Ignition temperature

When a sparkler is lighted with a burning candle, it does not burn immediately. It takes some time and only when it attains a particular temperature, it starts burning.

A fuel has to be heated to a certain minimum temperature before it can catch fire. This temperature is different for different fuels. Some substances catch fire immediately, while some take a longer time. The lowest temperature at which a fuel catches fire is called its **ignition temperature**.

ACTIVITY 3.4 WE OBSERVE

Aim: To understand the importance of ignition temperature.

We need: paper cup, water, burner

Procedure:

1. Place a paper cup containing water on a flame.
2. The water will become hot, but the cup will not burn.
3. This is because the water takes away the heat from the cup and does not allow it to reach its ignition temperature.

Fig 3.4. Heating water in a paper cup

Now, we can easily understand why fire is extinguished by water, and a log of wood takes a longer time to start burning than wood shavings, when heated in a flame.

When water is poured over a burning substance, it absorbs heat from the substance. As a result the temperature of the substance falls below the ignition temperature, and it stops burning.

A log of wood has a huge mass. So, when we heat it with a flame, the heat received by the log is dissipated through its bulk mass. And the log takes a long time to attain its ignition temperature. On the other hand, wood shavings, having a smaller mass, attain the ignition temperature more readily. So, a large piece of wood takes a longer time to start burning than wood shavings.

Types of combustion

Combustion can be of different types. It can be spontaneous, rapid, slow and incomplete.

Spontaneous combustion

Some combustion reactions take place without the application of heat energy. When white phosphorus is exposed to air at room temperature, it catches fire immediately; even without being lit by a match stick. This type of combustion reaction that occurs without the help of any external heat source is called **spontaneous combustion**.

Rapid combustion

Bring a burning match stick or gas lighter near a gas stove in the kitchen with the help of your parents. Turn on the knob of the stove. What do you observe ? The gas burns rapidly. Such combustion is known as **rapid combustion**. Bursting of fire crackers, burning of camphor, magnesium ribbon in air, gas in a burner and kerosene in a stove are good examples of rapid combustion.

Fig 3.5. Burning of Magnesium ribbon

Slow combustion

Combustion that takes place at a very slow rate is called **slow combustion**. During this type of combustion low heat and light are produced. Food oxidized in our body to release energy is an example of slow combustion.

$$\text{Carbohydrates + Oxygen} \longrightarrow \text{Carbon dioxide + water + heat energy}$$

Incomplete combustion

Combustion takes place in the presence of oxygen. If the supply of oxygen is insufficient, then combustion will be incomplete. This is called **incomplete combustion**. Carbon forms carbon monoxide when it undergoes incomplete combustion.

$$\text{Carbon + Oxygen} \longrightarrow \text{carbon monoxide}$$

MORE TO KNOW

Rusting of iron is another good example of slow combustion. During rusting, iron is oxidised and energy is released, but the process is very slow. So we cannot see how it happens.

Fig 3.6. Rusting of iron

3.2. FIRE CONTROL

Heat energy in the form of fire plays an important role in our daily life. Unfortunately, fire has an enormous destructive quality, if it is not controlled properly. We read in the newspaper about the destruction by fire leading to loss of life and property. Thus, it is important to know not only the methods of controlling fire, but also the different means of putting out the fire when they get out of control.

Fig 3.7-Fire Control

Fire can be controlled and extinguished by

1. removing any combustible substances near the region of fire;
2. cutting off the supply of air by using sand or blanket;
3. bringing down the ignition temperature by using water;

Usually sand and water are thrown on burning substances to extinguish fire. Sand reduces the supply of air and cools it. **Water should not be used for oil fire**. Oil being lighter, floats, spreads and causes severe damage. So, oil fire should be extinguished by using substances like foamite. Fire that caused by electrical appliances or installations, solid carbon dioxide or carbon tetrachloride should be used. The risk of electrical shock is too great if water is used.

Fire Extinguishers

All of us are familiar with fire extinguishers, the red painted steel containers kept in factories, hospitals, schools, theatres, business places, etc. In the event of a fire breaking out, fire extinguishers can be used to put out the fire.

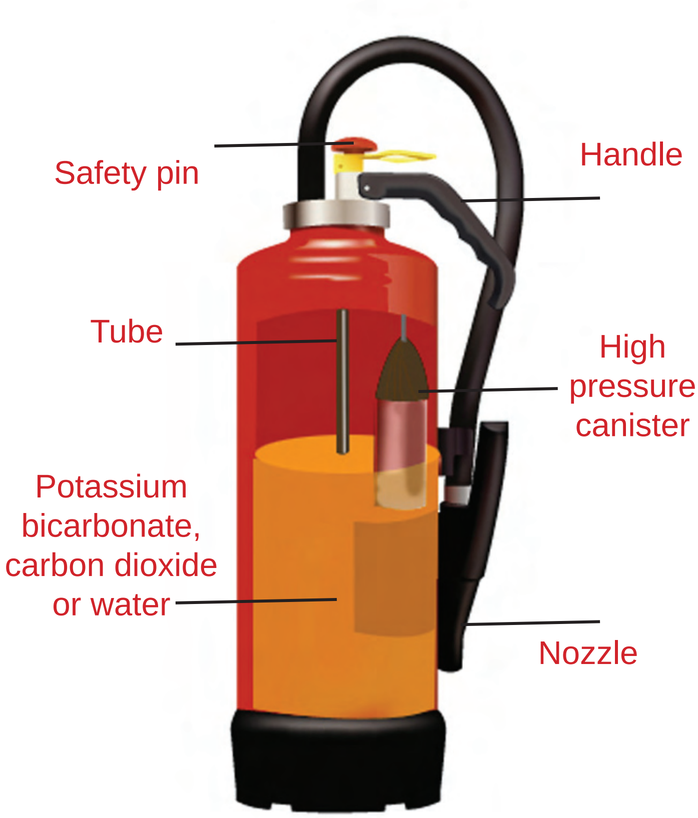


Fig 3.8. Fire Extinguishers

SCIENCE

3.3. FLAME AND ITS STRUCTURE

Observe an LPG flame. Did you observe the colour of the flame? What is the colour of a candle flame? Recall your experience of burning a magnesium ribbon. If you have not done the experiment so far, try burning the substances given in the table below.

Is flame formed on burning the following substances? Record your observations.

Table 3.2 (Tick the appropriate column)

Sl.no	Substance	Forms flame	Does not form flame
1	candle		
2	magnesium		
3	camphor		
4	kerosene		
5	charcoal		

Parts of a candle flame

Zone of non-combustion: This is the dark zone that lies around the wick. It contains unburnt gas particles. No combustion takes place here as no oxygen is available.

Zone of partial combustion: In this zone, the hydrocarbons present in the oil gas from wax decompose into free carbon and hydrogen. The unburnt carbon particles impart a pale yellow colour to the flame. This is the luminous part of the flame.

