pouring hot water in the tumbler the inner surface heats up and expands more as compared to its outer surface. This unequal expansion between the two surfaces causes a strain and the tumbler cracks.

Solution 37:
A substance is made up of molecules arranged in a lattice. On heating, the molecules vibrate faster in the lattice and bump into each other harder. So the distance between the molecules increases thus expanding lattice. Thus, the substances expand on heating.

Solution 38:
There are three types of thermal expansion

- Linear expansion
- Superficial expansion
- Cubical expansion

Solution 39:
Gaps are left in the railway tracks because the tracks gets heated during the day and as a result they increase in length. If the gaps are not provided, the railway line would buckle outward and may cause derailment.

Solution 40:
The beams of the bridges expand maximum during the summer days and contract maximum during the winter nights. If the beams are fixed at both ends on the pillars, they may develop crack due to expansion and contraction. To avoid this, beams are made to rest on rollers on the pillars to provide space for expansion.

Solution 41:

Let Coefficient of linear expansion be α

Coefficient of cubical expansion be γ

The relation between them is

$\gamma = 3\alpha$

Solution 42:

Original length, $l = 10\ cm = 0.1\ m$

Rise in temperature, $t = 30 - 20 = 10°C$

Coefficient of linear expansion, $\alpha = 1.7 \times 10^{-5} °C^{-1}$

Increase in length $= l \times t \times \alpha$

$= 0.1 \times 10 \times 1.7 \times 10^{-5}$

$= 1.7 \times 10^{-5}\ m$

Solution 43:

Volume of mercury, $V = 1$ liter

Rise in temperature, $t = 30 - 20 = 20°C$

Coefficient of volume expansion, $\gamma = 1.8 \times 10^{-4} °C^{-1}$

Increase in volume $= V \times t \times \gamma$

$= 1 \times 20 \times 1.8 \times 10^{-4}$

$= 3.6 \times 10^{-3}$ liter

Solution 44:

A ventilator is provided in a room because it helps in removing the hot air from the room and allows the fresh and cold air to come in.

Solution 45:

No, it is not possible to heat a liquid or gas from above because the transfer of heat through convection takes place vertically upwards in liquids and gases. So if they are heated from above, the liquid or gas at the top will only be heated because most liquids and gases are themselves bad conductor of heat so they cannot conduct heat from top layer to the bottom layer.

Solution 46:

- Water is heated generally from below because water itself is a bad conductor of heat and the transfer of heat through convection take place vertically upwards.
- Land becomes warmer than water during the day because water has more specific heat capacity so it absorbs the heat and heats up slowly but on the other hand land has less specific heat and it heats up faster than water.

Solution 47:
Main characteristics of thermometric substance are

- The substance should have high coefficient of expansion so that it is sensitive to the smallest change in temperature
- The substance should have uniform expansion all over its entire volume
- The substance should have minimum specific heat so that it absorbs minimum heat from the body under measurement.

Solution 48:
Wood is an insulator of heat.

Solution 49:

- In cold countries, windows are provided with two glass panes because in between these two glass panes, a thin layer of air is present: air being a bad conductor obstructs the conduction of heat from the room to outside.
- 1 calorie = 4.2 joules
- Yes, it is possible to boil water in a thin paper cup because when heated the heat in the paper cup is transferred to the water through convection and paper cup doesn't get sufficient heat to get burnt

Solution 50:
Thermometer works on the principle that substances expand on heating and contract on cooling. So we use a thermometric substance which expands and contracts uniformly.

Solution 51:
Advantages of mercury and alcohol as thermometric liquid are

- They both are good conductors of heat.
- They have high coefficient of expansion thus are sensitive to the smallest change in temperature
- Their freezing points are very low and boiling point is high in case of mercury

Disadvantages

- Alcohol is transparent and this makes hard to read the thermometer.
- It does not have uniform expansion.
- Mercury is less sensitive than alcohol as its coefficient of expansion is less than alcohol.
- Alcohol is a volatile liquid.

Solution 52:
Lower point of a thermometer is the temperature at which ice starts melting at normal atmospheric pressure i.e. 0°C
Upper point of a thermometer is the temperature at which water just starts boiling at normal atmospheric pressure i.e. 100°C.

Solution 53:

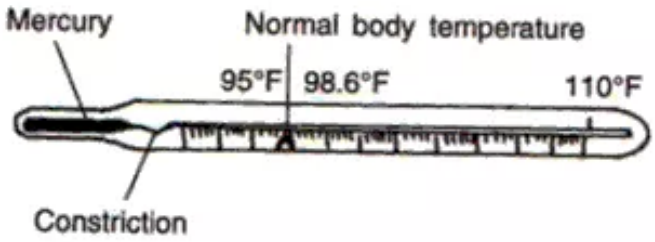


Fig. 6. *Clinical thermometer*

A clinical thermometer is used to measure the body temperature. The capillary tube has a constriction above the bulb preventing mercury to fall back once it has risen.

Solution 54:

- Laboratory thermometer is used to measure and observe the temperature of various chemical reactions
- Clinical thermometer is used to measure human body temperature
- Six's maximum and minimum thermometer is used in meteorology and horticulture.

Solution 55:

Difference between laboratory and clinical thermometer

Laboratory thermometer	Clinical thermometer
1. The range of temperature is high	The range of temperature is low
2. It has no kink in it	It has a kink(constriction) in it
3. It is used to measure the temperature of chemical reactions	It is used to measure human body temperature

Solution 56:

The temperature that is common in both clinical and Fahrenheit scale is -40°C
Derivation is as follows
Let the temperature be x
C/100= (F − 32)/180
x/100 = (x-32)/180
x * 180/100 = x-32
9/5 x = x − 32
-4/5 x =32
x = − 40

Solution 57:

- 60°C
  60/100 = (F-32) / 180
  F = 6 x 18 +32
  = 110°F
- 100°C
  100/100 = (F − 32) /180

F = 180 x 1 + 32
= 212°F

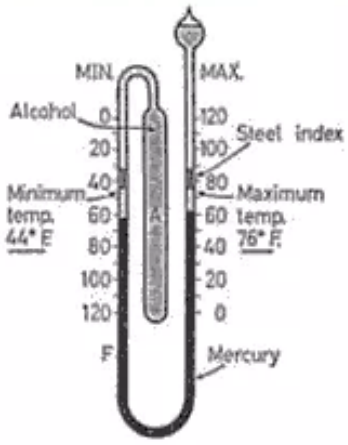
- -40°C
  -40/100 = (F – 32) /180
  F = -4 x 18 + 32
  = 40°F
- 85°C
  85/100 = (F – 32) /180
  F = 85 x 18/10 +32
  = 185°F

Solution 58:

