

SUMMARY

- Heat is a form of energy capable of doing work.
- The heat that we use or which affects life comes from six main sources: the sun, the earth, fuels, nuclear energy, friction, electricity.
- Heat changes the temperature, shape, size, state, chemical composition, and volume of substances.
- Temperature is the degree of hotness or coldness of a body.
- We can measure temperature with universal standards, like Celsius, Fahrenheit, and Kelvin.
- Thermometers are used to measure temperatures of objects. Different thermometers have different scales of temperature.
- A scale of temperature is defined by using two fixed points, a lower fixed point (freezing point of water) and an upper fixed point (boiling point of water).

Exercises**Q.1 MULTIPLE CHOICE QUESTIONS:**

- The liquid used in thermometers usually is:

(a) water	(b) silver
(c) alcohol	<input checked="" type="checkbox"/> (d) mercury
- Mercury is _____ in appearance.

(a) sticky	<input checked="" type="checkbox"/> (b) shiny
(c) dull	(d) none of these
- The lowest possible temperature is

(a) absolute zero	(b) -273.15°C
(c) -459.67°F	<input checked="" type="checkbox"/> (d) All of the above
- On heating, an object usually:

<input checked="" type="checkbox"/> (a) expands	(b) contracts
(c) does not change	(d) can't say
- The range of clinical thermometer is:

(a) $0 - 100^{\circ}\text{C}$	(b) $0 - 273^{\circ}\text{C}$
(c) $32 - 214^{\circ}\text{C}$	<input checked="" type="checkbox"/> (d) $35 - 42^{\circ}\text{C}$
- The normal human body temperatures is:

(a) 32°F	<input checked="" type="checkbox"/> (b) 98.6°F
(c) 32°C	(d) 98.6°C
- The difference between lower fixed point and upper fixed point is divided into _____ parts on a Celsius scale.

(a) 50	<input checked="" type="checkbox"/> (b) 100
(c) 180	(d) 273

Q.2 VERY SHORT ANSWER QUESTIONS:

- Heat energy is capable of doing work.
- Hot and cold are relative terms.
- Steam engine converts heat energy to mechanical energy. Mercury, Alcohol
- Mercury and glycerine are two commonly used liquids in thermometers. True or false? False
- All solid metals expand equally on heating. True or false? False
- When heat passes from a hot to a cold body,

convert 70°C to $\text{Fe} \dots$

there is a change in mass. Do you agree? NO

- Human body temperature in Fahrenheit scale. 98.6°F
- The phenomenon of expansion of substances on heating. Thermal expansion.
- The degree of hotness or coldness possessed by a body. Temperature.

Q.3 SHORT ANSWER QUESTIONS:

- Why do cycle tyres sometimes burst on hot summer days?
- When two stones are rubbed together, they produce a spark. Why?
- What is the advantage of providing a constriction in clinical thermometers?
- Why is it not possible to use mercury thermometer to measure temperatures below -39°C ?
- Define temperature. Name the SI unit for temperature.
- Why does the level of mercury not fall rapidly in a clinical thermometer?

Q.4 LONG ANSWER QUESTIONS:

- Mention all the advantages of using mercury in thermometers. Page-158
- Mention some important effects of heat. 151
- Differentiate between the following:
 - Expansion in solids, liquids and gases 151, 152
 - Freezing point and absolute zero
 - Laboratory and clinical thermometers 157,
 - Celsius and Kelvin scales 156
 - Thermal expansion and contraction
- Discuss how can you use a laboratory thermometer correctly to measure the temperature of a chemical. 158.

HOTS Questions (Higher Order Thinking Skills):

1. A sealed glass bottle of soda breaks on keeping in deep freezer for a long time. Give reasons.
2. Why is there no kink in a laboratory thermometer?
3. Why can't we use a laboratory thermometer to measure the temperature of our body?

Activities

(A) Classroom Activity

All of you must be carrying your lunch box and water bottles to school. In your tiffin break, find out in whose tiffin food is still warm and what kind of water bottle helps to keep water cool for a longer time. Notice the materials of such lunch boxes and water bottles. Does any of your friend bring a vacuum flask for water and an insulated tiffin box for food?

(B) Conversational Activity

Various types of energy conversions result in the production of heat energy, such as rubbing our palms together generates heat due to friction (mechanical energy).

