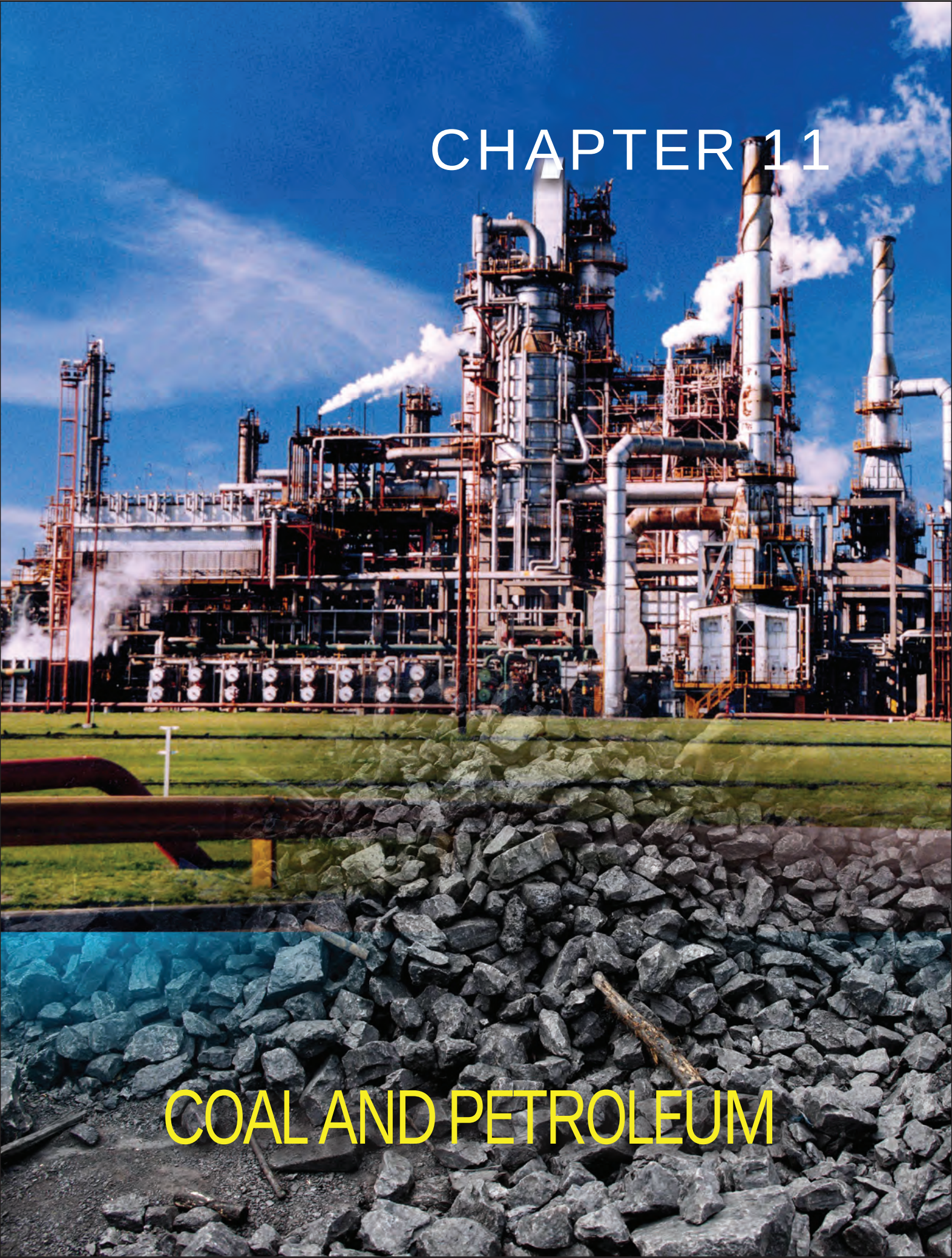


CHAPTER 11

COAL AND PETROLEUM

11. COAL AND PETROLEUM

Do you know Ram? He is studying in 8th standard. He goes to school by bicycle. His father goes to office by car. His brother goes to college by bus. Ram's family cooks food using gas stove.

What are the fuels used by Ram's family members in the above activity? Petrol, Diesel and L.P.G. (Liquified Petroleum Gas)

Fuels

ACTIVITY 11.1

Tabulate the following vehicles that uses (i) Man power (ii) Fuel








Man Power	Fuel

MORE TO KNOW

Why is a burning candle extinguished when covered by a jar?

Combustion takes place in the presence of air. When the air supply is cut off, the burning candle gets extinguished.

Substances that burn in air to give heat energy are called fuels.

Fossil Fuels

Fossil Fuels are defined as naturally occuring substances that are extracted from the earth and also useful as fuels.

Coal, crude oil and natural gas are collectively called as fossil fuels.

11.1. COAL

Occurence of coal

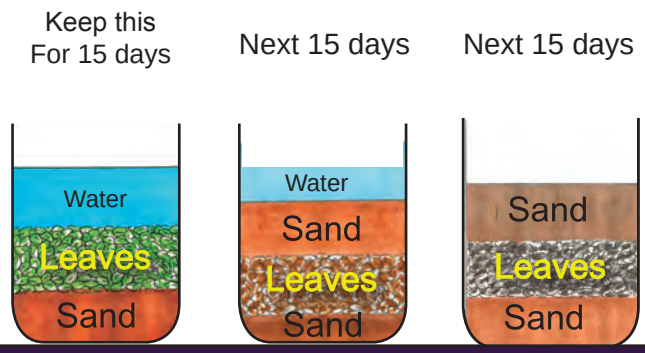
Coal mining was started in India in 1774. India ranks now third among the coal producing countries in the world. USA and China have 2/3 of world's coal reserve.

MORE TO KNOW

- Coal will have higher sulphur content if it was formed in swamps covered by sea water.
- Combustion caused by the chemical union of Hydrocarbon with oxygen. When heat is applied, the fuel molecules are broken down and release heat energy.

ACTIVITY 11.2

1. Take a glass beaker and spread 2 inches of sand at the bottom. Then pour some water and drop small leaves, sticks and pieces of fern on sand. Let it stand for two weeks.
2. Note down the colour change.
3. Gently put some mud on top of the plant layer to a depth of 2 inches.
4. Wait for two weeks and drain the water. Let it dry for another two weeks. Now you could see fossil imprint between the sand layers.



Do you know how coal was formed?

Three hundred and fifty million years ago, some plants grew into giant ferns and mosses. These plants got buried into the bottom of the soil and deposited as fossil due to heat and pressure. The decaying plants were pressed and coal was formed.

11.1.1. Types Of Coal

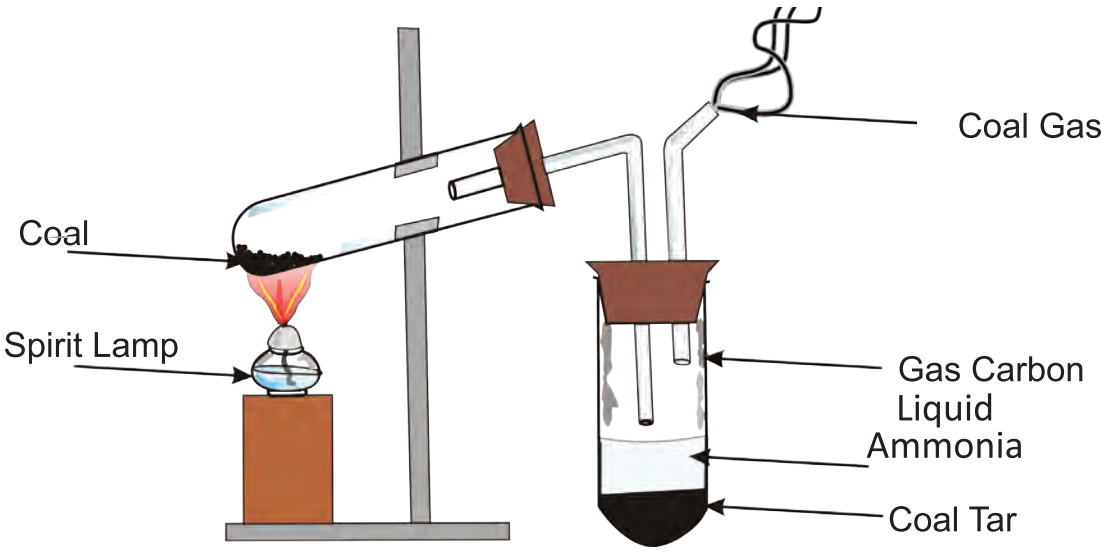
1. Lignite (Brown Coal) contains 25 – 35 % carbon.
2. Bituminous coal (Soft coal) contains 45 – 86 % carbon.
3. Anthracite coal (Hard coal – It has the highest heat energy) contain 87 – 97%carbon.

ACTIVITY 11.3

Take a little coal and heat it as shown in the figure.

When coal is heated in the absence of air is called destrictive distillation of coal. We get many useful products.

