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INTRODUCTION OF HEAT

Heat is a form of energy that may be changed from one form to another form.

We can feel heat when we rub our hands. We feel hotness because mechanical energy is converted into heat energy. In the other words heat is a kind of fluid which flows from hot body to the cold body. The Kinetic energy in solid, liquid and gas is increased when they are heated. The molecules of the matter start to move faster. By giving more heat movement of the molecules become more faster.

**Effect of Heat**

1. On heating, ice changes into water and on further heating, it changes into steam. So, heat can change the physical state of the substance.
2. On heating, movement of molecules increase so volume of substance increases. Therefore, heat causes expansion.
3. Heat can rise the temperature of substance.
4. After boiling the liquid such as water, some harmful bacteria present in it are dead.

EXPANSION

When we heat a substance, the movement of its molecules increases. This increases the molecular space therefore, the space occupied by the molecules, that is the volume of the substance increases. Thus it concludes that heat causes expansion.



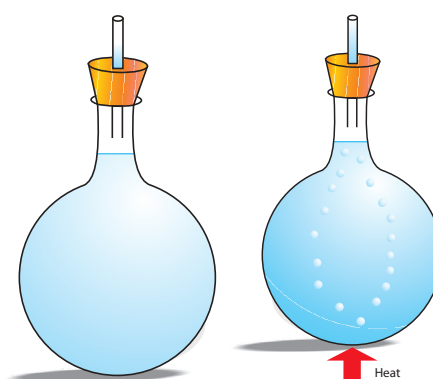
Gaps for expansion between two sections of rail tracks

Expansion of Solids

It can be proved by following experiment. Take a solid metal ball and ring of its size. At normal temperature the ball just passes the ring. Now, heat the ball and try to pass it through the ring because it expands on heating and size of ball increases. So, it can not pass through the ring.

Expansion in Liquids

Liquids have not fixed shape because molecules of liquids are not closely packed. Therefore, on heating molecules of liquids vibrate freely here and there very fast. So, liquid expands more than solids on heating. It can be shown by an experiment. Take liquid in a flask and heat it. First level of water will go down a little due to expansion of flask but after further heating, water expands and level of water goes up.



Before heating

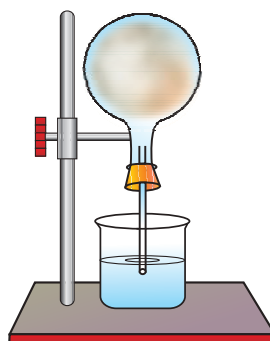
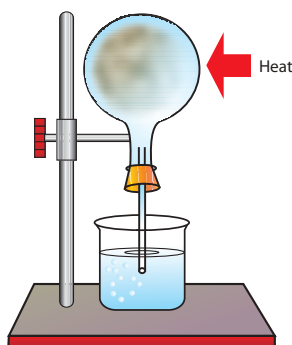
After heating

Expansion of Gases

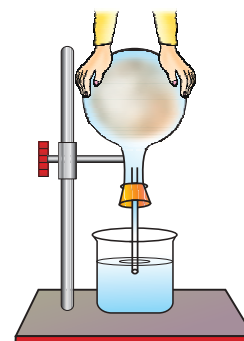
Gases have not fixed shape and volume because molecules of gases are not closely packed, they are free to move anywhere they take the shape of container. These gases expand more than liquids and solids on being heated.

It can be shown by an experiment.

Take a flask and turn it upside down over a beaker of water, so that the glass tube dips inside the water. Fix the flask to a stand and heat it. Bubbles of gas can be seen coming out of the tube. This is because that when air expands on heating, it comes out of the flask as bubbles. Now cool the flask. As the air inside contracts, the water rises up the tube. After the flask has cooled to room temperature, hold it firmly with your palms. You will see that the water level in the tube goes down. This is because of expansion of gas.



Gases expand on heating



TEMPERATURE

The degree of hotness and coldness of a body is called temperature. The hotter a substance is, the higher its temperature. When we touch a hot object, we feel hot because heat energy is transferred in our body. When we touch a cold object, we feel cold because heat energy is transferred from our body to the cold body. We use a device to measure the hotness and coldness called thermometer.

We use different thermometer scales for measuring the temperature :

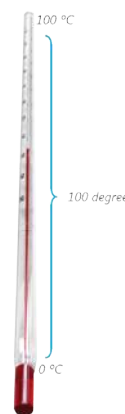
1. Celsius scale
2. Fahrenheit scale
3. Kelvin scale

Celsius Scale

Temperature on this scale is measured in °C. C is called degree celsius.

The lower end is marked at 0°C and upper end is marked at 100°C.

0°C is called freezing point of water and 100°C boiling point of water.



Celsius

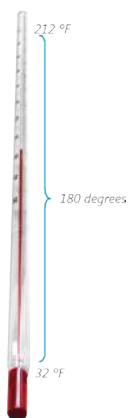
Fahrenheit Scale

Temperature is also measured in °F. F is called degree fahrenheit. Its lower fixed point is taken as 32° F and the upper fixed point is taken as 212°F.