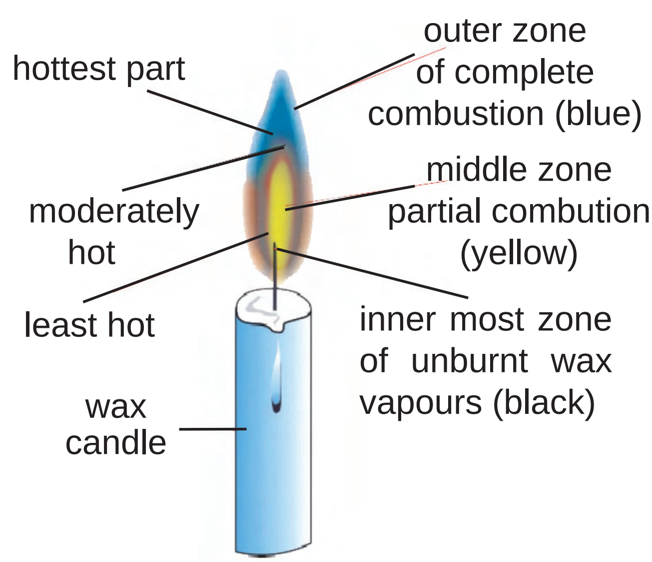


Fig 3.9. Structure of candle flame

Zone of complete combustion (blue) : This is the non-luminous thin zone of the flame. It is the outermost hottest region in the flame that is invisible. Here, carbon and hydrogen are completely oxidized to carbondioxide and water vapour.

Hydrocarbon + Oxygen ⟶ Carbondioxide (blue flame) + Water (vapour)

MORE TO KNOW

Incase of emergency we should call...

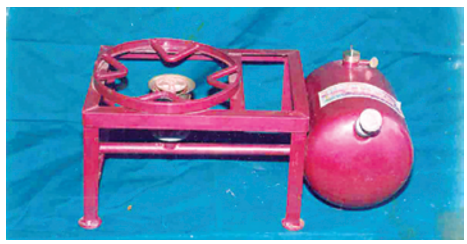
108 - Free Ambulance Service

101 - Fire Service

3.4. EFFICIENCY OF FUELS

Any substance that can be burnt or otherwise consumed to produce heat energy is called a fuel. Wood, natural gas, petrol, kerosene, diesel, coal, and LPG are commonly used as fuels.

We use fuels to run all forms of modern transportation like automobiles, trains, buses, ships, and aeroplanes. Fuels are the important source of energy for many industries. Thermal power stations depend heavily on fuels for generating electricity. We also use fuels for domestic purposes, e.g., cooking.



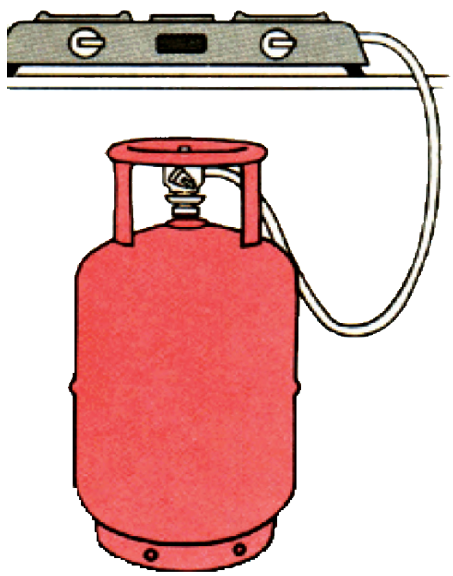


Fig 3.10. using different types of fuel

Characteristics of a good fuel:

We know that a large number of substances burn to produce heat energy. But not all of these substances can be used as fuel. The characteristics of a good fuel are as follows:

1. It should be cheap and readily available.
2. It should be easy to store, transport and handle.
3. It should not produce toxic fumes or smoke or other harmful products on combustion.
4. The amount of soot or ash left behind should be minimum.
5. It should have a high calorific value.
6. It should have a low ignition temperature.

Calorific Value

The main constituents of fuels are hydrocarbons. During combustion, these hydrocarbons get oxidized to form carbon dioxide and water. Heat is evolved in this process (exothermic process).

Hydrocarbon + Oxygen $\longrightarrow$ Carbon dioxide + Water + Heat energy

Fuel

The nature of the fuel can be determined by the amount of heat energy evolved. The higher the heat energy evolved, the better is the fuel.

The amount of heat energy liberated when 1 kg of the fuel is burnt completely in oxygen is called the **calorific value** of the fuel. The calorific values of some common fuels are given in Table 3.3.

Table 3.3

Calorific value of some fuels

Fuel	Calorific value (Kcal/Kg)
Wood	4000
Coal	7000
Coke	8000
Kerosene	10,300
Petrol	11,500
Natural gas	8000-12,000
Water gas	3000-6000
Hydrogen	34,000
Methane	13,340
LPG	11,900

Types of Fuels

There are three types of fuels. They are solid, liquid, and gaseous fuels.

Solid Fuels

Coal, wood, charcoal, coke, and paraffin wax are some commonly used solid fuels. The drawbacks of solid fuels are as follows:

1. They have a high ignition temperature.
2. They produce a large amount of residue (soot, ash) after combustion.
3. Their calorific value is low.

SCIENCE

Liquid Fuels

Petrol, kerosene, and diesel are some commonly used liquid fuels which are obtained from petroleum (an oily mixture of hydrocarbons in its crude form). Ethyl alcohol is also a liquid fuel. Locomotives, buses, and lorries use diesel as fuel.

Gaseous Fuels

Gases such as methane, carbon monoxide and hydrogen are combustible. Natural gas, producer gas, coal gas, water gas, LPG (Liquefied Petroleum Gas), and biogas (gobar gas) are other examples of gaseous fuels.Gaseous fuels are preferred over solid and liquid fuels because of the following advantages:

- They have a low ignition temperature.
- They burn completely (complete combustion) and leave no residue (soot, ash, smoke).
- They are easy and safe to handle, transport, and store.
- They have a high calorific value.
- They are cheap.

Natural gas

Natural gas is obtained from petroleum wells. It contains a mixture of hydrocarbons (methane and ethane). It is one of the cheapest available gaseous fuels.

Producer gas, coal gas and water gas

Producer gas, coal gas, and water gas are important gaseous fuels used in industries. All these are obtained from coal or coke.

LPG (Liquefied Petroleum Gas)

It is the most widely used gaseous fuel for cooking. LPG is a mixture of propane (15%) and butane (85%) liquefied under pressure. It has a high calorific value. A small amount of ethyl mercaptan, an inert gas with a characteristic odour, is added to LPG to detect any leakage.

Biogas (Gobar gas)

Gobar gas contains a mixture of methane and ethane and is a very cheap form of gaseous fuel.Gobar gas is becoming increasingly popular in villages, where cattle can be maintained in large numbers. It is also comparatively less expensive.

Fig.3.11-Biogas (Gobar gas) plant

3.5. FUELS AND ENVIRONMENT

The increasing fuel consumption has harmful effects on the environment.

1. Carbon fuels like wood, coal and petroleum release unburnt carbon particles. These fine particles are dangerous pollutants causing respiratory diseases like asthma.