Destrictive distillation of coal



Coal products and their uses

S.No	Coal Products	Uses
1.	Coal Gas	As a fuel in cooking food
2.	Liquid Ammonia	To make fertilisers
3.	Gas Carbon	Carbon electrodes in batteries
4.	Coke	As a fuel and as a reducing agent in steel manufacturing
5.	Coal Tar	To make plastics, paints, dyes,naphthalene balls and explosives

MORE TO KNOW

1000 kg of coal contains

- 700 kg of coke, b. 100 litres of ammonia
- 50 litres of coal tar, d. 400 m^3 of coal gas

Consumption of Coal

The coal that we consume in one day what the earth took 1000 years to form.The amount of coal we produce is greater than the amount that we consume.

11.2. PETROLEUM

Dead plants and animals buried at the bottom of the sea millions of years ago. They got covered with layers of sand and clay. Due to high pressure and temperature, they got transformed into petroleum.

Petroleum and Natural Gas Formation

MORE TO KNOW

Countries like Dubai, Saudi Arabia, Abu Dhabi etc.have become very rich in recent years. Why?

The world's first petroleum well was drilled in Pennsylvania, USA in 1859.

Eight years later in 1867,oil was struck at Makum in Assam

11.2.1. Occurrence of Petroleum

The chief petroleum producing countries are U.S.A Kuwait, Iraq, Persia, Russia and Mexico.

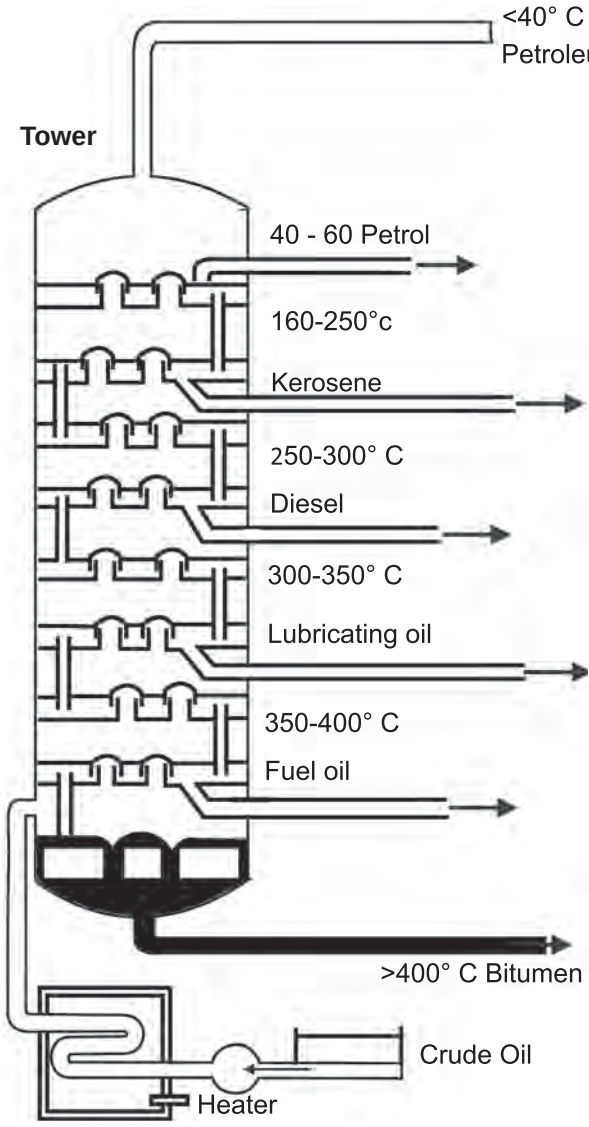
In India, petroleum is found in Assam, Gujarat, Maharashtra (Mumbai high) and Andhra Pradesh (Godavari and Krishna basin) and Tamil Nadu (Cauveri Basins).

Petroleum is obtained by drilling through the earth.The crude oil is pumped out from a well as a black liquid.

Refining of crude petroleum

Petroleum is a dark oily liquid. It is a mixture of various consititutents such as petroleum gas, petrol, diesel, lubricating oil, paraffain wax, etc. The process of separting various constitutents / fractions of petroleum by fractional distillation in fractionating columns is known as refining of petroleum. The process of heating a mixture of many liquids having different boiling points and separating them by cooling is called fractional distillation.

Crude petroleum is first heated to about 400° C in a furnace. As the vapours of crude oil move up the tower,they condense according to their boiling point ranges. These are the various fractions which make up crude oil. The various fractions of petroleum obtained are tabulated below;



Fraction	Uses
Petroleum Gas	Fuel for home (LPG)
Petrol	Motor fuel
Kerosene	Fuel for stove and jet aircrafts.
Diesel	Fuel for heavy motor vehicles.
Lubricating oil	Lubrication
Fuel Oil	Fuel for Power Stations and Ship
Paraffin wax	Candles, Vaseline
Bitumen	Paints, road surfacing

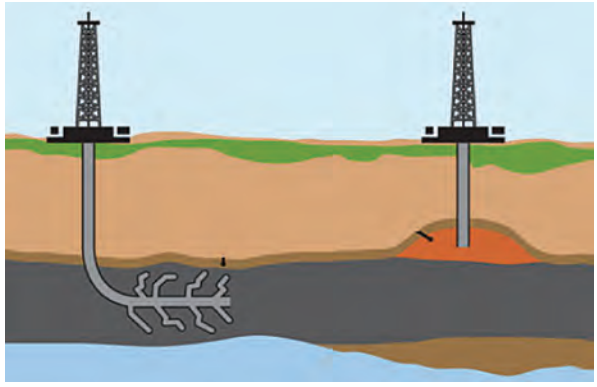
MORE TO KNOW

Many useful substances are obtained from petroleum and natural gas. These are termed as 'Petrochemicals. These are used in the manufacture of detergents, fibres,polyethene,and other man-made plastics. Hydrogen gas obtained from natural gas, is used in the production of fertilisers. Due to its great commercial importance, pertoleum is also called 'black gold'.

MORE TO KNOW

If we consume petroleum in this rate, in the year 2,050 there may be no petroleum at all.

11.3. NATURAL GAS



Formation of Natural gas

Natural gas is formed whenever vegetation decomposes in marshes, sewage and in coal or petroleum mines. It is made up of 90 % methane.

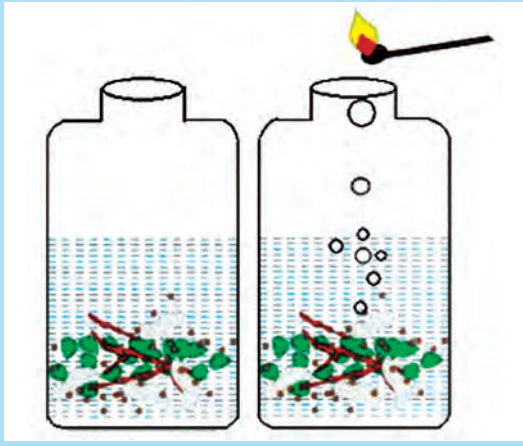
11.3.1. Occurence

There is a vast reserves of Natural gas in Tripura, Rajasthan, Maharastra, Andhra pradesh (Krishna, Godavari Basins) and Tamilnadu (Cauveri Delta.)

ACTIVITY 11.4

Take a glass bottle and put some leaves, sticks, waste papers and saw- dust in it. Pour water as shown in the figure and keep it for 20 days. Then open the bottle and bring a glowing splinter near the mouth. You can see the natural gas coming out.

The splinter catches fire and burns.



CNG and LNG

1. CNG (Compressed Natural Gas)
2. LNG (Liquified Natural Gas)

CNG is stored at high pressure whereas LNG is in ultra cold liquid form. CNG can be produced at lower cost.

Advantages and uses of CNG

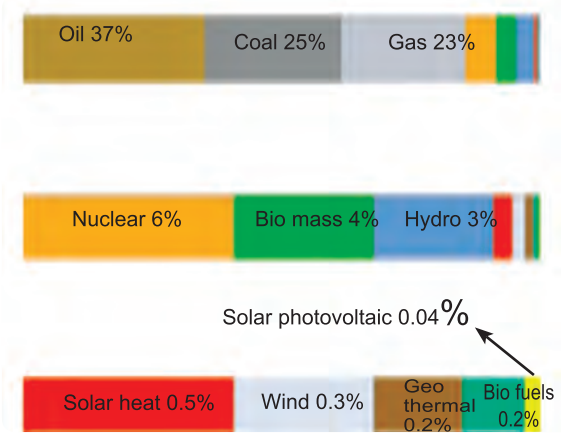
1. It is a less pollutant fuel.
2. It is directly used for burning at home and factories.
3. It is the starting material for the manufacturing of a number of chemicals and fertilisers.

11.4. NATURAL RESOURCES AND LIMITATION

The natural resources in the world have been consumed by man in a rapid way and so very soon all our exhaustible sources like coal, petroleum and gas would soon be reduced to zero level.

Natural Resources	Lasting period
Coal	148 years
Petroleum	40 years
Natural Gas	61 years

So we need to find new alternative sources of energy. Already, energy from natural resources like sun, wind and water are consistently being harnessed.



Not for fun

My father rode on a cart.

I drive a car.

My son flies a jet plane. His son will ride on a cart

Alternative sources of energy

1. Biodiesel : Biodiesel is a fuel derived from vegetable oils such as Soyabean oil, Jatropha oil, Cornoil, Sunflower Oil, Cotton seed oil, Rice bran oil and Rubber seed oil.