We can convert the value of temperature from one scale to other scale.

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

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



Fahrenheit

Measuring Temperature

A thermometer is an instrument used to measure temperature. The thermometers available in the laboratory are thin glass tube sealed at one end, with a filled with a liquid at the other end. The most commonly used liquid is mercury. Mercury is used because :

It is silvery and can be easily seen.

It does not stick to the walls of the thermometer.



Thermometer

It is a good conductor of heat, and has uniform expansion and contraction over a wide range of temperature.

Mercury cannot be used for measuring temperature below -39°C . In such thermometers, alcohol, which freezes at -117°C is used.

When the temperature of the body is measured, it is put along with the body. With heat, the mercury expands and rises in the thin capillary tube. The temperature at which the mercury rises is the temperature of the object.

There are two types of thermometer, clinical thermometer and laboratory thermometer.

Clinical Thermometer

It is smaller in size with the temperature range of 35°C to 42°C . The corresponding markings in $^{\circ}\text{F}$ are also usually marked on it. These thermometers are used for measuring human body temperature. The normal human body temperature is about 98.6°F .

These thermometers have a kink or slight bend just above the bulb of the thermometer so as to stop the mercury from coming back into the bulb after the thermometer has been removed from the contact with the body.

A clinical thermometer consists of a narrow glass capillary. It has a bulb at one end and is sealed at the other end. As the temperature rises, the mercury expands and moves up to show the temperature against the printed scale.

Precautions while reading a clinical thermometer :

- Wash the thermometer before and after use.
- Hold the thermometer horizontally (parallel to the floor) at the eye level.
- Handle the thermometer with care to prevent breakage.
- Make sure the mercury level is below 35°C before use.
- Do not touch the bulb of the thermometers while reading it.



A clinical thermometer

Do You Know?

It was only around 1866 that a convenient portable 6 inch thermometer was built. Before that, doctors had to use thermometer that were one foot long and took 20 minutes to measure the patient's temperature.

Laboratory Thermometer

Laboratory thermometer is longer with no kink in the capillary above the bulb.

The range of this thermometer varies but usually is between -10°C and 110°C .



A laboratory thermometer

Calibrating a Laboratory Thermometer

To calibrate a laboratory thermometer, the bulb is first put in melting ice (since the melting ice will have the temperature of 0°C). Wherever the mercury level gets stable, that point is marked as 0°C and is referred to as the lower fixed point of the thermometer. Next, the thermometer is kept in contact with boiling distilled water from which steam is coming out. The level at which the mercury level stabilises is marked as the upper fixed point.

The space between the two fixed points is equally divided and further subdivided. The larger the number of subdivisions, the more accurate is the thermometer. To use the thermometer, it is kept in contact with the object whose temperature is to be measured and the level of mercury in the capillary is read against the scale printed.

Know the Keywords :

Heat : A form of energy that gives us the sensation of warmth.

Temperature : The degree of hotness or coldness of a body.

Thermometer : An instrument used to measure temperature.

Point to Remember

- Heat is a kind of fluid which flows from hot body to the cold body.
- The thermometers are thin glass tube sealed at one end, with a filled with a liquid at the other end.

EXERCISE TIME

A. Answer the following questions :

1. What is heat ? Write the effects of it.
2. Explain the expansion of solid.
3. Write in your words why a substance expands on heating ?
4. What is temperature ?
5. How many types of scales are there to measure the temperature ?
6. What is fahrenheit scale ?
7. What is clinical thermometer? Write the precautions.

B. Fill in the blanks :

1. Heat is a form of _____.
2. Heat energy flows from _____ to _____.

3. _____ temperature scale is used for scientific work.
4. Upper fixed end of °C is marked at _____.
5. _____ is a shiny liquid.

C. Write 'T' for true and 'F' for false statement :

1. 0°C is called freezing point and 100°C is called boiling point.
2. Intermolecular space is more in solids.
3. Mercury is shiny liquid.
4. During expansion, there is no effect on intermolecular space.

D. Tick (✓) the correct option :

1. The kinetic energy in solid, liquid and gas is when heated :
 - (i) decreased (ii) increased (iii) none of them
2. After boiling the liquid such as water, some harmful bacteria present in it :
 - (i) live (ii) dead (iii) run away
3. The degree of hotness and coldness of a body is called :
 - (i) temperature (ii) substance (iii) both of them



Creative Work

- Place articles like a metal spoon, wood stick or a pencil, plastic scale, cotton thread and a piece of wool in a porcelain mug. Pour some hot water into the mug. After a while, feel the objects to find out the good and poor conductors of heat.
- Write the lower and upper fixed of the following temperature scales -

Scale	Lower fixed point	Upper fixed point
(i) Celsius scale	_____	_____