- 104°F
  C = (F – 32) x 100/180
  C = 72 x 100/180
  = 40°C
- 95°F
  C = (F – 32) x 100/180
  = 63 x 10/18
  = 35°C
- 113°F
  C = (F – 32) x 100/180
  = 81 x 10/18
  = 45°C
- 32°F
  C = (F – 32) x 100/180
  = 0 x 10/18
  = 0°C

Solution 59:

Diagram of six's maximum and minimum thermometer



Six's thermometer is a thermometer which can measure the maximum and minimum temperatures reached over a period of time, usually during a day. It is commonly used wherever a simple way is needed to measure the extremes of temperature at a location, for instance in meteorology and horticulture

Solution 60:
Three modes of heat transfer are

- Conduction involves the transfer of heat from the hot end to the cold end from particle to particle of the medium.
- Convection is the transfer of heat from one body to another by actual movement of the particles of the medium
- Radiation is the transfer of heat from one body to another without the need of an intervening material medium

Solution 61:

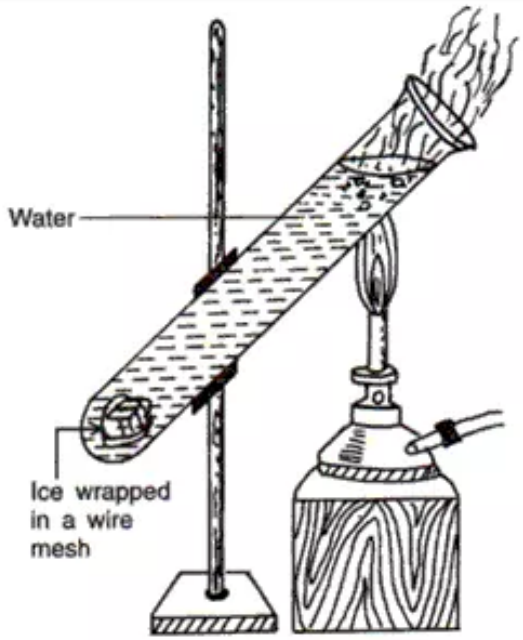


Fig. 3. *Water is a bad conductor of heat*

An ice cube is wrapped into a wire mesh and is put at the bottom of the glass test tube. The test tube is then heated near the top of the water. It will be noticed that though the water at the top starts boiling, the ice at the bottom does not melt. This clearly shows that water is poor conductor of heat.

Solution 62:

The cold air that blows from land towards sea during night, is called land breeze

The cold air that blows from the sea towards the land during the day is known as the sea breeze. These breezes are the examples of natural convection current.

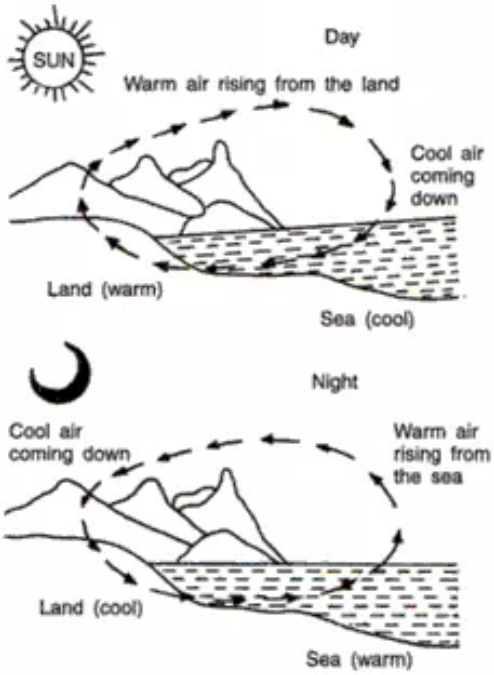


Fig. 8. *Natural convection currents*

Solution 63:

A wooden knob and a metal latch are both being at same temperature but it feels colder to touch the latch because metal is a good conductor and as soon as we touch it heat from our hand flows to the latch and we feel cold while on the other hand wood is a bad conductor of heat, heat of our hand does not flow into it therefore it does not feel cold.

Solution 64:

The flask consists of double walled glass container with vacuum between the walls A and B to prevent heat loss due to conduction and convection as vacuum is the excellent insulator .to prevent heat loss by radiation, the inner side of the wall A and outer side of wall B is silvered. It has a narrow mouth which is closed by a non-conducting rubber stopper.

Solution 65:

The spiral starts moving because due to the flame of the candle the spiral heats up and expands. While expanding, the spiral tries to create space for the extension in length and an outward pull is created which causes the spiral to move.

Solution 66:

- In winters, the human body covered with a blanket keeps warm because the blanket has air trapped in it which provide heat insulation to the body from the surroundings and keep us warm

- It is better to use two thin blankets to keep the body warm rather than using a single blanket of equal thickness because in between the two thin blankets there is more air trapped than in the single blanket of equal thickness so using two thin blankets better heat insulation is provided to the body from the surroundings and keep us warm
- In winter the birds fluff their feathers in order to trap air in their feathers so that the air provides heat insulation to their body from the surroundings and keep them warm and save them from winter.
- Old quilts are less warmer than new ones because the cotton in the old quilt gets compressed and very little air will remain trapped in it, hence heat insulation is quite poor
- People wear light colured clothes in winter because these clothes reflect most of the sun's radiations and absorb only a little of them. Therefore, they keep themselves cool.

PAGE NO : 231

Solution 67:

Transformation of Sun's energy in sun-eco system through a food chain is called energy flow.

Solution 68:

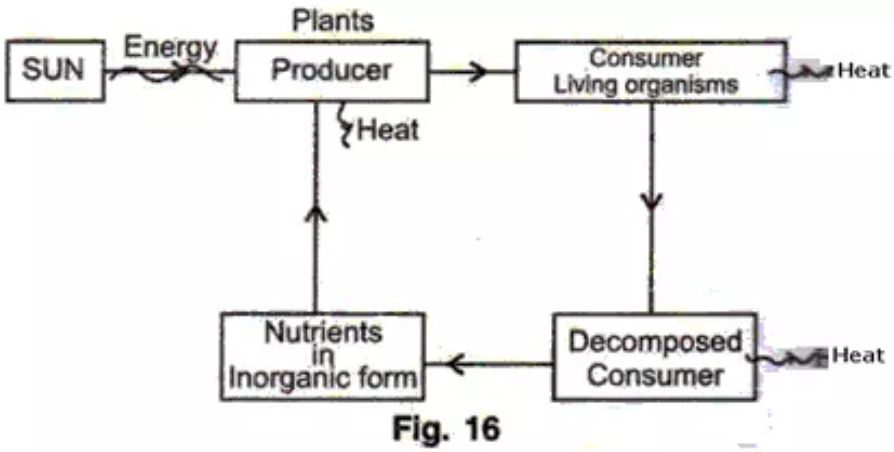


Fig. 16

Heat produced in various conversion processes like production, consumption, etc is not returned to the sun. Thus energy flow of the sun-eco system is not cyclic.