2. Incomplete combustion of these fuels gives carbon monoxide gas. It is a very poisonous gas. It is dangerous to burn coal in a closed room, because the carbon monoxide gas produced can kill persons sleeping in that room.

3. Combustion of most fuels releases carbon dioxide in the environment. Increased concentration of carbon dioxide in the air causes global warming.

4. Burning of coal and diesel releases sulphur dioxide. It is an extremely suffocating and corrosive gas. Moreover, petrol engines give off

Acid rain formation

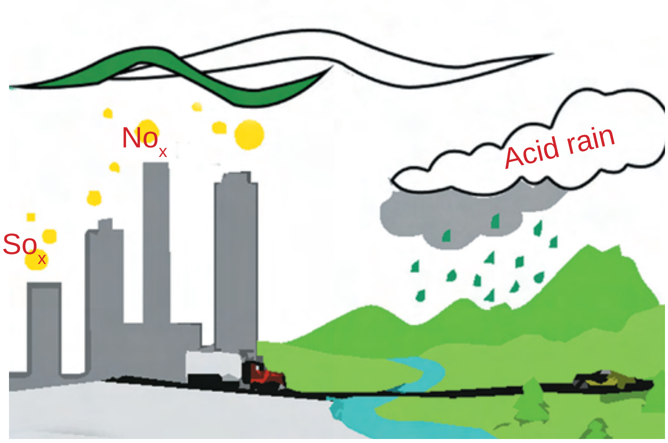


Fig 3.12. Acid Rain Formation

gaseous oxides of nitrogen. Oxides of sulphur and nitrogen dissolve in rain water and form acids. Such rain is called **Acid Rain**. It is very harmful for crops, buildings and soil.

The use of diesel and petrol as fuels in automobiles is being replaced by CNG (Compressed Natural Gas), because CNG produces harmful products in very small quantities. CNG is a cleaner fuel.

GLOBAL WARM(N)ING

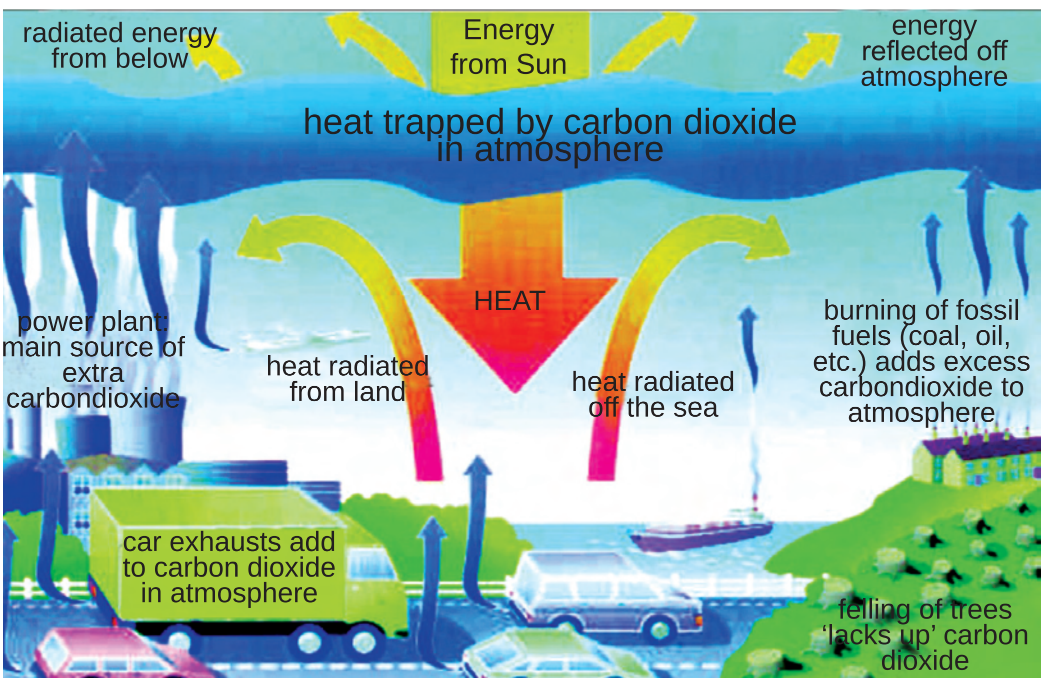


Fig 3.13. Global warming

It is the rise in temperature of the atmosphere of the earth. This results, in the melting of polar glaciers, which leads to a rise in the sea level, causing floods in the coastal areas. Low lying coastal areas may even be permanently submerged.

SCIENCE

EVALUATION

I.Choose the correct answer

a. During combustion light is evolved along with

i. heat   ii. flame   iii. air   iv. none of these

b. Substances that catch fire easily are

i. inflammable   ii. non-combustible   iii. heavy   iv. light

c. L.P.G is a mixture of

i. methane and propane   ii. propane and butane

iii. butane and methane   iv none of these

d. Rusting of iron is an example of _________combustion

i. slow   ii. rapid   iii. spontaneous   iv. incomplete

e. _________is a good supporter of combustion.

i. oxygen   ii. carbon di oxide   iii. nitrogen   iv. hydrogen

f. Petrol is a

i. solid fuel   ii. highly inflammable substance

iii. non combustible substance   iv. less inflammable substance

II. Fill in the blanks:

a) The lowest temperature at which fuel catches fire is called ________

(body temperature / ignition temperature)

b) ___________ is used to extinguish oil fire. (Water / Foamite)

c) The amount of heat energy liberated by completely burning 1 kg of fuel is called_____

(calorific value / flame value)

III. Write True for the correct statement and False for the wrong statement. Also correct the wrong statement(s)

a. In a rapid combustion, substances catch fire without application of heat.

b. All types of fire can be extinguished by water.

c. Non –luminous zone is the hottest part of a flame.

d. A good fuel should have a low calorific value.

IV. Match the following:

1) Oxides of Sulphur and Nitrogen	-	Luminous flame
2) Biogas	-	Non- Luminous flame
3) Ethyl alcohol	-	Acid rain
4) Yellow colour flame	-	Gaseous fuel
5) Blue colour flame	-	Liquid fuel

V. Sharmila has the following substances. Help her to classify them into combustible and non-combustible.

dry leaves, petrol, rubber tube, chalk, paper

VI. Oil fire should be controlled by using foamite. Water should not be used to control oil fire. Could you explain why this is so?

VII. Give reasons.

a. Water is not used to control fire involving electrical equipments.

b. Gaseous fuels are considered superior to solid fuels.

c. Large piece of wood takes a longer time to start burning than wood shavings.

d.Kerosene burns more readily than wood.

VIII. Magesh and Keerthivasan were doing an experiment in which water was to be heated in a beaker. Magesh placed the beaker close to the wick in the yellow region of the flame. Keerthivasan placed the beaker on the outer most blue region of the flame. Which beaker would get heated faster?