2. Wind Mills : All of us know about wind mills. They have long blades connected to a dynamo. When wind blows, they rotate and current is produced in the dynamo. Wind mills are mostly located at Kayathar, Aralvaimozhi, Palladam and kudimangalam in TamilNadu.

3. Solar Energy : Sun is the foremost energy source that makes life possible on our earth.Solar energy has been used by man from ancient time itself. Solar energy is harnessed using (i) solar cookers (ii) solarwater heaters and (iii) solar cells.

11.5. SCIENCE TODAY

1. Hydrogen - The future fuel

Hydrogen could be the best alternative fuel. It is a clean fuel as it gives out only water while burning. Moreover, it has the highest energy content.

2. Cold Fusion Process

Cold fusion is a process in which two one more lighter nuclei of atoms are combined to produce nuclear energy. This process requires very high temperature. In cold fusion, the same process is carried out at room temperature.

3. Methane from sewage

Sewage sludge can be decomposed by microorganisms to produce methane gas along with impurities carbon dioxide and hydrogen sulphide. After removing these impurities, methane gas can be used as an efficient fuel.

MORE TO KNOW

In india, the Petroleum Conservation Research Association(PCRA) advises people how to save petrol/diesel while driving. Their tips are

- Drive at a constant and moderate speed as far as possible.
- Switch off the engine at traffic lights or a t a place where you have to wait.
- Ensure correct tyre pressure.
- Ensure regular maintenance of the vehicle.

"Today's wastage - tomorrow's shortage"

"A mile we walk we save a litre of petrol and a day of life"

EVALUATION

1. Ramu's family cooks food using LPG gas. But Murugan's family cooks food slower. What could be the reason?

2. Fill in the blanks

   a. Coal – Coal gas

   b. Petroleum – _____

   c. LPG – Propane and Butane

   d. Natural gas – _____

   e. Diesel – Petroleum

   f. Bio diesel – _____

3. At present we use petroleum in huge quantities.If we consume petroleum in this rate, in the year 2200 there would be no petroleum at all. Find the alternative. sources of energy and actions to be taken.

4. Read the following tabular column carefully and decide which fuel you should use for cooking.

Wood	L.P. Gas
Smoke is produced	Smoke is not produced
Has low calorific value	Has high calorific value
It takes long time to cook	It takes less time to cook
Ashes are formed	Ashes are not formed

5. Read the following fuels carefully and write the fuels which pollute the environment and which do not pollute.

   1. Coal, petrol, diesel, natural gas, liquefied petroleum gas (LPG) , compressed natural gas (CNG), wood, liquefied natural gas (LNG), kerosene.

   2. Coal, petrol, diesel and LPG are the fuels used by us now. If they are harnessed completely we would be running short of fuels for cooking and using vehicles and working of factories in near future. So we need alternative sources of energy. Being young scientists find the alternative energy in the below circle.

3. Make a list of fuels used by us now

1. We live in a tropical country. Fossil fuels are fast depleting. name some future fuels.

2. Students! Types of coal and % of carbon in each type is given below. Which coal should be used to get high calorific value?

Lignite	-	25 to 35% C
Bitumen	-	45 to 86% C
Anthracite	-	87 to 97% C

6. Fill in the blanks

1. _____ gas is responsible for the burning of fuels.
2. Fossil fuels are mainly made up of _____, _____, and _____.
3. The expansion of L.P.G. is _____.
4. _____method is adapted to get bio--diesel from algae.
5. India ranks _____ among the coal producing countries.
6. The expansion of CNG is_____.
7. The chief element in coal is _____.
8. _____state has the largest coal reserve in India.
9. India exports coal to _____ country.
10. Solar Cells convert solar energy into _____ energy.

FURTHER REFERENCE

Books

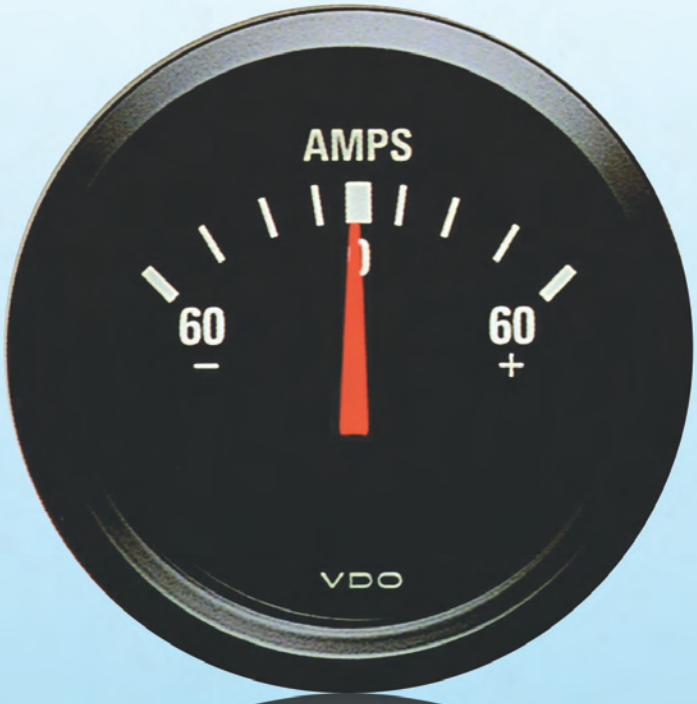
Advanced organic chemistry- B.S. Bahl and Arun Bahl - S.Chand & Company Ltd.,

Websites

www.en.wikipedia.org/wiki/Non-renewable _resources.

www.bbc.co.uk/schools/gscebitesize/physics/energy/energy_resources

CHAPTER 12



MEASUREMENTS

12. MEASUREMENTS

In a warm summer vacation, Aruna is eagerly waiting for her friend Swathi. Finally, Swathi came to Aruna's home with an umbrella .

Aruna: Is it raining, Swathi?

Swathi: No Aruna, but my mother asked me to take this, as it is very hot outside.

Aruna: Of course, I heard in the TV news that the temperature was 42^0C yesterday and it seems to be more than that today.

Swathi: I am confused about the unit that we use for temperature. We see people using celcius but my brother said this morning that kelvin is the unit for temperature.

Aruna: we will clear this doubt with my father (who is a teacher). (They go to Aruna's father for clarification. Aruna's father explained them clearly about units).

You know that measurement is nothing but comparing an unknown quantity with a standard quantity. The standard quantity is called unit. For example, if ,you say a distance as 300km, here 300 is its magnitude and km is its unit. we can't measure anything without a unit.

We have been following many system of units to measure physical quantities. For example kilometre, mile, foot, centimetre etc., are all units of length. Similarly kilogram, gram, pound etc., are units of mass.

Le Systeme International d' Unites (SI system of units)

To bring uniformity, the general conference on Weights and measures in 1971, decided to have an uniform system of measurement called SI system of units. In SI system, the units for all physical quantities are fixed and derived. This is logically far superior to all the other systems. It has certain features, they are based on the properties of atom. So, they do not vary with time. SI system is more convenient to practice.

There are seven fundamental quantities and twenty two derived quantities in this system of units.

We know about the units of length, mass and time in SI system. Let us learn more about other basic units.

Temperature

Kelvin is the primary unit of temperature in SI system. The Kelvin is the fraction of 1/273.16 of the thermodynamic temperature of the triple point of water. (Triple point of water is the temperature at which saturated water vapour, pure water and melting ice are all in equilibrium).

Quantity	SI Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	S
Temperature	kelvin	K
Electric Current	ampere	A
Amount of substance	mole	mol
Luminous Intensity	candela	cd

The freezing point of water is 0ºC in celcius scale but at 0ºC, water molecules do not come to rest. Only at -273ºC, the molecules come to rest. This -273ºC is called absolute zero and it is taken as null point for kelvin scale.

Hence -273ºC.=0K

273K = 0ºC

The usage of negative values in celcius scale can be avoided by using kelvin scale.

Electric current

Ampere is the SI unit for electric current. The ampere is the constant current which, flowing through two straight parallel infinitely long conductors of negligible cross-section and placed in vaccum 1m apart would produce between the conductors a force of 2 X 10^{-7} newton per unit length of the conductors

Amount of Substance

Mole is the SI unit for amount of substance. A mole is the amount which contains as many elementary entities(atoms,molecules,ions) as there are atoms in 0.012 kg of carbon-12.

Luminous intensity

Candela is the SI unit for luminous intensity. The Candela is the luminous intensity in a given direction due to a source, which emits monochromatic radiation of frequency 540 X 10^{12} Hz and of which the radiant intensity in that direction is 1/683 watt per steradian.

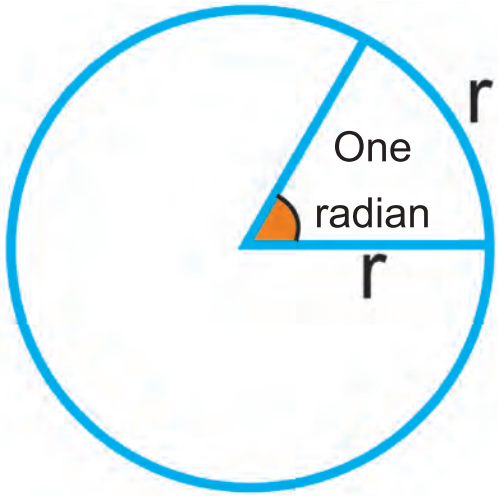
A common candle emits light with a luminous intensity roughly equal to one candela.