Give at least one example of any such energy conversion. Ask your friends to do the same.

Note down all the examples in your notebook

Intext Questions (Page No. 158)

Q.1 Temperature

Q.2 As water cools, the slowing rate of vibrations of the molecules allows the water to freeze into ice. A point is eventually reached at which all vibrations almost cease. The temperature which corresponds to this point is called absolute zero. This is lowest possible temperature. An object at a temperature of absolute zero would contain no heat at all.

Q.3 Vibrations of constituent particles of the solid decides the temperature of a solid body.

Q.4 Anders Celsius

Q.5 Relation between Celsius and Fahrenheit scale:

$$C = \frac{5}{9} (F - 32)$$

or

$$F = \frac{9}{5} C + 32$$

Q.6	Freezing point of water	Boiling point of water
Celcius	0°C	100°C
Fahreheit	32°F	212°F
Kelvin	273 K	373 K

Q.3 Short Answer Questions:

1. Cycle tyres sometimes burst on hot summer days because as temperature increases, the air in the tube expands. Beyond a level, the tube cannot expand, so the tube bursts with an explosion.
2. When two stones are rubbed, friction works between their surfaces. Due to continuous rubbing, friction causes heat which subsequently produces sparks.
3. Constriction does not allow the mercury thread to fall after measuring the temperature. This allows us to read the temperature in the clinical thermometer even after it has been removed from the mouth or armpit.

85-

86-7

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4. Mercury freezes at temperatures below -39 $^{\circ}\text{C}$. Hence it cannot be used to ~~measures~~ temperatures below it.
 5. The degree ~~of~~ hotness or ~~coldness~~ of a body is called its's temperature. S.I. unit of temperature is Kelvin.
 6. The level of mercury does not fall rapidly in a clinical thermometer due to the kink present near the bulb.

Q.4 Long Answer Questions

Liquids in thermometers

Depending on the range of temperature to be measured, different liquids are used in thermometers.

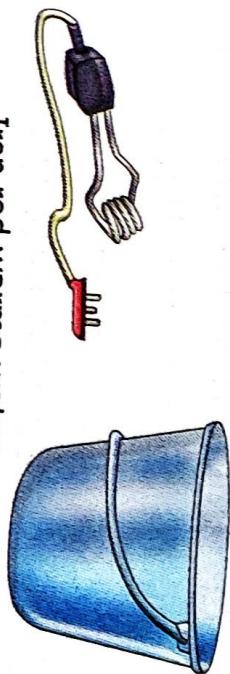
Alcohol and mercury are two commonly used liquids.

Mercury as a liquid has many advantages, due to which it is preferred over other liquids. They are:

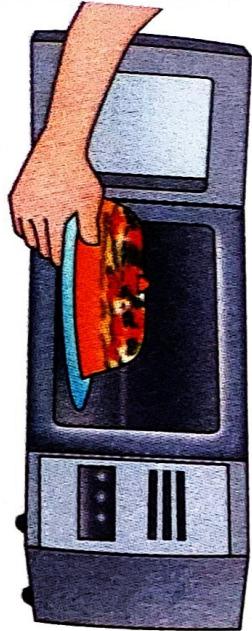
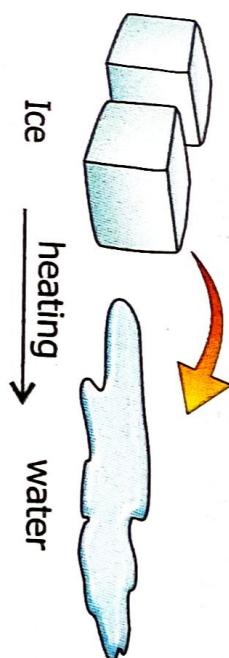
- (i) Due to a large difference between its freezing and boiling points, it measures a wide range of temperature.
- (ii) It is a good conductor of heat and so attains the temperature quickly.
- (iii) It does not wet glass, i.e., it does not stick to the glass.
- (iv) It has good visibility, because it is a shiny and silvery white liquid.

L-2

Whenever a substance (solid, liquid, or gas) is heated, a number of changes take place.