IX. How would you put out the fire in each of the following cases? Justify the method chosen.

1) a pan of hot oil catches fire

2) a cotton pillow catches fire

3) a wooden door is on fire

4) an electric fire

X. Classify the following into solid, liquid, and gaseous fuels.

petrol, coal, wood, oil, natural gas, LPG, coke, water gas, charcoal, kerosene

Solid fuel	Liquid fuel	Gaseous fuel

XI.Compare the characteristics of the following fuels and choose the best fuel on the basis of the responses to the following questions.

i) Coal ii) Kerosene iii) LPG

- How much heat energy does it give out ?(Use table 3.3)
- Does it cause pollution ?
- Is it easily available ?
- Is it easy and safe to store and transport ?
- How much does it cost ?

XII. Debate on the following topics

a. Are biofuels a better alternative to fossil fuels ?

b. Carbon dioxide is necessary for photosynthesis but it causes global warming.

PROJECT

1) Survey 5 houses in your area. Find the number of households using LPG, kerosene, electricity, wood, biogas and cattle dung as fuel. Then tick (✓)the appropriate column in the table below.

Name of the resident : Door No. :

Characteristics of the fuels used		Types of fuels					
		LPG	Kerosene	Electricity	Wood	Biogas	Cattle dung
Smoke produced	High						
	Moderate						
	Low						
Residue formed	High						
	Moderate						
	Low						
Time taken to cook food	Long						
	Moderate						
	Less						
Cost of the fuel	Costly						
	Moderate						
	Less						

Based on your observations and data provided by the households.
which of these fuels would you choose for use in your house ? Why?

SCIENCE

FURTHER REFERENCE

Books

1. Chemistry-Facts, Patterns and Principles - Kneen, Rogers and Simpson (ELBS), The Language Book Society
2. Framework of Science – Paddy Gennom, Oxford University Press, New Delhi

Websites

http://www.einstrumentsgroup.com

http://www.en.wikipedia.org/wiki/combsustion

http://www.chem.csustan.edu./consumer/fuels

Places of scientific importance for visit:

1. Murugappa Chettiyar Research Centre, Tharamani, Chennai
2. A Fire and Rescue Station

4.1. HEAT

Dip a steel spoon into a pan of boiling water. What do we notice? After a few minutes the steel spoon becomes too hot to hold. What happened? The boiling water has transferred its heat energy to the spoon. When we touch ice, we feel cold. Here, the heat energy is transferred from our body to the ice.

So the energy which can be transferred from a hotter body to a colder body and which produces a sensation of hotness or coldness is called heat.

4.1.1. SOURCES OF HEAT:

1. The Sun

The sun gives us light. Does it also give us heat?

1. Place a metal piece in sun light. Touch the metal piece after a few minutes. Do we feel any change ? Yes, it has become hot.
2. On standing under the sun for some time, touch your head. Won't you feel hot?
3. Will we be able to walk bare-footed on a sunny day in the afternoon? It may be uncomfortable because the ground is hot.

So we understand that the sun gives out heat besides light.

Fig 4.1. Sun

Fig 4.2. Coal fire

2. Combustion

Burning of coal, kerosene etc., produces heat.

These are called **fossil fuels** since they are made from the remains of plants and animals that died millions of years ago and were buried deep inside the earth.

MORE TO KNOW

The sun gives us 3.8×10^{26} joule of heat energy per second. This energy is produced by nuclear fusion.

The sun is the prime source of heat energy without which life would be impossible on the earth.

Now a days solar energy is used in solar cookers and solar heaters.

joule is the unit used to measure energy.

SCIENCE

3. Friction

The weather becomes very cold in winter. If we rub our hands together, they become warm. The faster we rub, the hotter they become. Rubbing two things together produces heat due to friction.

The ancient man used friction to produce a spark. Sometimes he rubbed two flint stones to make a fire.

Fig 4.3. Producing spark

Fig 4.4. Forest fire

4. Electric current

When electric current flows through a conductor heat energy is produced as in a water heater, iron box, electric kettle etc.

Fig 4.5. Electric kettle

4.1.2. HOT AND COLD OBJECTS

Heat energy is not visible but can be felt.

ACTIVITY 4.1 **I DO**

I need: Three large bowls, ice cold water, hot water, tap water

1. I take three large bowls. I fill one with ice cold water, the other with hot water and the third with tap water.
2. I dip one hand in ice cold water and the other in hot water for a few minutes.
3. Then I take out my hands and plunge both into the bowl containing tap water.
4. I find that the tap water feels hot to my hand that was in cold water while the same tap water feels cold to my hand that was in hot water.
5. I infer that sense of touch cannot tell accurately the amount of heat energy possessed by a body.

SCIENCE

4.1.3. HEAT AND TEMPERATURE

Heat energy is not visible but can be felt. To measure the heat energy we use the physical quantity, namely temperature. Temperature measures the degree of hotness or coldness of a body.

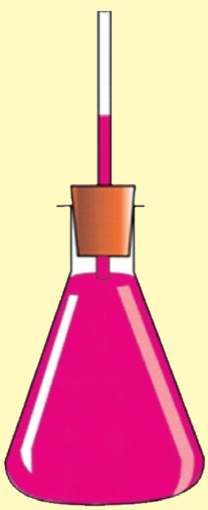
Thermometer

Since the sensation of hotness or coldness is relative, we use thermometers to measure the temperature. On what basis is a thermometer constructed?

ACTIVITY 4.2 — I DO

I need: A glass bottle, a one hole cork, ink, narrow glass tube of suitable size

1. I put some ink into a glass bottle and fill it with water.
2. I close the bottle tightly with a one hole cork and insert the narrow glass tube into the hole.



3. I keep the bottle in a pan of boiling water and note that the coloured water in the glass tube rise up.
4. I understand that the water gets heated and expands to rise up in the glass tube.
5. I realize that the rise in the level is the measure of the temperature.
6. Now I cool the bottle. I note that the water level in the glass tube goes down.

I infer that

liquids expand on heating and contract on cooling.

This principle is used in the construction of thermometer.

Almost all television channels end their news telecast with a mention of the maximum and minimum temperatures recorded in major cities for the day. In some channels the term Celsius is used, while in some other channels the term Fahrenheit is used. What is the difference? Both Celsius and Fahrenheit are valid terms used in the measurement of temperature.

Thermometers have two different scales to measure temperature.

a) Centigrade or Celsius scale.

b) Fahrenheit scale.

MORE TO KNOW

Kelvin scale

- The SI unit of temperature is kelvin(K)
- Kelvin scale is also known as absolute scale of temperature
- On this scale 0 kelvin = - 273^0C
- 0 K(kelvin) is also known as absolute zero

SCIENCE

Thermometers have two fixed points based on which graduations are marked.

These are called the upper fixed point and the lower fixed point. The distance between these two fixed points is divided into an equal number of degrees.

The lower fixed point is the **melting point of pure ice**.

The upper fixed point is the **boiling point of water**.

To convert Celsius into Fahrenheit we use the relation

$$\frac{C}{100} = \frac{(F-32)}{180}$$

'C' : Reading shown by the Celsius thermometer.