Plane angle and Solid angle

Plane angle and solid angle are supplementary quantities till the year 1995. Now they are derived quantities.

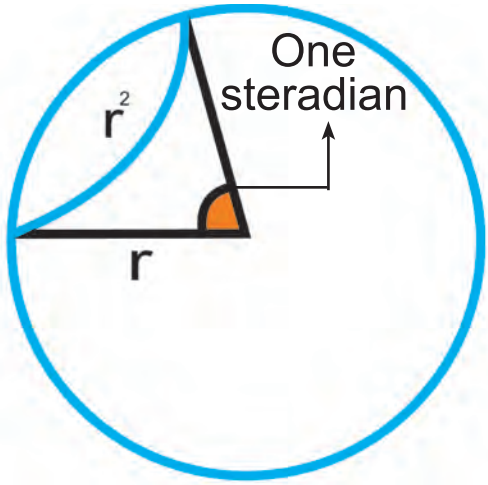
Radian is the SI unit of plane angle.

An angle of one radian results in an arc with a length equal to the radius of the circle.



Steradian is the SI unit of solid angle.

The solid angle subtented at the centre of a sphere of radius r by a portion of the surface of the sphere whose area A, equals r^2.



Conventions to be followed in writing the units in SI system

- The symbols for units should be written with a small letter
- For example: m for metre, kg for kilogram
- Units which are named after scientists should always be written with small letter.
- For example: newton, joule
- The symbols of the units named after scientist should be written by capital letter
- For example: N for newton, W for watt
- Symbols should not be written in plurals but in words,plurals are used.
- For example: 30 kg or 30 kilograms
- There should be no full stop at the end of a symbol for units
- For example: Symbol for unit of length is m(it is not m.)

MORE TO KNOW

1. The intensity of sound is measured in a logarithmic unit called decibel (dB).
2. Intensity of earthquakes are measured in Ricter scale.
3. Very long distances (Distance between Stars and Planets) are measured in Astronomical Unit.

Units of Length

10 millimetres (mm)	= 1 centimetre (cm)
10 centimetres	= 1 decimetre (dm) = 100 millimetres
10 decimetres	= 1 meter (m) = 1000 millimetres
10 metres	= 1 dekametre (dam)
10 dekametres	= 1 hectometre (hm) = 100 metres
10 hectometres	= 1 kilometre (km) = 1000 metres

Units of Area

100 square millimetres (mm2)	= 1 square centimetre (cm2)
100 square centimetres	= 1 square decimetre (dm2)
100 square decimetres	= 1 square metre (m2)
100 square metres	= 1 square dekametre (dam2) = 1 are
100 square dekametres	= 1 square hectometre (hm2) = 1 hectare (ha)
100 square hectometres	= 1 square kilometre (km^2)

Units of Liquid Volume

10 millilitres (mL)	= 1 centilitre (cL)
10 centilitres	= 1 decilitre (dL) = 100 millilitres
10 decilitres	= 1 litre1 = 1000 millilitres
10 litres	= 1 dekalitre (daL)
10 dekalitres	= 1 hectolitre (hL) = 100 litres
10 hectolitres	= 1 kilolitre (kL) = 1000 litres

Units of Volume

1000 cubic millimetres (mm^3)	= 1 cubic centimetre (cm^3)
1000 cubic centimetres	= 1 cubic decimetre (dm^3)
	= 1 000 000 cubic millimetres
1000 cubic decimetres	= 1 cubic metre (m^3)
	= 1 000 000 cubic centimetres
	= 1 000 000 000 cubic millimetres

Units of Mass

10 milligrams (mg)	= 1 centigram (cg)
10 centigrams	= 1 decigram (dg) = 100 milligrams
10 decigrams	= 1 gram (g) = 1000 milligrams
10 grams	= 1 dekagram (dag)
10 dekagrams	= 1 hectogram (hg) = 100 grams
10 hectograms	= 1 kilogram (kg) = 1000 grams
1000 kilograms	= 1 megagram (Mg) or 1 metric ton(t)

EVALUATION

1. Ramu and Madhu are friends. They wanted to measure the length of a room. Ramu wanted to measure it in foot. But Madhu wanted to mesure it in metres. Who is right in measuring the room in the inernationally accepted system.

2. Match the following

S.No	Quantities	SI Unit
1	Temperature	Candela
2	Amount of Substance	Kelvin
3	Luminous Intensity	Kilogram
4	Mass	Radian
5	Plane angle	Mole

3. Which of the following statement is correct?

   a. The unit of force is Newton

   b. The unit of force is newton

4. Murugan measured the electric current. What unit should he use?

5. Say true or false.

   a. The symbol for units should be written with a small letter.

   b. There should be a full stop at the end of a symbol for units.

   c. We should not use plurals when we write the unit in words.

   d. The SI unit for solid angle is Radian.

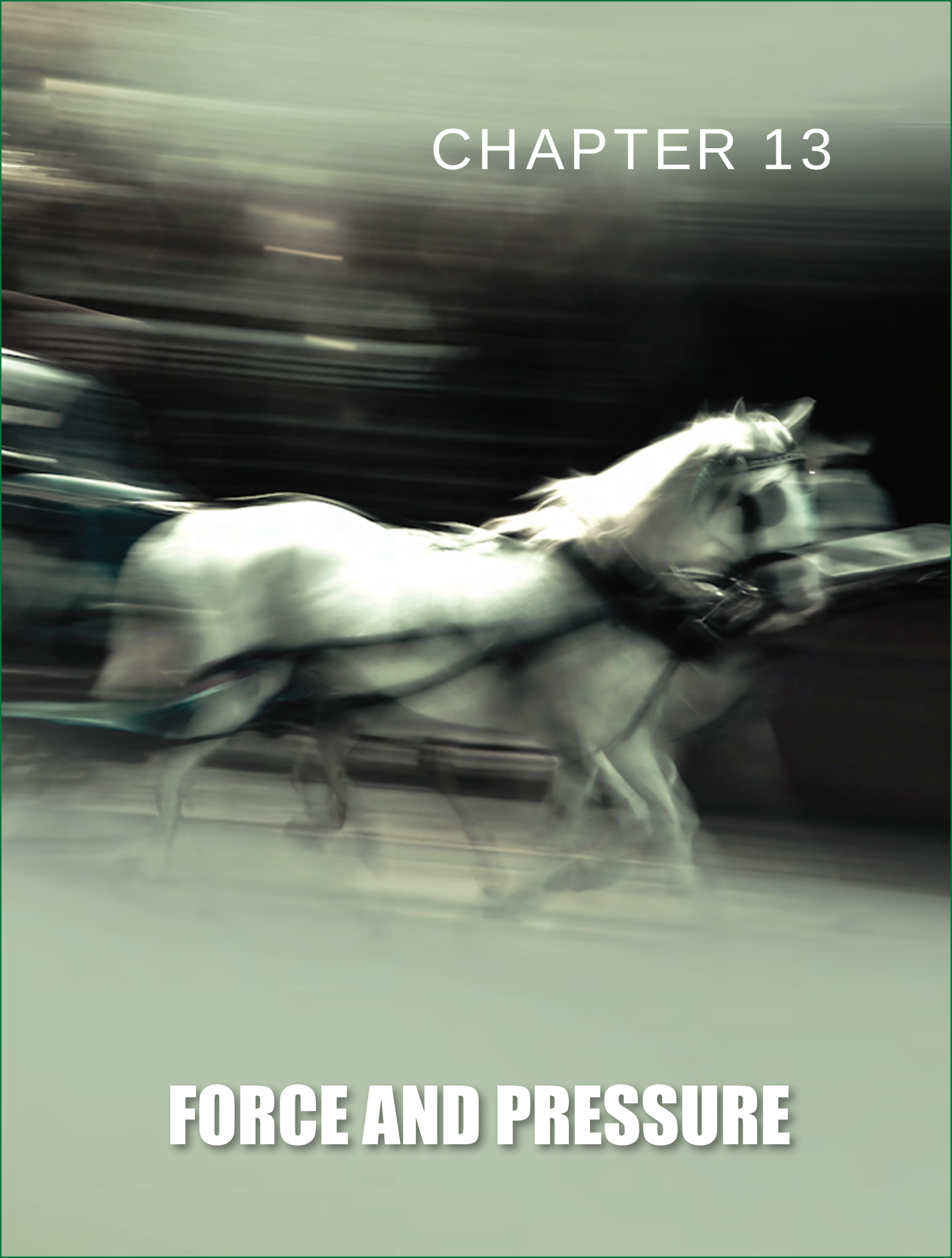
FURTHER REFERENCE

Books:

1. Physics vol (1) and(2) - Satya Prakash - Rahul Jain V K (India) Enterprises, NewDelhi-2
2. The Physics Quick reference guide - E.Richard Cohen 1996 - American Institute of Physics.