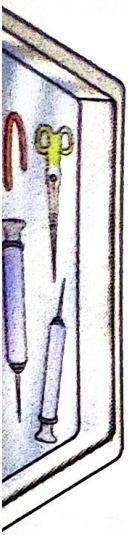


Iron rod warms water

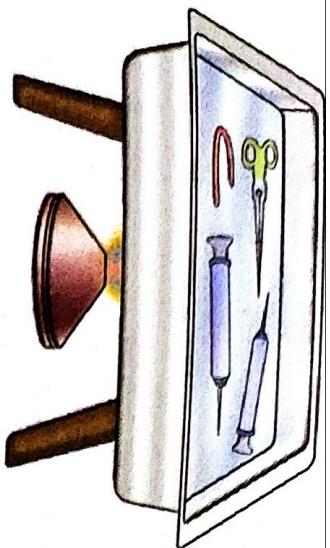


Oven heating → Baked cake

- Heating a substance raises its temperature. For example, when we heat water, it becomes warmer.
- Applying heat to a body changes its shape and size. For example, wax on heating melts and spreads.
- Heat accounts for changes in state, i.e., it can convert solids to liquid and liquids to gases. For example, ice is converted into water and water into steam (gas) on heating.
- Heat also accounts for chemical changes which are irreversible and form a new substance with different properties. For example, baking of a cake.
- Heat also affects living organisms. For example, we heat objects to disinfect and sterilise them. Harmful bacteria are killed by heat, making objects safe for use. That is why, water is boiled for purification.
- Heating a substance also results in changes in volume.) This we will study in detail in the next topic.



- Heating a substance also results in changes in volume. (This we will study in detail in the next topic.)



Objects $\xrightarrow{\text{heating}}$ sterilised objects
Changes due to heating

14.4 THERMAL EXPANSION

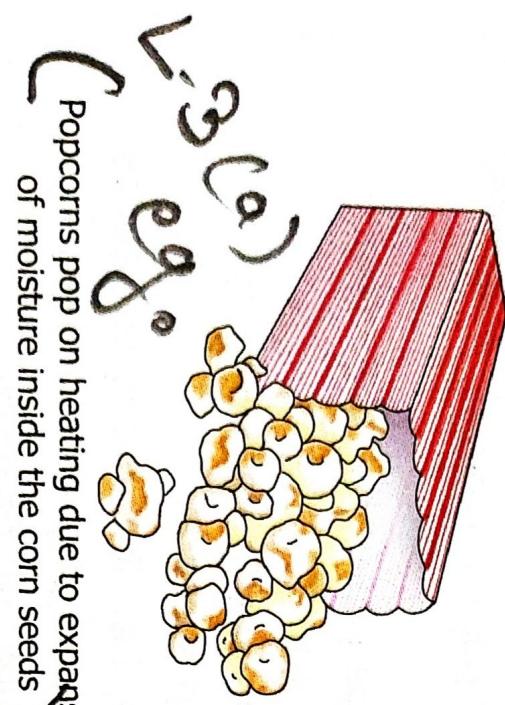
The most common change caused by heat is expansion, called **thermal expansion**. Matter increases in volume when there is an increase in temperature.

$V = V_0(1 + \alpha \Delta T)$

Expansion of solids: A solid substance expands slightly on heating as its molecules (the constituent particles of a substance) are very tightly packed. This expansion can be noticed easily as the change in shape and size of a solid are easily visible. (For example, metallic wires sag in summer due to intense heat of the sun.)

R. 151

L-3(a)



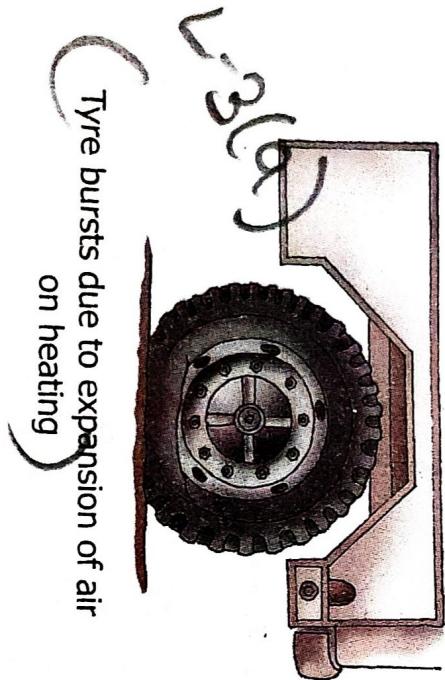
Expansion in liquids Liquids also expand when temperature is raised. Molecules of liquids are less closely packed in comparison to solids. These molecules are comparatively free to move. Raw popcorns are the seeds of a plant that pops open on heating because the amount of moisture inside the seed changes from liquid to gas. The water vapour formed expands vigorously and explodes through the covering, blowing out the starch inside. Different liquids expand to different levels on heating.