'F' : Reading shown by the Fahrenheit thermometer.

TEMPERATURE SCALES	UPPER FIXED POINT	LOWER FIXED POINT	NUMBER OF DIVISIONS
CELSIUS	100^0 C	0^0 C	100
FAHRENHEIT	212^0 F	32^0 F	180

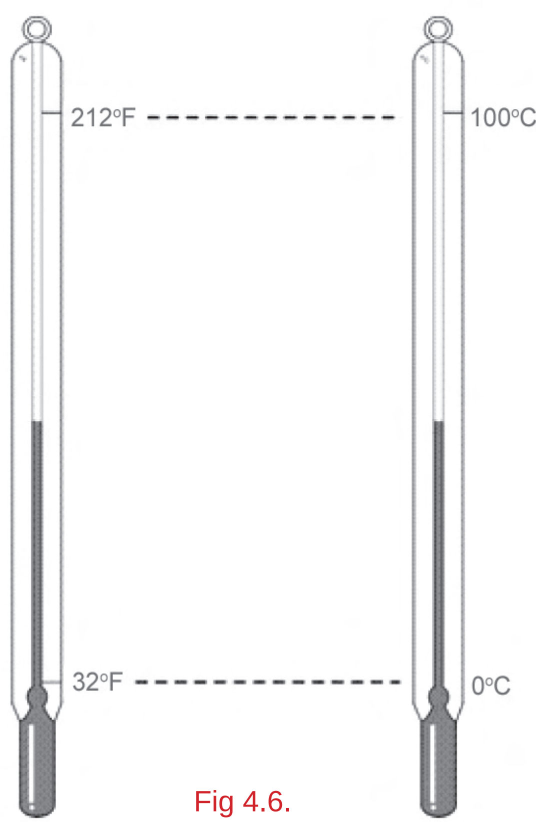


Fig 4.6.

Self Check:

(i) 86^0F = ----- ^0C

(ii) 122^0F = ----- ^0C

(iii) ----- $^0F = 37^0C$

(iv) ----- $^0F = 70^0C$

Most thermometers use mercury because

1. it is opaque and shiny.
2. does not stick to glass.
3. it is a good conductor of heat.
4. it shows large expansion for small temperature changes.
5. it expands uniformly.

In some thermometers ALCOHOL is used.

4.1.4. MEASURING TEMPERATURE

Laboratory Thermometer

The laboratory thermometer consists of a thick walled glass tube enclosing a fine uniform bore capillary tube. There is a cylindrical bulb at one end. The bulb and a part of the stem are filled with mercury. The top end is sealed after removing air. The graduations are marked from -10^0 C to 110^0 C

When the bulb is immersed in hot water, the mercury in the bulb expands and rises up in the capillary tube. The level of mercury in the tube gives the measure of temperature of the hot water.

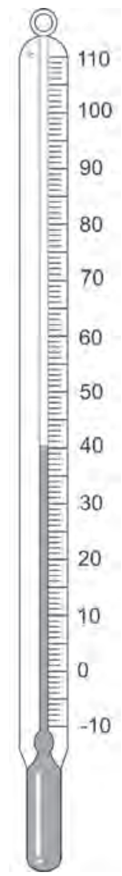


Fig 4.7

Clinical Thermometer

When we are sick, we visit a doctor. The first thing the doctor does is to record the body temperature. He would do so with the help of a clinical thermometer. Shall we learn about the construction of a clinical thermometer?

Fig 4.8

It consists of a thick walled glass tube marked in degrees enclosing a capillary tube of fine bore. There is a cylindrical bulb at one end. Air is removed from the tube and the other end is sealed. The bulb and a part of the stem are filled with mercury. There is a constriction just above the bulb which prevents mercury from flowing back into the bulb. The reading of the mercury level gives the body temperature of the patient. The thermometer is marked from 35^0 C to 42^0 C. The normal body temperature is 36.9^0C (98.4^0F). This is indicated by an arrow mark in the thermometer. It is used only to measure the temperature of the human body.

Clinical thermometers are available with Fahrenheit markings. They are also available with both Celsius and Fahrenheit markings.

MORE TO KNOW

Now a days the digital thermometer is in use. The digital thermometer is an electronic device containing no glass or mercury. It is unbreakable and safe to use.

It beeps one minute after it has been kept under the arm or inserted into the mouth of the patient.

The temperature can be read from the numerical display.

4.2. LIGHT

Fig 4.9.

Look at the picture of the city taken at night. Can you imagine how the city would look if all the lights were turned off? Would you be able to see anything?

Can we see objects when there is no light? We cannot see any object when there is no light.

Light and darkness:

Light is a form of energy that gives us the sense of vision. The absence of light causes darkness. To see objects, our eye should receive light from them.

4.2.1. REFLECTION

When light falls on a transparent material like clear glass it passes through it. However, when it falls on opaque objects like table, chair, etc., some of it bounces back.

This bouncing back of light from a surface is called reflection.

The story of the Dog and the Bone

One day a dog with a bone in its mouth was crossing a bridge. Suddenly it looked down into the water and saw another dog carrying a big bone in its mouth. The greedy dog wanted the second bone also.

Thinking that it would frighten the other dog and get another bone, it barked loudly. Alas! The bone fell into the water and the greedy dog lost its own bone.

What do you think the dog saw in the water?

The dog thought that there was another dog, but what it saw was its own image reflected in the water.

Fig 4.10.

Taj Mahal

Candle

Let us observe the pictures given.

We see an exact replica of the object known as its image.

What causes the formation of an image?

Reflection of light produces the image.

Swan

4.2.2. MIRROR

What is a mirror ?

A mirror is used by us every day for looking at our own image while combing our hair or washing our face. We can see our image in a mirror; but not in a plane glass sheet or in a piece of wood or a stone. Why?

This is because most of the light falling on a mirror is reflected, but other objects do not reflect as much light.

A mirror is a shiny surface which reflects almost all the light falling on it.

Most mirrors are made of glass. A mirror that is flat is called a plane mirror.

ACTIVITY 4.3 — WE DO

We need: A piece of glass, a mirror, a sheet white paper

1. We hold each object so that sunlight falls on it and the reflected light is projected on a wall.
2. We find that the mirror reflects the maximum amount of light and the paper reflects the minimum amount of light.

We infer that, different objects reflect different amounts of light

Let us investigate the nature of an image formed by a plane mirror.

ACTIVITY 4.4 — WE OBSERVE

We need: A mirror, a candle

1. Keep a candle in front of the plane mirror.
2. Observe the image of the candle in the mirror.
3. Place a screen behind the mirror.
4. Can we get this image on the screen?

   No, we cannot get the image.

   Such an image which we can sea only inside the mirror and cannot be got on a screen is called a virtual image.

A virtual image is always erect.

The image formed by a plane mirror is always virtual and erect.

ACTIVITY 4.5 — WE OBSERVE

We need: A mirror

1. Let us stand in front of a mirror and observe our image. Is it big or small?
2. Gradually let us move away from the mirror. What happens to the size of the image?
3. Does it change?
4. The size of the image remains unchanged.