Web sites:

www.metrication.com
www.surfnet.org/wiki/A-level-physics
www.physics.nist.gov/cuu/unit



CHAPTER 13

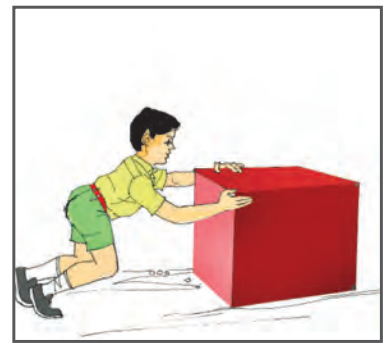
FORCE AND PRESSURE

13. FORCE AND PRESSURE

Murugan and Nila are students of 8th standard. In their day to day life the following activities take place.







Actions like opening, lifting, kicking, pulling, pushing are some of the tasks we do every day. All these actions result in the change of position of an object.

Do you notice that each of these activities involve a push or a pull? From this we infer that to move any object, effort is needed (push or pull). This effort is called a force.

Force is a push or a pull acting on an object which changes or tends to change the state of the object.

UNIT OF FORCE

In the international system of units (SI System), the unit of force is newton (N).

Sir Issac Newton (1642 - 1727) One of the greatest scientists the world has ever seen. He was an English mathematician, physicst and astronomer. The SI unit of force is named after him.

MORE TO KNOW

There are also other units that are used to measure force. They are dyne, kilogram weight and pound.

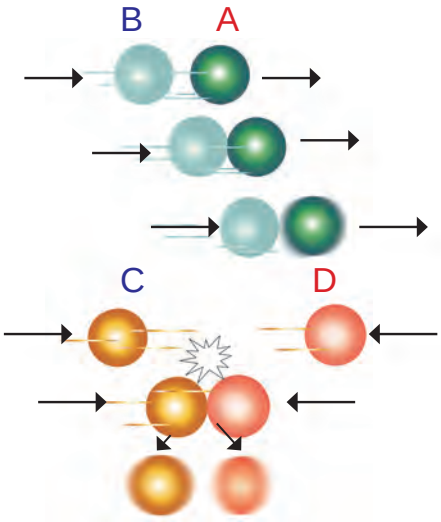
13.1. STATE OF MOTION

Let us play a game with marbles to understand what happens when force acts on an object.

Set a marble A in motion. Hit it from behind with another marble B. What do you notice?

The marble A moves faster. It is because the marble B exerted a force on A.

Take two more marbles C and D. Let them move in the opposite direction and collide with each other. After the collision, the marbles C and D change their directions of motion as shown in the figure. This is due to the exertion of force between them.



Hence a force changes either the speed of an object or its direction of motion.

A change in either the speed of an object or its direction of motion or both is described as a change in its state of motion. Thus, a force may bring a change in the state of motion of an object.

A force does not always result in a change in the state of motion. For example, the wall of a room may not move at all even if we apply the maximum force that we can exert. This does not mean that we are not applying force, but the force that we are applying is not sufficient to move the wall.

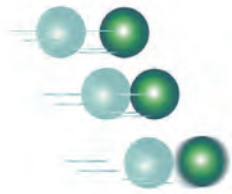
ACTIVITY 13.1

Ask your friend to bowl a cricket ball towards you. Hit the ball with a cricket bat. What happens to the state of motion of the ball?

13.2. ACTION OF FORCE AND ITS EFFECTS

ACTIVITY 13.2

Some situations have been given in the column 1 of the table; column 2 shows diagrams of some actions. Match the situation in column 1 with suitable diagram in column 2.
Table

Column 1	Column 2
Moving an object which is at rest	
Changing the speed of an already moving object.	
Changing the direction of motion of an object	
Changing the shape of an object	

From the above activity, you would have realised that a force

- can move an object from rest.
- may change the speed of an object if it is already moving.
- may change the direction of motion of an object.
- may bring about a change in the shape of an object.
- may cause some or all of these effects.

It is important to note that none of these actions is possible without the action of a force.

13.3. CONTACT FORCES

Can you lift a pot of water without holding it? Can you push this table without touching it?

Generally, to apply force on an object, we need to come in contact

with that object. A force that can cause or change the motion of an object by touching it is called **Contact Force.**

In the above activities, the force is caused by the action of muscles. Hence this force is known as Muscular force. Do you agree that muscular force is a contact force?

Are there other types of contact forces? Come, let us find out.

A ball rolling on the play ground gradually slows down and comes to rest. If the ground is made smooth, the distance covered by the ball would be more than that what was covered earlier. Why?

The ball slows down due to the force acting between the ball and the ground. It is the force of friction which causes the ball to rest. The frictional force is always in a direction opposite to the direction of motion of the object.

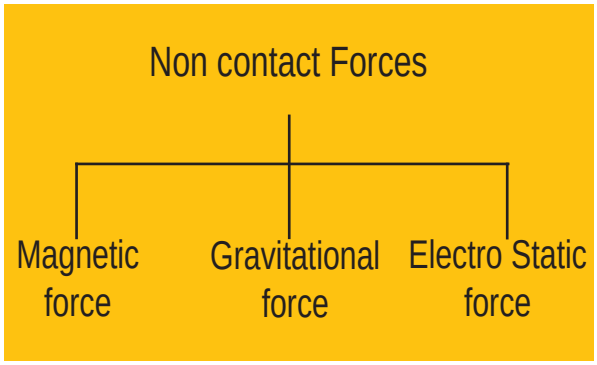
The force of friction arises due to contact between the ball and ground. It acts between any two bodies when both are in contact with each other and either any one or both are moving. Is friction also a contact force? Yes.

13.4. NON-CONTACT FORCES

A non-contact force is any force applied to an object by another body without any contact.

13.4.1. Magnetic Forces

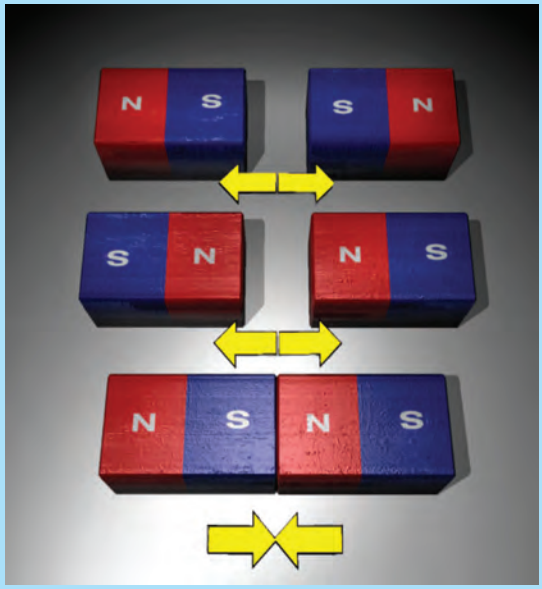
Is it necessary to bring the two magnets in contact to observe the force between them? No. A magnet can exert a force on another magnet



ACTIVITY 13.3

Take a pair of bar magnets. Place one of the magnets on a smooth surface such as a table. Now bring one end of the other magnet to one end of the magnet on the table and observe what happens.

Next, separate the two magnets, and bring the other end of the magnet you are holding to the same end of the magnet on the table. Again, watch what happens.



without touching it. Magnetic force is a non contact force.

13.4.2. Gravitational Force

Have you wondered why the ball hit for a six by a batsman comes back to the ground? Or why a mango or an apple falls to the ground? Why are objects fall towards the earth? It is because the earth pulls them down. This force is called the **force of gravity**. This is an attractive force. This is an example for non-contact force.

MORE TO KNOW

Gravity is not a property of the earth alone. In fact, every object in the universe whether small or large, exerts a force on every other object. This force is also known as the gravitational force.

13.4.3. Electrostatic Force

ACTIVITY 13.4

When you switch off the Television in your house after watching for some time, you can notice that hairs in your hands are getting attracted towards the screen. Why?

The television screen becomes electrically charged and it exerts an electrostatic force on the hair of your hand. This force is a non-contact force because, there is no contact between the screen and the hair.

The force exerted by a charged body on another charged or uncharged body is known as electrostatic force. This force acts when the bodies are not in contact. The electrostatic force is another example of non contact force.

13.5. PRESSURE

ACTIVITY 13.5

Take two bags of the same size. Let the strap of one bag be narrow and that of the other broad.

Place your books in the bag with broad strap. Hang the bag on your shoulder and walk for some time. How do you feel?

Transfer the books to the other bag with narrow strap. Hang it again on your shoulder and walk for some time. How do you feel?

It is comfortable to carry the bag with broad strap. Isn't it? Why?

when you hang a bag with broad strap, the weight of the books is distributed over a larger area of the shoulders and hence the pressure on your shoulders is less.

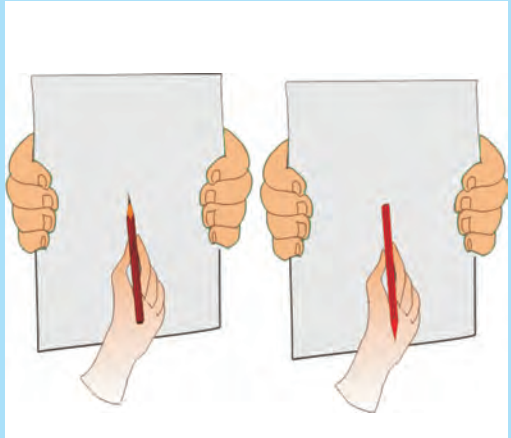
ACTIVITY 13.6

Let us take a pencil and a paper. Try to make a hole in the paper by pressing the blunt end of the pencil on the paper.