Popcorns pop on heating due to expansion of moisture inside the corn seeds

2

Conclusion: Coloured liquid in the bottle expands when heated in a water bath.

L-3(a)



Expansion in gases: The molecules of gases are not as tightly packed as those of solids and liquids. That is why there is maximum expansion in gases when heat is supplied. In summer season, you must have often heard a huge explosive sound due to bursting of a cycle tube placed in sunlight. Do you know why? This is because as temperature increases, the air in the tube expands. Beyond a level, the tube cannot expand, so the tube bursts with an explosion.

P. 152

L-3(c)

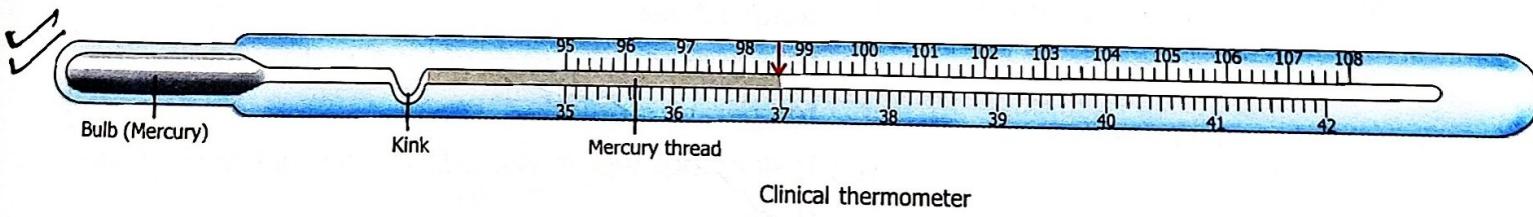
Did You Know?

- Ethanol has a freezing point of -114°C and a boiling point of 78°C .
- Mercury has a freezing point of -39°C and a boiling point of 357°C .

Clinical thermometer

A clinical thermometer is used by doctors and nurses to measure body temperature. This is the thermometer we normally have at home. It looks like a thin narrow glass tube with a bulb at one end. The bulb contains mercury. It expands when it is heated and rises in the tube. The range of scale in the thermometer varies a few degrees on either side of the normal human body temperature, which is between 35°C to 42°C . This thermometer may also have scale given in $^{\circ}\text{F}$ as shown in the given figure.

To measure body temperature, first we should look carefully at the thermometer in order to observe the position of mercury thread. If we cannot see it, then we should rotate the thermometer slowly until shiny thread of the liquid is visible. In order to bring the level of mercury thread below normal body temperature we can flick the thermometer a few times. Also remember to never hold the thermometer from its bulb. Now wash and wipe the bulb. Place it under the tongue and after about a minute remove it. We can look for the mercury thread in a similar manner again. In order to read the temperature we should count the number of divisions between any two degrees. In most thermometers there are 5 divisions. This means that each division is 0.2° of the scale. Now you can easily read the body temperature. Mercury thread in the thermometer does not fall when we try to read it due to the kink present near the bulb. We must be very careful in handling a mercury thermometer because if it breaks mercury can be very dangerous.



Clinical thermometer

L-3(c)

Laboratory thermometer

Laboratory thermometer is used to measure the temperature of objects other than human body. It is mainly used in laboratories to measure the temperatures of various substances accurately. It is made up of a narrow tube containing mercury in the bulb at one end. The amount by which it rises shows the rise in temperature. A laboratory thermometer is taller than a clinical thermometer due to the range of temperature it can measure which is from -10°C to 110°C .



Laboratory thermometer

Did You Know?

In United States of America, Fahrenheit scale is still used. The rest of the world uses the Celsius scale for denoting weather, etc.