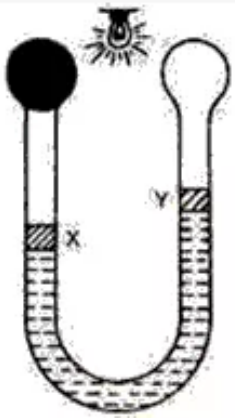
Solution 69:

Any energy transfer is not 100% because energy is lost to the surroundings in the form of heat, friction losses during the transfer of energy. Therefore complete energy is not transferred.

Solution 70:

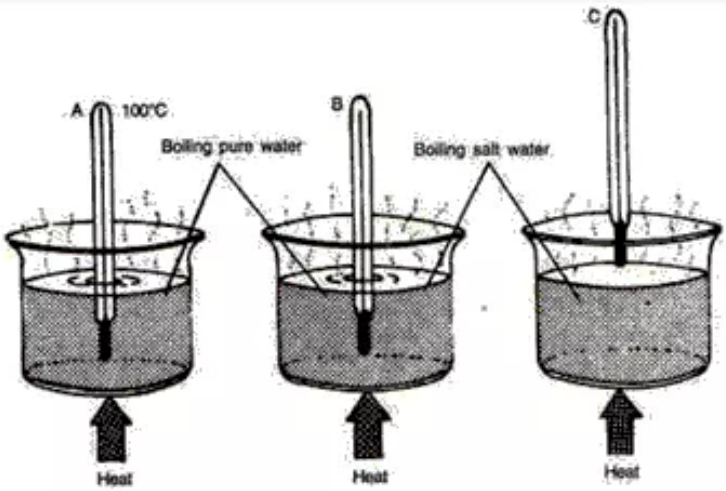
Bio gas is produced by the action of bacteria on decaying organic matter. The primary source of bio gas in villages is dung of cow, or buffalo. The bio gas is mostly methane which can be used as a chief source of light and heat energy.

Solution 71:



The level Y will rise and the level X will drop because the air in blackened bulb is heated more than clear bulb; hence the air expands and pushes the mercury to the other limb.

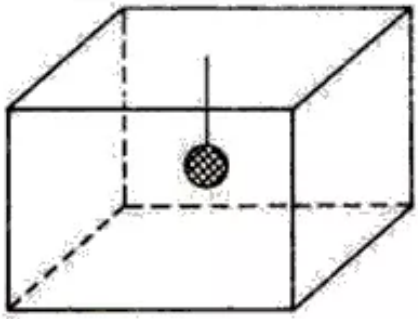
Solution 72:



(i) Temperature of steam and boiling water is equal so reading of thermometer is same. But due to addition of salt boiling point of water elevates so reading of thermometer would be slightly higher than the boiling point of water i.e 100° C.

(ii) Due to addition of salt boiling point of water increases so thermometer has to measure temperature for a wider range and thus it helps in calibration of thermometer.

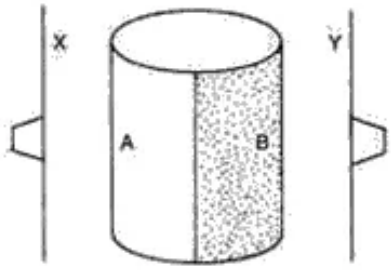
Solution 73:



(i) As ball is suspended in the air there is no material medium present around the ball, it will not lose heat by the process of conduction of convection. Ball will lose hest by the process of Radiation only.

(ii) Speed of heat radiation is equal to the speed of light and intensity of heat radiation does not depend upon direction so all side of the box would be equally hot as the box is cubical.

Solution 74:



After a few minutes the rubber stopper fixed to plate y will drop down because since the plate y is on the black side of the cylinder. The black side of the cylinder radiates more heat than the polished side so it heats up the plate Y faster than heating up of plate X by polished surface of the cylinder which melts down the wax holding the stopper and the stopper will drop down

PAGE NO : 232

Solution 75:

Difference between mercury and alcohol as thermometric substance

Mercury	Alcohol
1. It is non volatile	It is volatile
2. It has uniform expansion	It has non-uniform expansion
3. It is opaque making it easier to read the thermometer	It is transparent thus making it difficult to read the thermometer
4. It has low coefficient of expansion	It has high coefficient of expansion
5. It has high boiling point so it can be used to measure high temperatures	It has low boiling point so it cannot be used to measure high temperatures

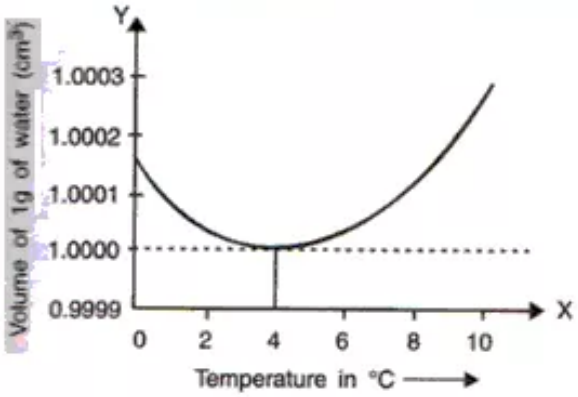
Solution 76:
Water is not used as a thermometric liquid because It has low coefficient of expansion so it is less sensitive to temperature changes. Moreover, It is transparent thus making it difficult to read the thermometer and water evaporates with time thus producing error and also the freezing and boiling points are also low.

Solution 77:
The sensitivity of a thermometer can be increased by using a substance having high coefficient of expansion and uniform expansion so that its expands with the slightest change in temperature.

Solution 78:

- When hot water is poured into a thick glass tumbler, it generally cracks because on pouring hot water in the tumbler the inner surface heats up and expands more as compared to its outer surface. This unequal expansion between the two surfaces causes a strain and the tumbler cracks.
- Pyrex glass tumbler does not crack on adding hot water because Pyrex glass has low coefficient of expansion. It does not expand less when hot water is added to the tumbler.

Solution 79:
It can be seen from the graph that the volume of the water decrease from 0°C to 4°C and the volume is minimum at 4°C. After 4°C the volume increases with the increase in temperature.