Now try to make a hole in the paper by pressing the sharp end of the pencil.

Which was easier why?

Although the force applied on the pencil is almost the same in both the cases, the sharp end of the pencil is able to make a hole. In this case the area over which the force acts on the paper is very small and its effect on the paper is much greater (it makes a hole in the paper).



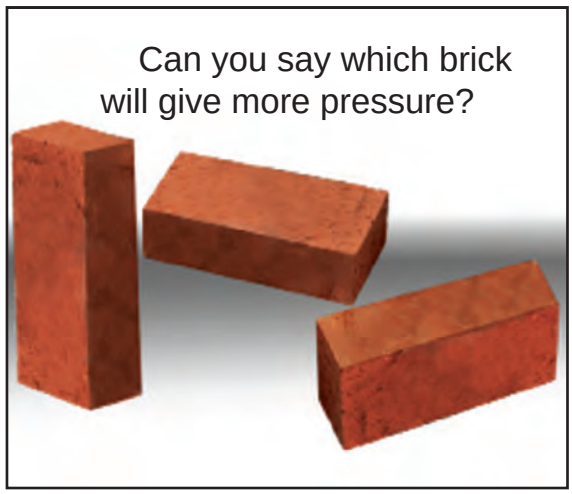
From these activities we understand that the effectiveness of the force applied depends on the area on which it is acting.

Now we will define a new physical quantity, pressure.

Pressure is defined as the force acting on a unit area

$$\text{Pressure} = \frac{\text{Force}}{\text{Area on which it acts}}$$

The SI unit of pressure is N/m^2. It is also called pascal (Pa) .



Solved Problem 1:

A liquid gives force of 100N over an area of $2m^2$. What is the pressure?

Force = 100N

Area = $2m^2$

Pressure = ?

$$\text{Pressure} = \frac{\text{Force}}{\text{Area on which it acts}}$$

Blaise Pascal (1623-1662)

One of the greatest scientists of the 17th century. He was a child prodigy. A French mathematician, physicst,inventor, writer and philosophor. The SI unit of pressure is named after him.

Substituting the values

Pressure = $100N / 2m^2$

= $50 N/m^2$

Pressure = 50 N/m^2

TRY YOURSELF

A liquid's force is acting over an area of $4m^2$. If the pressure is

25 N/m^2, what is the force?

13.6. PRESSURE EXERTED BY LIQUIDS AND GASES

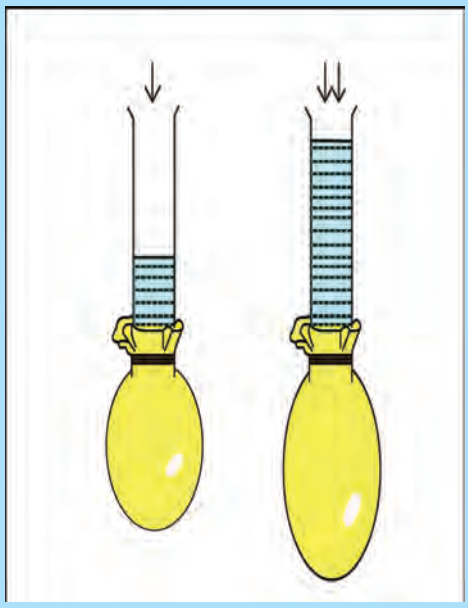
You know that liquids and gases are called fluids. Solids always exert pressure downwards. But the fluids exert pressure in all directions.

Fluids exert pressure on all bodies immersed in them and also on the walls of the container that holds them.

Pressure exerted by Liquids

ACTIVITY 13.7

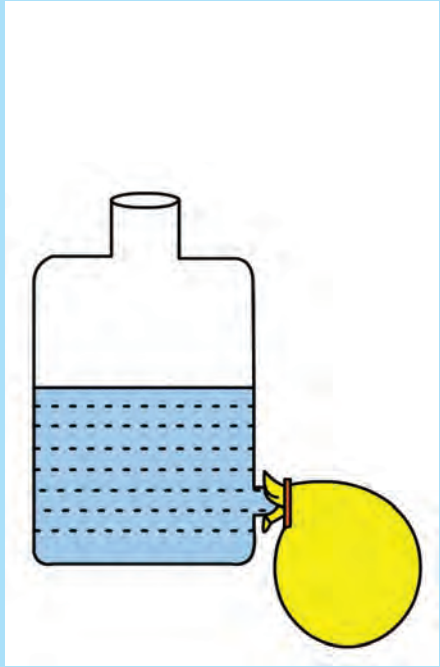
Take a transparent glass tube or a plastic pipe. Also take a piece of thin good quality of rubber (Piece of a rubber balloon). Stretch the rubber sheet tightly over one end of the pipe. Hold the pipe vertically. Ask one of your friends to pour some water in the pipe. Does the rubber balloon bulge out? Notice the height of the water column in the pipe. Pour some more water. Observe again the bulging in the rubber baloon and the height of the water column in the pipe.



This shows that the pressure exerted by liquids at the bottom depends on the height of the liquid column.

ACTIVITY 13.8

Take a discarded plastic water bottle, fit a glass tube near the bottom of the bottle. You can do so by slightly heating one end of the glass tube and then quickly inserting it. Make sure that the water does not leak from the joint. Cover the mouth of the glass tube with thin rubber baloon as you did in Activity 1. Now fill the bottle with water up to half of the bottle. What do you observe? Why does the rubber sheet bulge this time? Now pour more water and watch, what happens to the rubber sheet?

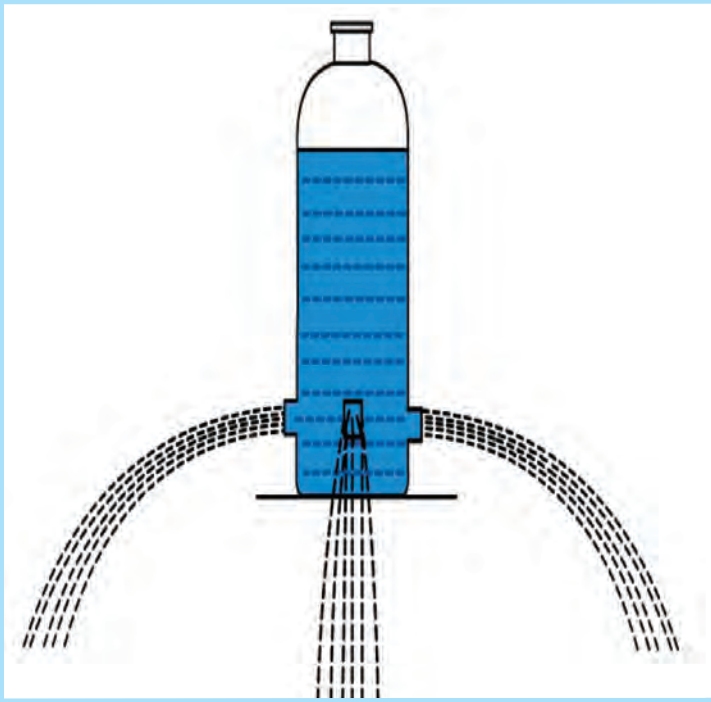


This shows that liquid exerts pressure on the walls of the container.

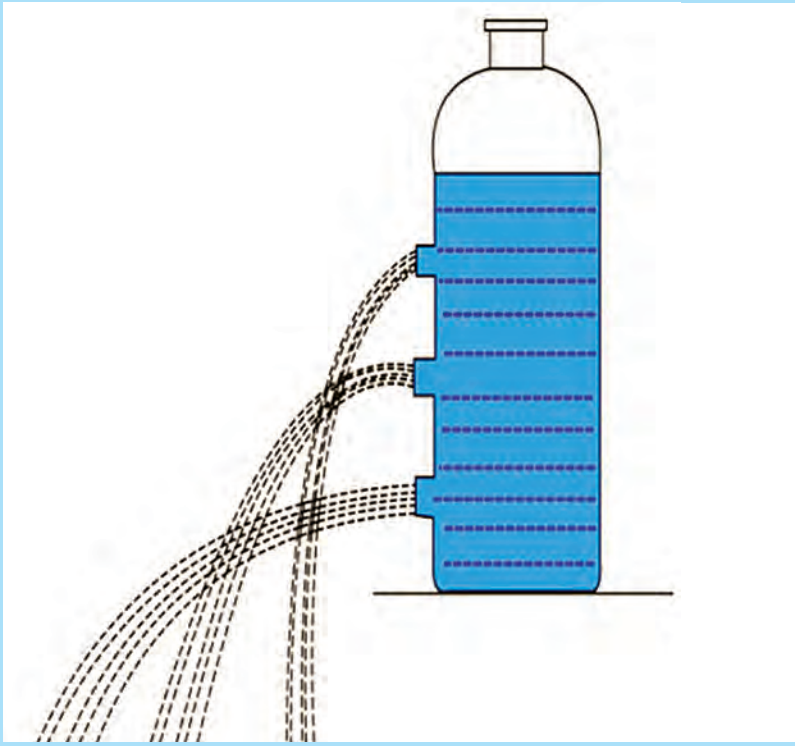
ACTIVITY 13.9

Take a plastic bottle and drill four holes all around near the bottom of the bottle. Make sure that the holes are at the same height from the bottom. Now fill the bottle with water. What do you notice? Do the different streams of water coming out of the holes fall at the same distance from the bottle?