Fahrenheit scale	Celsius scale	Kelvin scale
212°F Boiling point of water	100°C Boiling point of water	373 K Boiling point of water
98.6°F Body temperature	37°C Body temperature	370 K Body temperature
77°F Room temperature	25°C Room temperature	298 K Room temperature
32°F Freezing point of water	0°C Freezing point of water	273 K Freezing point of water

Temperature scales

(i) **Celsius scale:** This scale of temperature is in degrees Celsius (0°C) and is defined in terms of ice point (0°C) and steam point (100°C) of water. The normal body temperature is 37°C .]

(ii) **Fahrenheit scale:** This was the first widely used temperature scale. This scale of temperature is in degrees Fahrenheit (0°F). The scale was designed by Gabriel Fahrenheit. On this scale, the freezing point of water (corresponding to 0°C) is 32°F and boiling point (corresponding to 100°C) is 212°F . The normal body temperature is 98.6°F .

(iii) **Kelvin scale:** This scale of temperature is in Kelvin (K). The freezing point of water (corresponding to 0°C) is 273 K and the boiling point of water (corresponding to 100°C) is 373 K on this scale. Kelvin is the SI unit for temperature. The normal body temperature is 310K.

Long Ans 36

(b) Freezing point: The temperature at which a liquid freezes, i.e., changes into its solid state is called its freezing point, e.g., water freezes at 0°C . Freezing point varies for different substances.

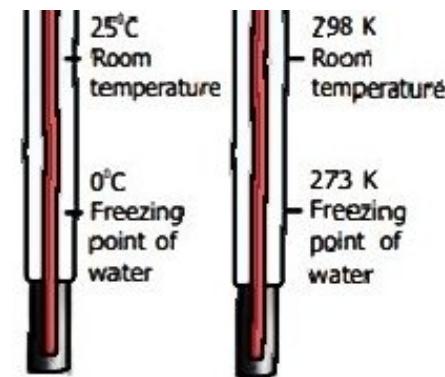
Absolute zero: It is the lowest possible temperature. It is constant and is equal to -273.15°C . An object at absolute zero would contain no heat at all.

~~An alcohol thermometer is used to measure the temperature~~

Long Ans 3(e)

(e) Thermal expansion: Expansion in the substances due to heat is known as thermal expansion. Matter increases in volume, when there is an increase in temperature.

Thermal Contraction: Compression or contraction in the substances on cooling them is known as thermal contraction. Opposite to expansion volume of matter decreases on lowering its temperature. It is also called shrinking.



HOTS Questions (Higher Order Thinking Skills):

1. Liquids like carbonated water on cooling shrinks, but on freezing at 0°C or less, acquires larger volume. To make space for the expanded volume, it breaks the glass. That is why, sealed glass bottle of soda breaks on keeping in deep freezer for long time.
2. A laboratory thermometers are mostly used to record room temperature etc. They usually are hanged or placed permanently in rooms or in open area for continuous/regular watch of temperature. These are also used in various experiments to observe temperature of chemicals etc. Unlike clinical thermometers, these do not undergo temperature change on removal. Their readings are taken than and there at the site of experiment. Since, they are used for continuous monitoring of temperature, they do not have any kink or constriction.
3. We cannot use laboratory thermometer to measure our body temperature because as soon as we remove it from our mouth, the mercury thread starts falling

Intext Questions (Page No. 154)

- Q.1 (i) Using steam to cook food in pressure cooker.
(ii) Using heat from burning fuels to run ships and launch rocket etc.
(iii) Using steam to spin wheels of turbines which helps in generating electricity.
- Q.2 Ice cream, Fruits, Salad leaves, Chocolates, Sweets
- Q.3 (i) Expansion in solids: Expansion of clothesline in summers.
(ii) Expansion in Liquids: Popping of popcorns due to moisture inside.
(iii) Expansion in gases: Bursting of tyres on very hot day.
- Q.4 Heat can be defined as energy travelling from one object to another due to their temperature difference.
Anything that gives off heat is a source of heat. Sources of heat are:
Sun, earth, Fuels and nuclear energy.
- Q.5 Whenever a substance (solid, liquid, or gas) is heated, a number of changes take place.
- Heating a substance raises its temperature. For example, when we heat water, it becomes warmer.
 - Applying heat to a body changes its shape and size. For example, wax on heating melts and spreads.



- Heat accounts for changes in state, i.e., it can convert solids to liquid and liquids to gases. For example, ice is converted into water and water into steam (gas) on heating.