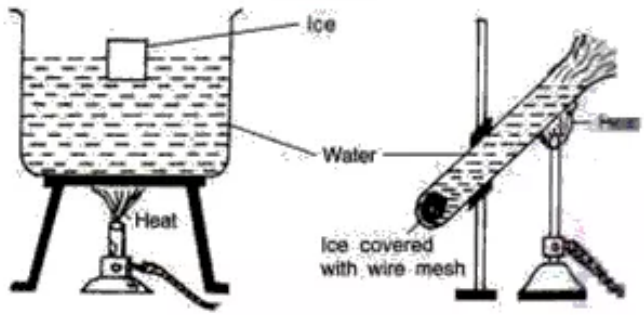


(a) *Variation of volume of water with temperature*

Solution 80:
Difference between laboratory and clinical thermometer

Laboratory thermometer	Clinical thermometer
4. The range of temperature is high	The range of temperature is low
5. It has no kink in it	It has a kink(constriction) in it
6. It is used to measure the temperature of chemical reactions	It is used to measure human body temperature

Solution 81:



In the diagram it is clear that the ice will melt faster in the flask than in the test tube because water is bad conductor of heat and the transfer of heat in liquid through convection is from bottom to top

Solution 82:

Temperature in °C = 1°C
C/100 = (F-32)/180
F = 1 x 18/10 + 32
= 33.8°F

Solution 83:

Lower fixed point = 10°C
Upper fixed point =130°C
Range of thermometer= 130°C – 10°C = 120°C
No of divisions = 100
So least count = 120/100 = 1.2°C
On actual thermometer 40°C would have 40 divisions
So, on this thermometer it would show = 40 x LC = 48°C

Solution 84:

The green house is referred to a glass house. The heat enters the house but cannot escape out, because the glass reflects the heat back to the inside of the house. This makes glass house warmer than the outside environment. This phenomenon is called green house effect.

Solution 85:

Global warming occurs due to the presence of carbon di oxide, CFCs, methane in the atmosphere. Carbon dioxide acts as a transparent gas to incoming shortwave radiations which the earth re-radiates into space. It, therefore traps the outgoing radiations thus warming lower atmosphere of the earth thereby causing global warming.

Solution 86:

Harmful effects of global warming are

- The atmospheric temperature of earth would increase thereby making it difficult for a living being to survive
- It would melt down the polar caps thus increasing the size of the ocean and leading to floods, tsunami, etc.
- The increase in temperature would affect climate and rainfall thus affecting flora and fauna.

- Human beings would be vulnerable to diseases as microbes would get warmth to grow.

Solution 87:

The temperature in a green house rises because heat enters the house through the glass but cannot escape out, because the glass reflects the heat back to the inside of the house. This makes glass house warmer than the outside environment.

Chapter 5. Heat: Thermal Expansion

PAGE NO: 202

Solution 1:

- Coefficient of Linear expansion is equal to the change in length of a rod of length 1m when its temperature rises by 1°c.
- Coefficient of superficial expansion is equal to the change in area of a rod of area $1m^2$ when its temperature rises by 1°c.
- Coefficient of volume expansion is equal to the change in volume of a rod of volume $1m^3$ when its temperature rises by 1°c.

Solution 2:

If the Coefficient of Linear expansion is denoted by α

Coefficient of superficial expansion is denoted by β

And Coefficient of volume expansion is denoted by γ

Then the relation between α, β and γ is stated as

$\beta = 2\alpha$ and $\gamma = 3\alpha$

$\alpha : \beta : \gamma :: 1 : 2 : 3$

Solution 3:

A bimetallic strip consists of two metal strips- one with high coefficient of expansion and the other with low coefficient of expansion. Two different metals are used for regulating temperature in an electrical device as the strip bends due to different coefficient of expansion on excessive heating due to current, thus breaking electrical circuit until the strip cools down to a preset point. Two applications of bimetallic strip are thermostat in electric iron and in balance wheels.

- When boiling water is poured into a glass bottle, it generally cracks because on pouring hot water in the bottle the inner surface heats up and expands more as compared to its outer surface. This unequal expansion between the two surfaces causes a strain and the bottle cracks.
- Telephone wires sag in summer because due to heat of the sun, the wire expands and increases in length, thus they sag in summer.
- In cold countries water pipes burst in winter because the water has maximum density at 4°C and, due to anomalous expansion of water, it expands when the water is cooled to a temperature below 4°C
- Even when the water in the lakes is frozen, fishes can survive due to anomalous expansion of water, water has maximum density at 4°C and this dense water remains at the bottom of the lake and the upper layer of water is less dense and freezes but the temperature of each layer of water below increases by 1°C. Thus it is warmer in the lakes below the ice layer. This helps the fishes to survive.

Solution 4:

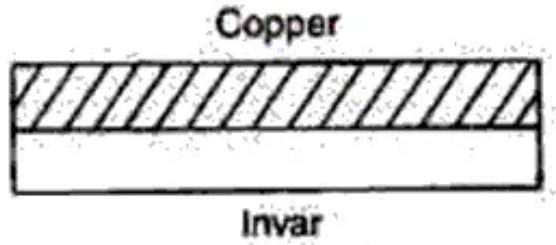


Diagram is to show how the given strip bends and cools. Due to heating the copper bends more than invar due to high coefficient of linear expansion of copper.

Solution 5:

Thermostat is a device for regulating temperature in electric circuits and it is made up of bimetallic strip. Two applications of thermostat are in electric iron and in refrigerators.

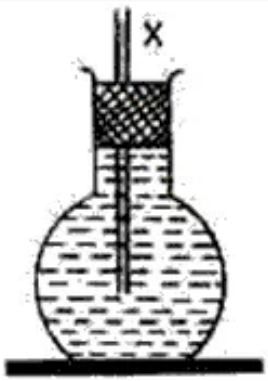
Solution 6:

When heated, water expands normally but behavior of water is unusual over a small range of temperature between 0 and 4°C. This is known as anomalous expansion of water.

Solution 7:

Anomalous expansion of water slows down the complete freezing of water in the lake.

Solution 8:



The level will rise above X when the flask is kept in hot water bath because the water in the flask will heat up and expand in volume thus raising the level of water in the tube above X

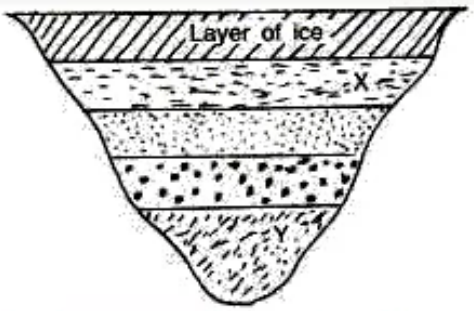
Solution 9:

- When boiling water is poured into a glass bottle, it generally cracks because on pouring hot water in the bottle the inner surface heats up and expands more as compared to its outer surface. This unequal expansion between the two surfaces causes a strain and the bottle cracks.
- Telephone wires sag in summer because due to heat of the sun, the wire expands and increases in length, thus they sag in summer.
- In cold countries water pipes burst in winter because the water has maximum density at 4°C and, due to anomalous expansion of water, it expands when the water is

cooled to a temperature below 4°C

- Even when the water in the lakes is frozen, fishes can survive due to anomalous expansion of water, water has maximum density at 4
- When boiling water is poured into a glass bottle, it generally cracks because on pouring hot water in the bottle the inner surface heats up and expands more as compared to its outer surface. This unequal expansion between the two surfaces causes a strain and the bottle cracks.
- Telephone wires sag in summer because due to heat of the sun, the wire expands and increases in length, thus they sag in summer.
- In cold countries water pipes burst in winter because the water has maximum density at 4°C and, due to anomalous expansion of water, it expands when the water is cooled to a temperature below 4°C.
- Even when the water in the lakes is frozen, fishes can survive due to anomalous expansion of water, water has maximum density at 4°C and this dense water remains at the bottom of the lake and the upper layer of water is less dense and freezes but the temperature of each layer of water below increases by 1°C. Thus it is warmer in the lakes below the ice layer. This helps the fishes to survive °C and this dense water remains at the bottom of the lake and the upper layer of water is less dense and freezes but the temperature of each layer of water below increases by 1°C. Thus it is warmer in the lakes below the ice layer. This helps the fishes to survive.

Solution 10:

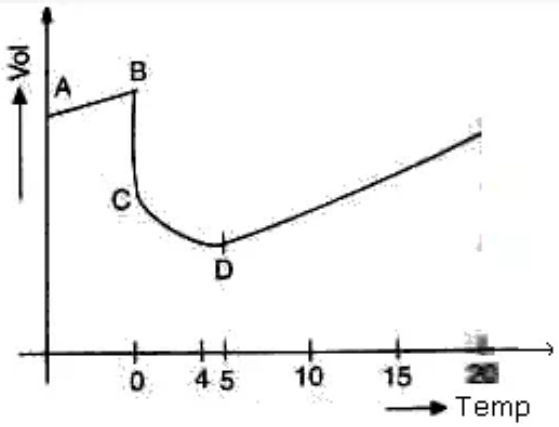


The layer at the top level is ice so its temperature is therefore 0°C and temperature at every layer of water below ice increases by 1°C

(i) At X = 1°C since it is the first layer below ice

(ii) At Y = 4°C since it is the fourth layer below ice

Solution 11:



(i) At BC temperature is constant because at 0° C all of the heat given is used in process of formation of water from ice and no part of heat is used in changing the temperature of ice.

(ii) At point D i.e. at 4°C the volume of water is minimum

(iii) At point D i.e. at 4°C, the density of water is maximum due to anomalous expansion of water in the temperature range of 0°C and 4°C as volume decreases, density of water increases

PAGE NO : 203

Solution 12:

- Maximum
- Increases; decreases
- Coefficient; expansion
- Anomalous expansion of water
- Calorie
- Kelvin(K)

Solution 13:

We should heat the neck of the bottle because due to heating the neck will expand and loosen the stopper stuck in the neck. In this way, we can easily remove the stopper.

Solution 14:

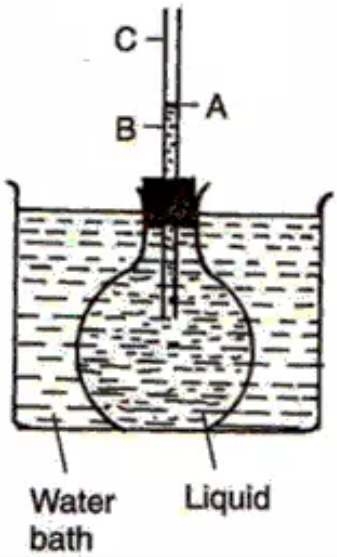
When a liquid is heated in a flask. Due to heat, the flask expands along with the liquid, thus providing more space for the liquid. Hence the level of the liquid falls. Thus this dropped level shows the apparent expansion of the liquid. The actual expansion of the liquid, when heated, is the real expansion.

Solution 15:

No, the both liquids i.e. mercury and alcohol will not have same volume on heating as they have different coefficient of expansions, thus they expand differently on heating at same temperature range. Alcohol expands more than mercury.

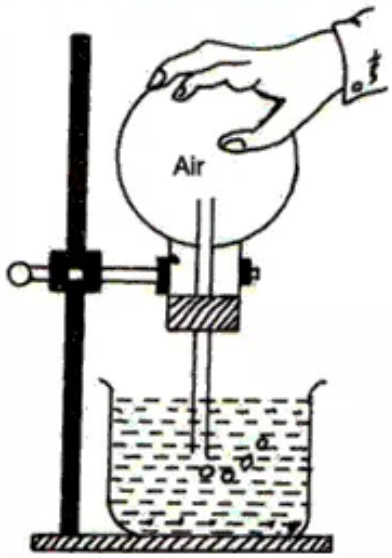
Solution 16:

Fill a round bottom flask with a coloured liquid up to the brim. Fit it with a one holed cork and pass a narrow glass tube through it. Mark the level of the liquid in the glass tube. Place the flask in a water bath and heat the bath. You will see that the level of liquid of water rises in the glass tube. This is due to the expansion of the liquid on heating.



Solution 17:

Take a round bottom flask which is filled with air and closed with a one holed rubber cork. A narrow capillary tube is passed through the cork and the flask is supported on a tripod in an inverted position as shown in the figure, so that the end of the capillary tube is under water. Now, heat the flask gently with a spirit lamp. You will observe bubbles coming out from the capillary tube. This shows that gases expand on heating.



Solution 18:

A hot glass chimney often crack when a drop of water falls on it because the glass of the chimney expands due to constant heating by the flame of the chimney but as a cooler

water drop falls on the glass, the outer surface contracts more than the inner side of the glass. . This unequal contraction between the two surfaces causes a strain and the glass cracks.

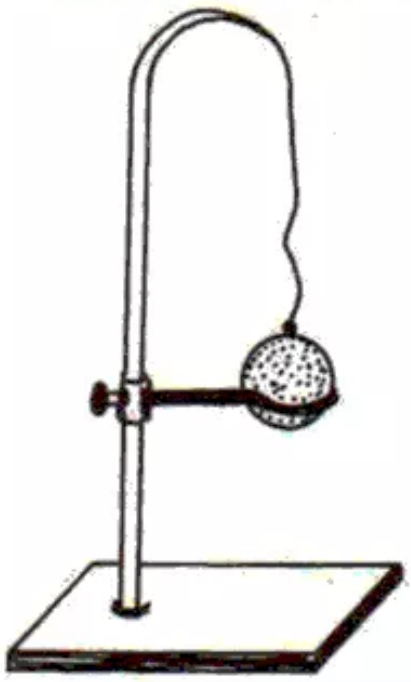
Solution 19:
No, we cannot fuse iron wire in glass rod because glass is bad conductor of heat and it does not allow heat to pass through it and iron wire would not be able to get sufficient heat to fuse.