Inference: Liquid exerts equal pressure at the same depth.



ACTIVITY 13.10



Take a plastic bottle, drill three holes at different heights from the bottom. Now fill the bottle with water. What do you observe? You can see that three different streams of water fall at different distances from the bottle.

Inference: The pressure of the liquid increases with the increase in depth.

PHYSICS

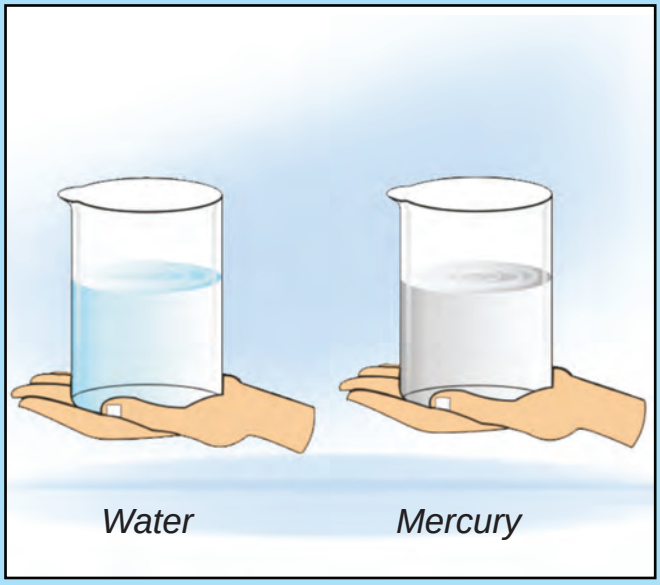
ACTIVITY 13.11

Let us take two identical glass beakers. Take some water in one beaker and an equal amount of mercury or caster oil in other beaker.

Let us approximately find out which beaker is heavier by keeping both the beakers on our palms.

Is the pressure exerted by both the beakers same?

No, the pressure is different. The pressure exerted by the beaker containing mercury or caster oil is more than that of the beaker containing water. This is because mercury or caster oil has more density than water.



Hence we can infer that pressure depends on density of a liquid.

Is the pressure exerted by a glass of water the same on the earth and the moon?

No, on the earth we have more gravitational force and hence the pressure exerted by the glass of water will be more.

On the moon, the gravitational force is less compared to our earth. Hence the pressure exerted by a glass of water is less on the moon.

So, pressure of a liquid depends on gravitational force (g).

The pressure of a liquid can also be calculated by using a formula

$p = hdg$

p = pressure of a liquid
h = height of the liquid column
d = density of the liquid
g = gravitational force

MORE TO KNOW

- Deep sea divers wear specially designed suits to protect them from the huge pressure of the water underneath.
- The walls of the dams are made stronger and thicker at the bottom than at the top of the dam to withstand the huge lateral pressure of water at the bottom

ACTIVITY 13.12

Take three kinds of vessels as shown in figure. Make holes in them at the same height from the bottom. Pour water into the vessels so that the height of the water level is same in all the vessels. Observe in which case the pressure is more.

13.7. PRESSURE EXERTED BY AIR

We must have walked on the road while there is a strong wind. How did we feel? Did we feel any force while walking against the wind?

What happens to the bicycle tube when it has a puncture?

From the above observations you can say that gases also exert pressure on the walls of their container.

13.8. ATMOSPHERIC PRESSURE

The earth is surrounded by air all around. This thick envelope of air is called the atmosphere. The atmospheric air extends up to many kilometers above the surface of the earth. The pressure exerted by this air column is known as the atmospheric pressure.

We know pressure is force per unit area, and if we imagine a unit area and a very long cylinder standing on it filled with air, up to the height of atmosphere, then the weight of the air in this cylinder is atmospheric pressure.

The atmospheric pressure at sea level is approximately 1,00,000 N/m^2 or (10^5 N/m^2). As we go higher and higher above the earth surface, the atmospheric pressure decreases.

MORE TO KNOW

Why do astronauts wear a special dress to go into the space?

The blood pressure inside our body would need air pressure outside to keep us safe.

When we go above the earth's atmosphere, the pressure outside is very less. But, the pressure inside our body is very high. Due to this our body will burst. So, to avoid this astronauts wear a special dress.

Measurement of atmospheric pressure

The atmospheric pressure is not the same at all places. It decreases as we go above the earth's surface. The instrument used to measure the atmospheric pressure is called Barometer.

In 1643, an Italian scientist named Torricelli invented the first barometer. It was a mercury barometer. Aneroid barometer and Fortein's barometer are other instruments used to measure the atmospheric pressure.

ACTIVITY 13.13

Take a glass of water. Suck a little water through a straw. Hold your finger above the straw. Pull the straw out of the water. What do you observe? Now remove your finger from the top of the straw. what happens?

ACTIVITY 13.14

Take an ink - filler. Press its bottom with your finger to Pump air out of it. Now keep its open end in water or ink and release your finger. What happens now?

ACTIVITY 13.15

Take a rubber ball and make many holes in it with a needle. Fill the ball with water. Squeeze the ball with your hand. What do you see?

Water rushes out through the holes with equal forces. What do you infer from this?

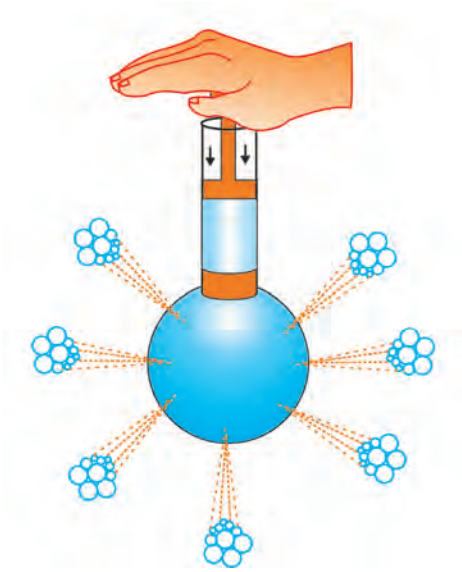
13.9. PASCAL'S LAW

The pressure applied to an enclosed liquid gets transmitted equally to every part of the liquid. This property was first demonstrated by Pascal and is called Pascal's law.

Hydraulic devices, like earth excavators (JCB) and car brakes work on the above principle.

Take a stout flask with holes of equal size at different places as shown in the figure. Fit a piston which can be moved up and down along the neck of the flask. When a force is applied on the piston, the piston moves down and the water flows

out equally in all directions through the holes. This shows pressure exerted on water is transmitted equally throughout the water so that water comes out of all the holes with equal force.



13.10. FRICTION

We must have seen children skating. These children wear shoes with wheels. Is it possible to skate on bare feet?

The force which opposes the action of sliding your foot on the floor is called 'friction'.

We saw earlier that the frictional force is a contact force.

> Friction is the force created whenever two surfaces move or try to move over each other.

Friction is caused by the irregularities on the two surfaces in contact. Even those surfaces which appear very smooth have a large number of irregularities on them. Irregularities on the two surfaces lock into one another. When we attempt to move any surface, we have to apply a force to overcome the interlocking. On rough surfaces there are larger number of irregularities. So the force of friction is greater if a rough surface is involved.

13.10.1. Factors affecting friction

The force of friction depends on two main factors

1. Mass of the body

2. Nature of the surfaces in contact

As the mass of the body increases, the force of friction also increases. A football goes farther than a cricket cork ball on a kick, since the mass of the cricket ball is more than that of a foot ball.

Friction is less when the surface is smooth. This you can

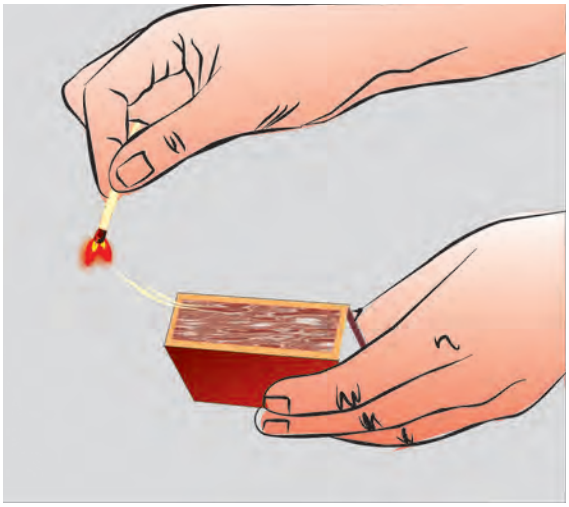
understand by rolling a stone on a tar road(rough surface) and a house floor(smooth surface).

13.10.2. Friction a necessary evil

Friction plays, an important role in our daily life. Friction opposes motion and so you may think it is an evil. But it is a necessary evil. Let us see why?

Friction is necessary

1. We are able to walk or run properly on the floor because of friction. If there is less or no friction we will slip and fall down.
2. It would not be possible to light a match stick without friction between its head and the side of the matchbox.
3. Cars and buses are able to run on the roads because of the friction between the wheels and the road.
4. We cannot write on paper without friction between the tip of a pen or a pencil and the paper.