We infer that the size of the image formed by a plane mirror is always equal to the size of the object.

MORE TO KNOW

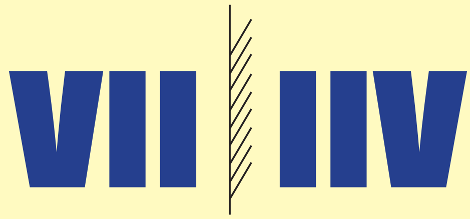
- Mirrors have a thin layer of silver coat at the back with the coating of red or orange paint. The paint covers the silvering and prevents it from being rubbed.
- When you look in a mirror, light arriving at your eyes is coming from the silvered surface. This gives the impression that the image is somewhere behind the mirror.

SCIENCE

ACTIVITY 4.6 — WE OBSERVE

We need: A mirror, a sheet of thick wihite paper

1. Take a sheet of thick white paper and write VII
2. Keep it in front of a mirror.
3. It appears as IIV in the mirror.



4. There is a side to side inversion.
5. Now stand in front of the mirror and touch your nose with your right hand. What do you see in the mirror?
6. The image appears in the mirror as if the nose is being touched with the left hand.

We will find that in the mirror right appears as left and left appears as right. This property is known as **lateral inversion.**

7. Does the image appear upside down? No! the image is erect.

The image formed by a plane mirror is always laterally inverted.

Have you ever noticed strange letters in front of an ambulance?

Actually it is nothing but the word AMBULANCE written such that drivers in vehicles ahead can read the word properly in their rear view mirrors.

Fig 4.11. Ambulance

Self Check

(i) TƎIUϘ ꟼƎƎꓘ

(ii) ИWOᗡ TIƧ ƎƧAƎ⅃ꟼ

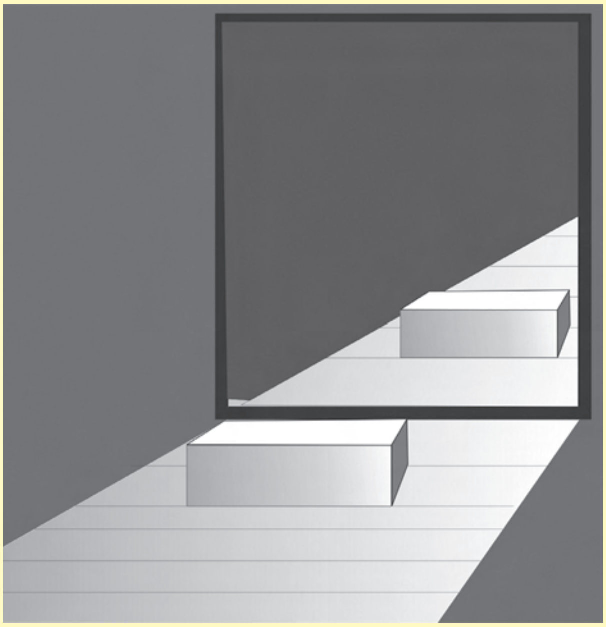
1. What do these mirror messages say?
2. Write your own mirror messages.

MORE TO KNOW

To see the full size image of an object, the mirror should be at least half of the height of the object.

ACTIVITY 4.7 **WE OBSERVE**

We need: A strip of plane mirror, a graph sheet, an eraser



1. Place a strip of plane mirror on a line on the graph sheet.
2. The image of the graph sheet is seen inside the mirror.
3. Place an eraser or sharpener at the boundary of the second line.
4. Note the position of the image inside the mirror.
5. Repeat by placing the eraser at different positions and observe the position of the image every time.
6. Is there any relation between distance of the image from the mirror and that of the object in front of it?

The image is formed at the same distance behind the mirror as the object in front of it.

4.3. SPHERICAL MIRRORS

Kannan and Kamala were waiting for their dinner. Kannan lifted up his new steel plate and saw his image in it. He told Kamala, "I can see my image due to reflection formed on the plate. We learnt this in our class today".

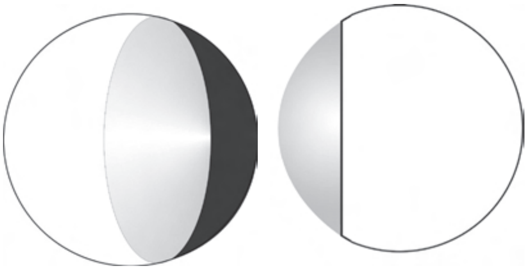
Kamala took up a new steel spoon and said "Look Kannan. I can also see my image. This spoon also acts as a mirror".

So mirrors need not necessarily be plane. Curved surfaces can also act as mirrors.

Look at your reflection in a polished steel spoon. Do both surfaces of the spoon give the same kind of image?

Some mirrors have a plane reflecting surface, some others have a bulged reflecting surface and yet some more have a hollow reflecting surface.

The mirror with the bulged reflecting surface is called a convex mirror and the mirror with a hollow reflecting surface is called a concave mirror. These are known as curved mirrors.



Concave mirror Convex mirror

Fig 4.12.

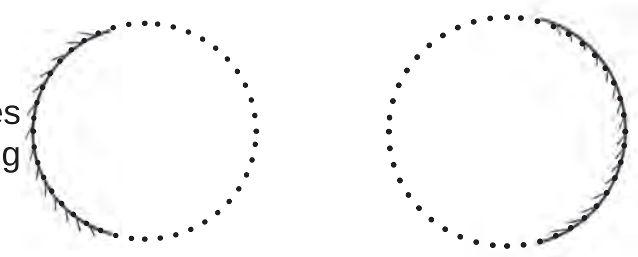
SCIENCE

Representation of mirrors in diagrams

Fig 4.13.

Self check

Let us complete the spheres with curved mirrors b & c forming a part of the sphere.



Any curved surface is a part of a sphere. Hence convex and concave mirrors are referred to as spherical mirrors.

Self Check

Let us take a rubber ball and cut a portion of the ball with a knife. The inner surface of the cut portion is concave while the outer surface is convex.

Are you now convinced that concave and convex mirrors are a part of the sphere? What happens when light falls on spherical mirrors?

Concave mirror makes the light meet at a point after reflection (converges) and convex mirror diverges the light.

ACTIVITY 4.8 WE OBSERVE

We need: A concave mirror, a sheet of white paper

1. Hold a concave mirror facing the sun and try to focus the light reflected by the mirror on a the sheet of paper.
2. Adjust the paper till you get a sharp bright spot on it.
3. The bright spot is, in fact, the image of the sun.

The image formed on the paper or screen is called a real image.