Solution 20:
We should heat the neck of the bottle because due to heating the neck will expand and loosen the stopper stuck in the neck. In this way, we can easily remove the stopper from the bottle.

Solution 21:
Two substances that expand on heating are water and iron.

Solution 22:
Two substances that contract on heating are plastic and poly-ethene.

Solution 23:
Take a ball and ring apparatus as shown in figure. At room temperature, the ball can just pass through the ring. Now heat the ball over a flame and try to pass it through the ring. You will find that the ball when heated is not able to pass through the ring. The diameter of the ball increases when the ball is heated. This shows the expansion of solid on heating.



Solution 24:
The joints in metal pipes loosen in summers because the joints get more space to expand due to the heat in summers as compared to the pipes therefore the joints become loose in summers

Solution 25:
The increase in length of a rod depends on the following factors

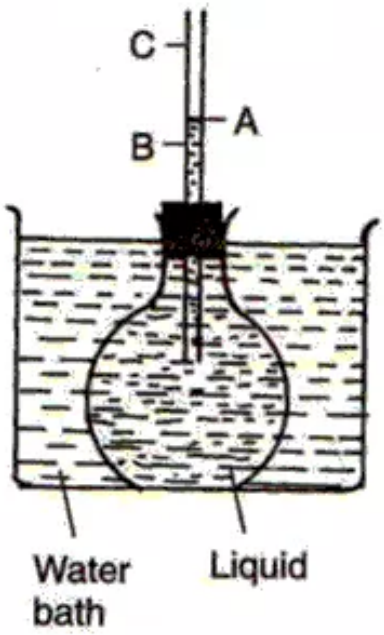
- material of the rod
- Original length of the rod
- Rise in temperature

Solution 26:
The given statement states that the change in length of the metal will be 0.000016 m when its temperature changes by 1°C.

Solution 27:
On heating the copper washer

- Its internal diameter will increase as the copper washer expands outwards
- Volume will increase as the size of the metal expands on heating
- Mass will remain the same as the mass does not change with change in temperature
- Density will decrease as the volume of the washer increases on heating and density is inversely proportional to volume
- External diameter will increase because the copper washer expands outwards

Solution 28:
Fill a round bottom flask with a coloured liquid up to the brim. Fit it with a one holed cork and pass a narrow glass tube through it. Mark the level of the liquid in the glass tube as A. Place the flask in a water bath and heat the bath. You will see that the level of liquid of water starts falling to level B and then it rises to level C. In this, AC is the apparent expansion and is due to expansion of the flask due to heating which provides more space for the liquid. Hence the level of liquid drops. As soon as the liquid also starts getting heated up, it expands and the level of liquid rises. BC is the real expansion. So the actual expansion of the water is sum of AC and AB

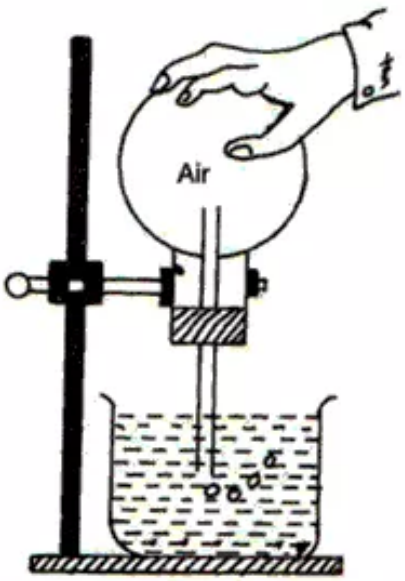


Solution 29:

At 4°C, water has the maximum density due to anomalous expansion.

Solution 30:

It can be seen from the graph that the volume of the water decrease from 0°C to 4°C and the volume is minimum at 4°C. After 4°C the volume increases with the increase in temperature.



Chapter 5. Heat: Thermometry

PAGE NO: 209

Solution 1:
Temperature is the quantity that tells about the thermal state of a body i.e. the degree of hotness or coldness of a body.

Solution 2:
Thermometer is used for measuring the temperature of a body.

Solution 3:
Thermometer works on the principal that substances expand when heated and contract on cooling.

Solution 4:
Range of thermometer is the range of temperature which can be measured by thermometer.

Solution 5:
Mercury is the liquid used in a clinical thermometer

Solution 6:
The usual range of temperature marked on clinical thermometer is 95° F to 110°F.

Solution 7:
Fahrenheit designed the first thermometer.

Solution 8:
Before constructing a thermometer, we determine lower fixed point and upper fixed point and divide the whole range of thermometer into specific number of equal divisions to provide a scale for measuring the temperatures within a range.

Solution 9:
The clinical thermometer is specially designed thermometer used to measure the temperature of a human body easily and as accurately as possible.

Solution 10:
Three properties of a liquid which make it suitable to be used in a thermometer are:

- The substance should have high coefficient of expansion so that it is sensitive to the smallest change in temperature
- The substance should have uniform expansion all over its entire volume
- The substance should have minimum specific heat so that it absorbs minimum heat from the body under measurement.

Solution 11:
Two disadvantages of using mercury as a thermometric liquid:

- It does not have uniform expansion.

- Mercury is less sensitive than alcohol as its coefficient of expansion is less than alcohol.

Solution 12:
Three advantages of using mercury as a thermometric liquid:

- Mercury is good conductors of heat.
- Mercury have high coefficient of expansion thus is sensitive to the smallest change in temperature.
- Freezing points is very low and boiling point is high.

Solution 13:
Water is not used as a thermometric liquid because it has low coefficient of expansion so it is less sensitive to temperature changes. Moreover, it is transparent thus making it difficult to read the thermometer and water evaporates with time thus producing error and also the freezing and boiling points are also low.

Solution 14:
Temperature in Kelvin To K = Temperature in Celsius To C + 273.
To K = 0°C + 273
To K =273 K.

Solution 15:
Body temperature of a healthy person is 98.4oF.
We know C/100 = (F – 32)/180.
C =5/9(F- 32)
C = 5/9(98.4 – 32)
C = 5/9 x 66.4
C =36.88°C
Temperature of body of healthy man is 36.88°C.

Solution 16:
Absolute scale of temperature is Kelvin scale.
Conversion of temperature from Celsius to Kelvin scale is
Temperature in Kelvin To K = Temperature in Celsius To C + 273.
So a rise of temperature of 1°C in Celsius scale is equal to rise of 1°K in Kelvin scale.

Solution 17:
Kelvin temperature scale is used in SI system.

Solution 18:
In Celsius scale there are two fixed points namely lower fixed point and upper fixed point at 0°C and 100°C respectively. This range is divided into 100 equal divisions and each part gives 1°C.

Solution 19:
We know C/100 = (F – 32)/180.
C =5/9(F- 32)
9/5 C + 32 =F
F = 9/5 C + 32.
Temperature given in Celsius = -15°C.
F = 9/5 x (-15) +32

F = -27 +32
F = 5°F.

Solution 20:
Absolute zero of temperature is 0°K.
Temperature in Kelvin To K = Temperature in Celsius To C + 273.
0°K = To C +273.
To C = -273°C.
Absolute zero of temperature on Celsius scale is -273°C.

Solution 21:
Difference of temperature of two bodies in Celsius scale = 1°C.
We know C/100 = (F – 32)/180.
C =5/9(F- 32)
9/5 C + 32 =F
F = 9/5 C + 32.
So, difference of 1° in Celsius scale is equal to the difference of 9/5° in Fahrenheit scale.
Thus, Difference of 1°C of temperature of two bodies in Celsius scale is equal to difference of 1.8° in Fahrenheit scale.

Solution 22:
Celsius invented the Celsius scale of temperature.

Solution 23:
Fahrenheit invented the Fahrenheit scale of temperature.

Solution 24:
Mercury, alcohol are commonly used in thermometers.

PAGE NO : 210

Solution 25:
Camel and are two animals which are able to increase their body temperature in summers and decrease their body temperature in winters.

Solution 26:
CGS unit of heat is Joule denoted by J.
1 J is amount of heat required to raise the temperature of a body by 1/4.12°C of temperature.

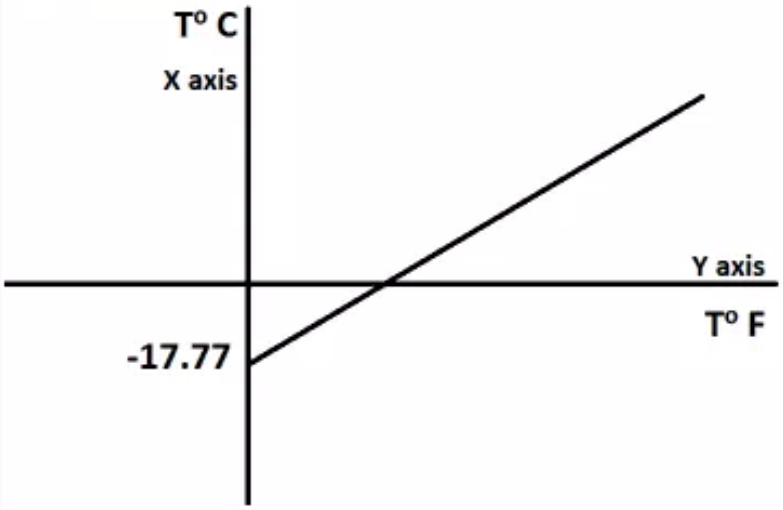
Solution 27:

We know C/100 = (F – 32)/180.

C =5/9(F- 32)

C = 5/9F – 17.77.

Graph between T° C and T° F is straight line having slope of 5/9 and intercept on Y axis is -17.77.



Solution 28:

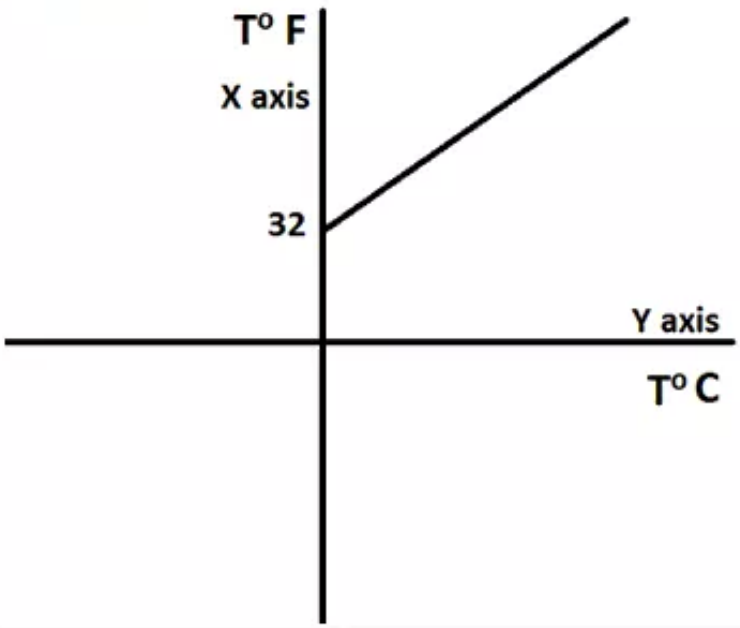
We know C/100 = (F – 32)/180.

C =5/9(F- 32)

9/5C + 32 =F

F = 9/5C + 32.

Graph between T° F and T° C is straight line having slope of 9/5 and intercept on Y axis is 32.



Solution 29:
Relation between Celsius and Fahrenheit scales of temperature is
$C/100 = (F - 32)/180$.

Solution 30:
Temperature of ice point on Fahrenheit scale $=32°F$.
Temperature of steam point on Fahrenheit scale $=212°$

Chapter 5. Heat: Transmission of Heat

PAGE NO: 226

Solution 1:
Conduction, convection and radiation are three modes of transfer of heat.

Solution 2:
The process of conduction involves the transmission of heat from the hot end to the cold end from particle to particle of the medium.

Solution 3:
No, conduction is not possible in vacuum.

Solution 4:
Thermal insulation means restriction of transfer of heat by any means.

Solution 5:
Good conductor allow heat to pass through them easily while bad conductor of heat does not allow heat to pass them.

Solution 6:
No, liquids are poor conductors of heat.

Solution 7:

- Metals are the best conductor of heat.
- Gases are the worst conductor of heat.

Solution 8:
Among all the metals, Silver is most conducting.

Solution 9:
Air is most non-conducting.

Solution 10:
No, air is not a good conductor of heat.

Solution 11:
Yes, this is a correct statement. Ebonite and asbestos are worst conductor of heat.

Solution 12:
Cooking utensils are made up of metals because metals are good conductors of heat and they easily allow the heat to pass through them.

Solution 13:
Brick is bad conductor of heat, hence bricks greatly reduce the conduction of heat from outside to the room. In order to ensure better insulation, bricks are made hollow so that air filled between these gaps provides insulation to heat.

Solution 14:
Mercury is good conductor of heat.