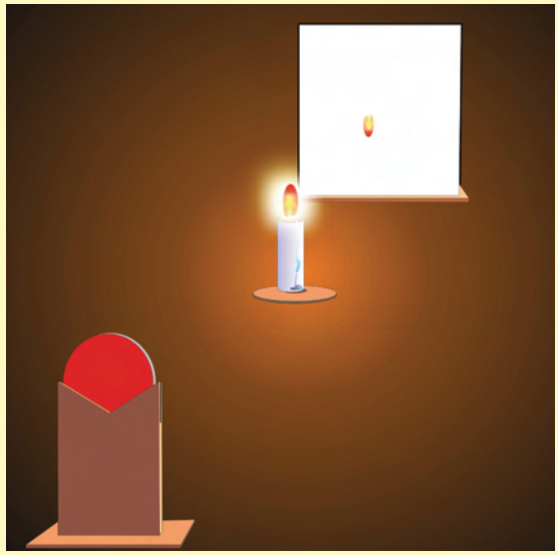
MORE TO KNOW

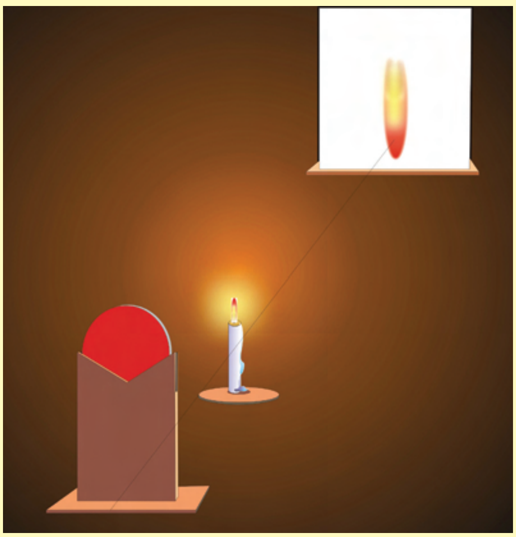
Mirrors are used in light houses. They reflect light a long way to help ships at sea.

ACTIVITY 4.9 — WE OBSERVE

We need: A concave mirror, a candle, a mirror stand, a screen

1. Fix the concave mirror on a stand and place it on the table. Paste a piece of white paper on a cardboard of size 15cm X 20cm. This will act as a screen.
2. Keep a lighted candle on the table at a distance of 50 cm from the mirror. Move the screen till a sharp image is obtained.
3. Is the image real or virtual? Is it bigger, smaller or of the same size as the flame?





4. Now move the candle towards the mirror and place it at different distances from the mirror. In each case try to obtain the image on the screen.
5. Record your observations.

We see that the image formed by a concave mirror on the screen is a real and inverted . It may be smaller or larger or of the same size as the object.

When the object is placed very close to the concave mirror, an erect and enlarged virtual image is formed inside the mirror.

ACTIVITY 4.10 — WE OBSERVE

We need: A convex mirror, a candle, a mirror stand, a screen

- Fix the convex mirror on a stand and place it on the table. Keep a lighted candle in front of the mirror. Try to get an image on the screen.
- It is not possible to get an image on the screen. The convex mirror diverges the light. Therefore a virtual image, smaller than the object is seen inside the mirror.

What do we understand?

Convex mirrors form only virtual images that are diminished in size.

SCIENCE

Uses of spherical mirrors:

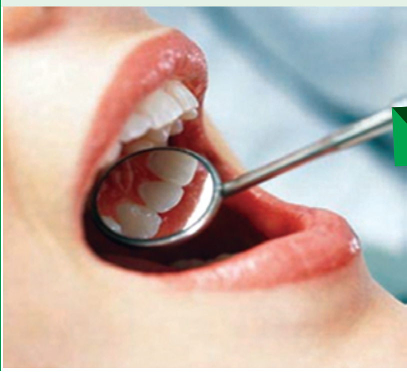
Used as reflectors in car headlamps and telescopes.

Used as shaving mirrors

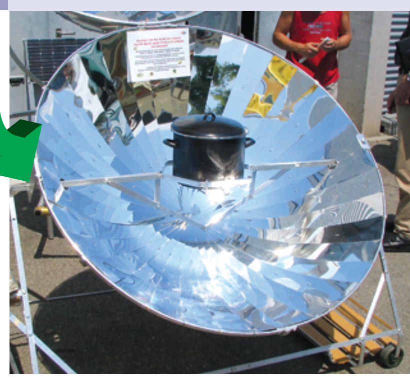
CONCAVE MIRROR

CONCAVE MIRROR

Used by dentists and ENT doctors to focus light on parts to be examined.



Used in solar cookers to converge the sunlight on the food to be cooked .



CONVEX MIRROR

Used as rear view mirrors in automobiles since its field of view is wide.

Used to watch over a large area.

4.4. SUN LIGHT – WHITE OR COLOURED?

Fig 4.14.

Have you seen the rainbow in the sky? The rainbow is seen as a large arc in the sky with many colours, in the opposite direction of the sun, when it rains.

The rainbow is a spectacular demonstration of white light as a combination of many colours.

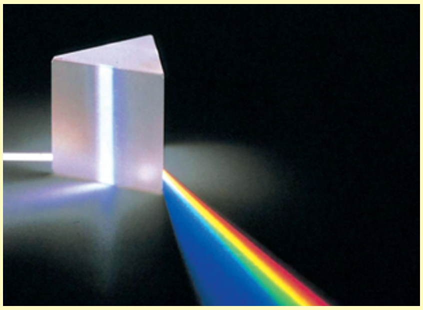
Rainbows occur when sunlight from behind the observer falls on water droplets. So, we infer that sunlight consists of many colours.

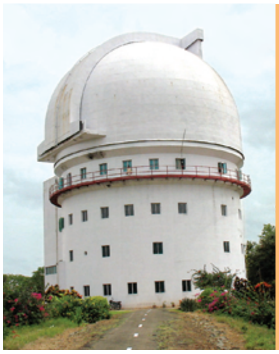
ACTIVITY 4.11 **WE OBSERVE**

We need: A glass prism, a mirror

1. Take a glass prism and with the help of a mirror reflect a beam of sunlight on one face of the prism.
2. The light coming out of the other face is made to fall on a white screen or wall.

We see colours similar to those of the rainbow. This proves that sunlight consists of many colours.





Interesting Fact:

Kavalur Observatory located in Javadu Hills (Vellore Dist) in Tamil Nadu has one of the largest reflector telescopes in Asia.

How many colours are present?

When observed carefully, there are seven colours, though it may not be easy to distinguish all of them.

The colours are Violet, Indigo, Blue, Green, Yellow, Orange and Red represented as **VIBGYOR.**

What is dispersion?

You have observed that white light is made up of seven colours. It is possible to split it into its constituent colours. The splitting up of white light into its seven constituent colours is called dispersion.

This band of colours is called a spectrum.

Can these colours be mixed to give white light?

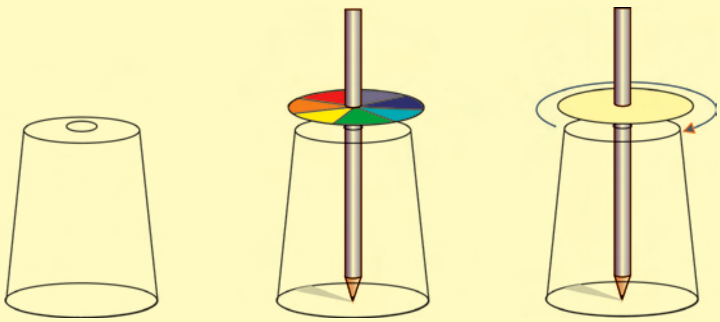
Yes, this can be done with the help of a Newton's disc.