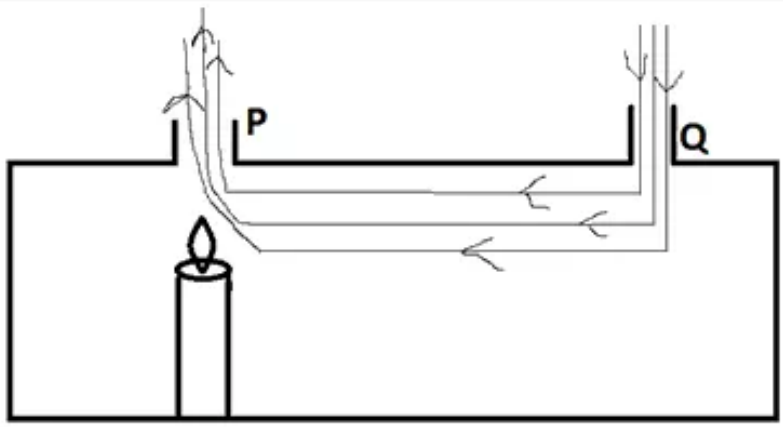
Solution 15:
In cold countries, windows have two glass panes and a thin layer of air in between these two glass panes because air is a poor conductor of heat; it obstructs the conduction of heat from the room to the outside.

Solution 16:
Order of increasing heat conductivity:
Air < water< mercury < copper.

Solution 17:

- Water is heated from below because water is heated by process of convection and in process of convection heat always flows in upward direction from downward direction.
- In process of convection heat is transferred from one point to another by actual movement of particles of medium and as particles of solid cannot move so process of convection is not possible in case of solids.
- Conduction is not possible in Vacuum because process of conduction require a material medium for transfer of heat.
- Inside the refrigerator, cooling takes place by convection. The freezing chamber at the top produces cool and heavy air which descends and hot air from below goes up setting convection current. Thus, cooling in a refrigerator is kept near the top.
- As earth surface gets heated by sun rays and due to process of convection the air near earth surface open to sunlight get heated while in shade sun rays does not fall on earth surface so air near that surface would not heat up.

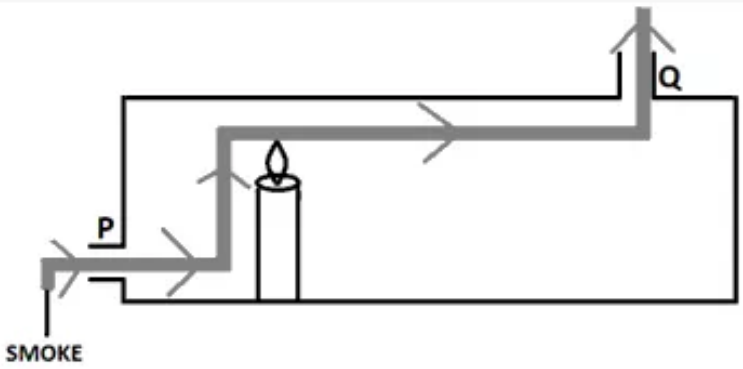
Solution 18:



(i) Air is entering into the box from tube Q and as air reaches near the candle its temperature increase and air become lighter and leaves out from tube P.

(ii) If opening Q is closed then circulation of air stops and there is no way for air to enter. Air inside box will leave out from tube P and after some time candle stops because for burning it requires air which is not circulating in the box now.

Solution 19:



Smoke is entering into the box from tube P and as smoke reaches near the candle its temperature increase and smoke become lighter and leaves out from tube Q.

PAGE NO : 227

Solution 20:
We receive heat from sun by process of Radiation.

Solution 21:
Radiating power of a surface can be increased by blackening it.

Solution 22:
Heat radiation travels with speed of light and always follows straight path.

Solution 23:
The flask consists of a double walled glass container with vacuum between the walls A and B. The inner side of A and the outer side of B are silvered. It has a narrow mouth which is closed by a non-conducting rubber stopper.
If a hot liquid is placed inside the flask, it cannot lose heat by conduction or convection, as there is no air between the walls. The small amount of heat lost from the liquid by radiation is reflected back into the liquid by silvering of the inner wall A and any radiation striking the outer wall B, is reflected back and prevented from reaching the liquid.

Solution 24:
Green house is a glass house constructed to keep delicate and rare plants that require warmth and protection from weather. It is constructed by panels of glass. The temperature in a green house rises because heat enters the house through the glass but cannot escape out, because the glass reflects the heat back to the inside of the house. This makes glass house warmer than the outside environment.

Solution 25:
Take two sheets of tin plates, one blackened and the other is polished brightly. Fix some drawing pins on the outer side of both sheets using wax. Fix these plates vertically at a very short distance apart. Place a Bunsen burner midway between them. When you light the burner you will observe that the pins from the black painted sheet start dropping while the pins on the polished surface remain in the same position for much longer time.
Thus, we can conclude that black surface is better absorber of heat than the polished one.

Solution 26:

- As convection require medium for transfer of heat so heat loss due to convection can be minimized if the substance is kept away from any material medium.
- Similarly for conduction, as conduction also require medium for transfer of heat so heat loss due to conduction can be minimized if the substance is kept away from any material medium.
- Heat loss due to radiation can be minimized by polishing the surface as polished surfaces radiate less heat.

Solution 27:

- As no material medium surrounds the ball so there is no possibility of losing heat by conduction or convection. The ball will lose heat by Radiation.
- Ball will lose minimum amount of heat if it is polished.
- As loss of heat take place by Radiation and process of radiation does not require any material medium, so there is no role of air in loss of heat.

Solution 28:

- CFC means Chlorofluorocarbons which are produced mainly by refrigeration industries, aerosol cans, coolants, propellants and plastic foams. They cause global warming.
- UV means ultraviolet range of radiations. These are the radiations which are emitted by sun and they enter our atmosphere.
- WHO is World Health Organization which put a check on diseases and global warming etc.

Solution 29:
Green house is a glass house constructed to keep delicate and rare plants that require warmth and protection from weather. It is constructed by panels of glass. The temperature in a green house rises because heat enters the house through the glass but cannot escape out, because the glass reflects the heat back to the inside of the house. This makes glass house warmer than the outside environment. This phenomenon is called green house effect.

Solution 30:
Carbon dioxide, Carbon monoxide, methane are green house gases.

Solution 31:
As fossil fuels are non-renewable sources of energy they are not available again and again if are fully exhausted, so they should not be used extensively.

Solution 32:
Global warming occurs due to the presence of carbon di- oxide, CFCs, methane in the atmosphere. Carbon dioxide acts as a transparent gas to incoming shortwave radiations which the earth re-radiates into space. It therefore traps the outgoing longwave radiations thus warming lower atmosphere of the earth thereby causing global warming.

Solution 33:
Harmful effects of global warming are:

- The atmospheric temperature of earth would increase thereby making it difficult for a living being to survive.
- It would melt down the polar caps thus increasing the size of the ocean and leading to floods, tsunami, etc.
- The increase in temperature would affect climate and rainfall thus affecting flora and fauna.
- Human beings would be vulnerable to diseases as microbes would get warmth to grow.