Newton's disc is a circular disc with segments painted in the seven colours of the spectrum. The disc is supported on a stand. It is provided with a handle to rotate the disc.

When the disc is rotated fast, the colours disappear and the disc appears almost white.

Fig 14.15. Newton's disc

ACTIVITY 4.12 **I DO**



I need: A white cardboard, colours or paints, knitting needle or sharp pencil, a plastic tumbler

To make a Newton's disc:

1. I cut out a disc from white cardboard.
2. I divide the disc into seven equal sections using a protractor.
3. I paint or colour each section with any one of the seven colours of the spectrum.
4. I make a hole at the centre of the disc. I push a long pencil or a long knitting needle through it and the plastic tumbler.
5. I spin the disc as fast as I can.When the disc spins very quickly the colours merge. I see only the white colour. From this I understand that white light consists of seven colours.

EVALUATION

I Choose and write the correct answer

1. 100 degree on the celsius scale is equal to 180 degree on the fahrenheit scale. Then 1 degree celsius is equal to

   a) (F-32) x 100/180 b) (F-32) x 180/100

   c) (F+32)x 100/180 d) (F+32) x 180/100

2. On the Fahrenheit scale the number of divisions between the upper and lower fixed points is

   a) 212 b) 180 c)100 d) 32

3. Ajay stands 1 m in front of a mirror. He moves 50 cm forward towards the mirror . The distance between Ajay and his image is

   a) 50 cm b) 2m c) 3m d)1m

4. To see your face in a mirror inside a dark room you should shine light from a torch on to

   a) the mirror b) your face

   c) the nearest wall d) the ceiling of the room

5. Which of these will form both real and virtual images?

   a) plane mirror b) concave mirror c) convex mirror d) all the above

II. Fill in the blanks:

1. __________ is a measure of the heat energy possessed by a body. (Temperature/ Pressure)
2. The tyre of a moving vehicle becomes hot due to _____________ (friction/combustion)
3. On a thermometric scale, the boiling point of water is taken as the ________ (upper fixed point / lower fixed point)
4. In a cinema, the image on the screen is a _______________ (real image / virtual image)
5. Bouncing back of light from a surface is called _____________ (reflection / refraction)

III. Match the following

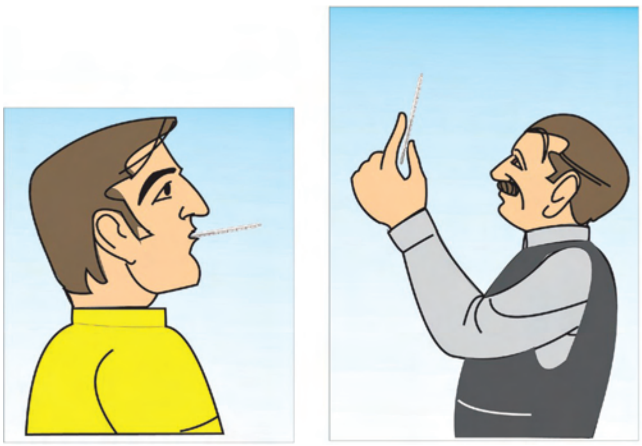
1. Sun	a) combustion
2. Burning of paper	b) measures temperature
3. Thermometer	c) dispersion of light
4. Convex mirror	d) source of heat and light
5. Spectrum	e) diverges light

IV Suggest a reason for the following:

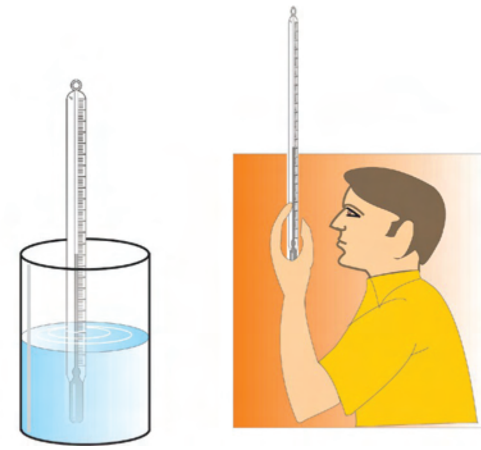
1. A shooting star is visible as it streaks across the night sky.
2. A clinical thermometer has a constriction.
3. We cannot use an ordinary laboratory thermometer to measure the temperature of a liquid which is at 400^0 c.
4. Concave mirror forms a real image while a convex mirror does not.

V.

Arun at the doctor's clinic



Muthu in the laboratory



Observe the pictures given above. One of them is correct and the other is wrong. Explain why the picture is wrong.

VI. Vijay wanted to help his mother who is a doctor to sterilize her instruments. So he washed her clinical thermometer in boiling water. Unfortunately it broke. What was his mistake?

VII. Write five English letters that appear the same even after lateral inversion. (Example: H)

VIII. Identify the nature of the mirrors by observing the images formed by them.

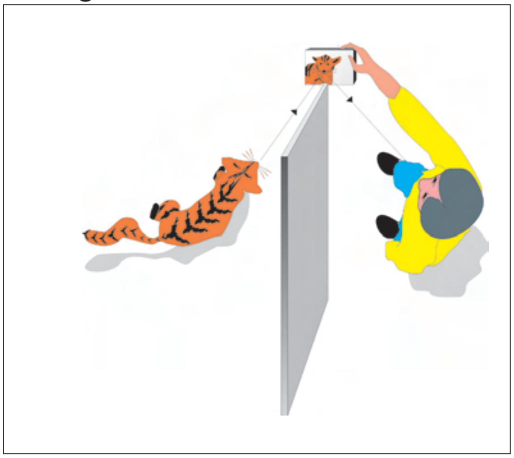
(a) ---------------------

(b) ---------------------

(c) ---------------------

IX. You are given samples of different kinds of mirrors. Suggest a simple method to identify them.

X. Observe the picture given below:



What is your inference?

PROJECT

1. Hold a concave mirror towards a distant object. Adjust the position of the concave mirror till a clear and well defined image is obtained on the wall or on a screen. Measure the distance from the concave mirror and the wall or screen. Repeat for different objects and record your observations.

Object	Distance

This distance is called the **'focal length of the mirror'.**

2. Take water in a metal container. Keep the bulb of the thermometer inside the water for two minutes at 10 am and measure the temperature. Keep the container in the sunlight for 30 minutes and again measure the temperature. Repeat at 12 noon and 2 pm. Record your observations.

Time	Temperature inside the class room (^{0}c)	Temperature after keeping in sunlight (^{0}c)
10 am		
12 noon		
2 pm		

FURTHER REFERENCE

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1. Young Scientist Vol-4 - World Book. Inc

Websites

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http://www.dmoz.org/kidandteens/schooltime/science.com