Friction as an evil

1. Friction produces heat. This heat causes wear and tear of the machinery parts.
2. Vehicle tyres and soles of footwear wear out because of friction.

13.10.3. Increasing and reducing friction

We have seen in the earlier section that friction is desirable in some situations. Can we increase this friction?

You may have seen that the sole of shoes and footwear are grooved. Why is it so? Have you ever thought of it?

It is done to provide them better grip on the floor, so that you can move safely. This means you have increased the friction.

The treaded tyres of cars, trucks and bulldozers provide better grip with the ground.

Sand and gravel are strewn on the slippery ground during rainy season to increase the friction.

Just as we can increase the friction, we can also reduce the friction.

Friction can be reduced

1. By using suitable lubricants, friction can be reduced. eg. oil (for light machinery), grease (for heavy machinery) ,
2. If the rubbing surfaces are polished, they become smooth and in turn, reduce friction between them.
3. By the use of wheels .

4. By the use of ball bearings.

Ball bearings have small balls of steel between metal surfaces. They are placed between hubs and the axles of ceiling fans, bicycles, motor cycles etc. to reduce friction.

Ball bearing

MORE TO KNOW

Friction can never be entirely eliminated. No surface is perfectly smooth. There are always some irregularities.

EVALUATION

1. Choose the correct answer.

a) The SI unit of pressure is N/m^2.This unit is otherwise called ----------(pascal, newton, joule)

b) Atmospheric pressure at sea level is approximately equal to ---------- (10^5 N/m^2, 10^7 N/m^2, 10^3 N/m^2)

2. Fill in the blanks

Friction is a---------- force (contact / non-contact)

3. Match the following

i)	wheels and ball bearings	non-contact force
ii)	grooves	based on Pascal's law
iii)	earth escavators	increases friction
iv)	fall of an apple from the tree	decreases friction

4. Correct the given statement.

The gravitional force of moon is equal to the gravitational force of earth.

5. List out the following actions on the basis of contact force and non contact force

a) lifting a chair

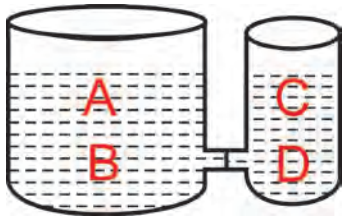
b) the falling of a coconut from the tree

c) friction between the road and the tyre of a car

d) a comb attracts bits of paper

e) attraction between two magnets

6. By observing the diagram, answer the following.



a) How does the pressure at A differ from the pressure at B.?

b) The pressure at B is greater than the pressure at D. Is it true?. Justify your answer.

c) Compare the pressure at A and C.

d) If the water is replaced with mercury, how would this affect the pressure at A and D?

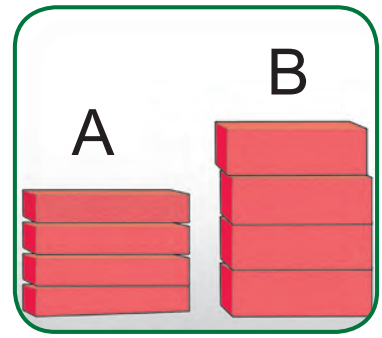
7. We know Pressure = $\frac{\text{Force}}{\text{Area}}$

If 50 N force is applied on a liquid and it experiences 25 N/m^2 pressure. Find out the area on which the force is applied?

8. Aswin and Anwar were playing with four bricks each. Aswin arranged his four bricks as shown in figure A. Anwar arranged his bricks as shown in figure B, in order to be a taller one.

Now let us complete the following sentences by choosing the right option below

(equal to, less than, more than)



a) The force of A on the ground is _____ the force of B on the ground.

b) The area that A occupies is _____ B on the ground.

c) The pressure exerted by A is _____ B

9. We know that pressure can also be calculated by using the formula p=hdg

A rectangular storage tank is filled with paraffin. The height of the tank is 2m. Density of paraffin is 800 kg/m^3, the value of g is 10 N/m^2

Calculate

a) the pressure at the bottom of the tank

b) the pressure at a depth of 1 m.

10. Swetha is wearing a sharp edged high heeled footwear. Madhu is wearing a flat footwear. If both the girls are having same weight and both are stepping over your foot, whose footwear will cause more pain to your foot? Why?

11. Swathi went by car to Ooty last week, when the car was climbing the mountain, her ears popped. She felt uneasy but after sometime she felt better. Why did her ears pop when she climbed the mountain?

12. As we go higher and higher atmospheric pressure _____ (increases / decreases)

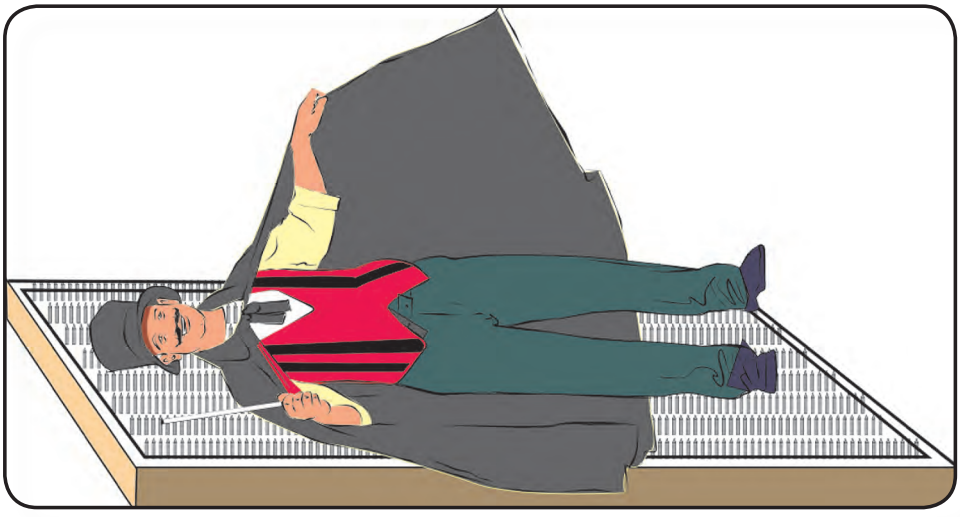
13. Kumaran went to a shop near his house on a bicycle. The bicycle made a lot of noise when he pedaled it. After coming home, he applied some oil on some parts of the bicycle. Now there is no noise, why?

14. We know that friction depends upon mass of the body when we roll down an iron ball and a football on the ground, which ball will travel more distance? Why?

15. When we “suck” on a straw, the liquid travels up in it. Explain why?

16. In a car, friction is essential in some parts but needs to be reduced in some parts. Give two examples of where friction is a) Essential and b) Needs to be reduced in a car.

17. Arasu went to an exhibition. There he saw a magician lying on a bed of nails. To his wonder, the magician was not hurt at all. help Arasu to understand the phenomenon.

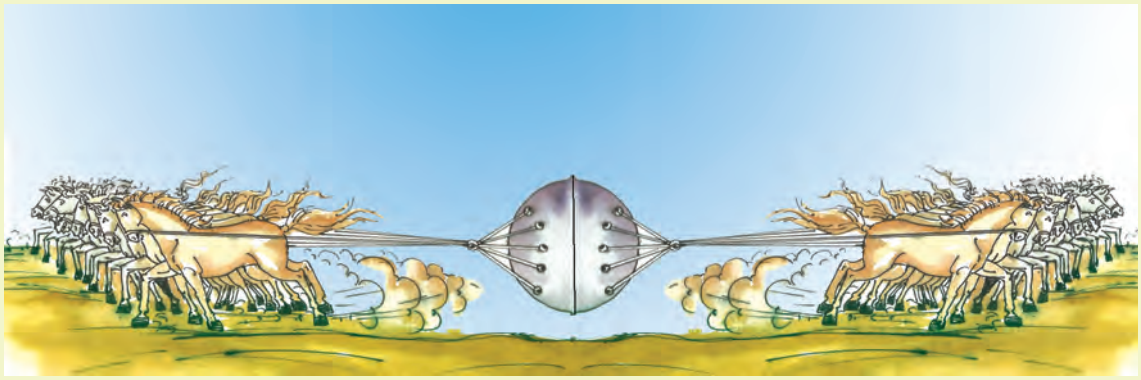


Project Work

Take a brick. Measure its length, breadth and height. Weigh the brick on a balance and note its weight. Now keep the brick on a table in various positions in turn. Find its area of contact with the table. The weight of the brick is the force applied by the brick. Now calculate the pressure applied by the brick on the table in various positions. Prepare a chart showing your observations. Similarly find the pressure exerted by a book, a wooden block, etc., and note your observations in the chart.

DO YOU KNOW?

Otto von Guericke, a german scientist of the 17th century, invented a pump to extract air out of a vessal. With the help of this pump, he demonstrated dramatically the force of the air pressure. He joined two hollow metallic hemispheres of 51cm diameter each and pumped air out of them. then he employed eight horces on each hemispher to pull them apart. So great is the force of air pressure that the hemispheres could not be pulled apart.



FURTHER REFERENCE

Books Advanced Physics - **Keith Gibbs-** Cambridge University Press (1996)

Physics Foundations and Frontiers - **G.Gamov and J M Cleveland - Tata McGraw Hill** 1978

Complete Physics for **IGCSE - Stephen pople- Oxford University Press**

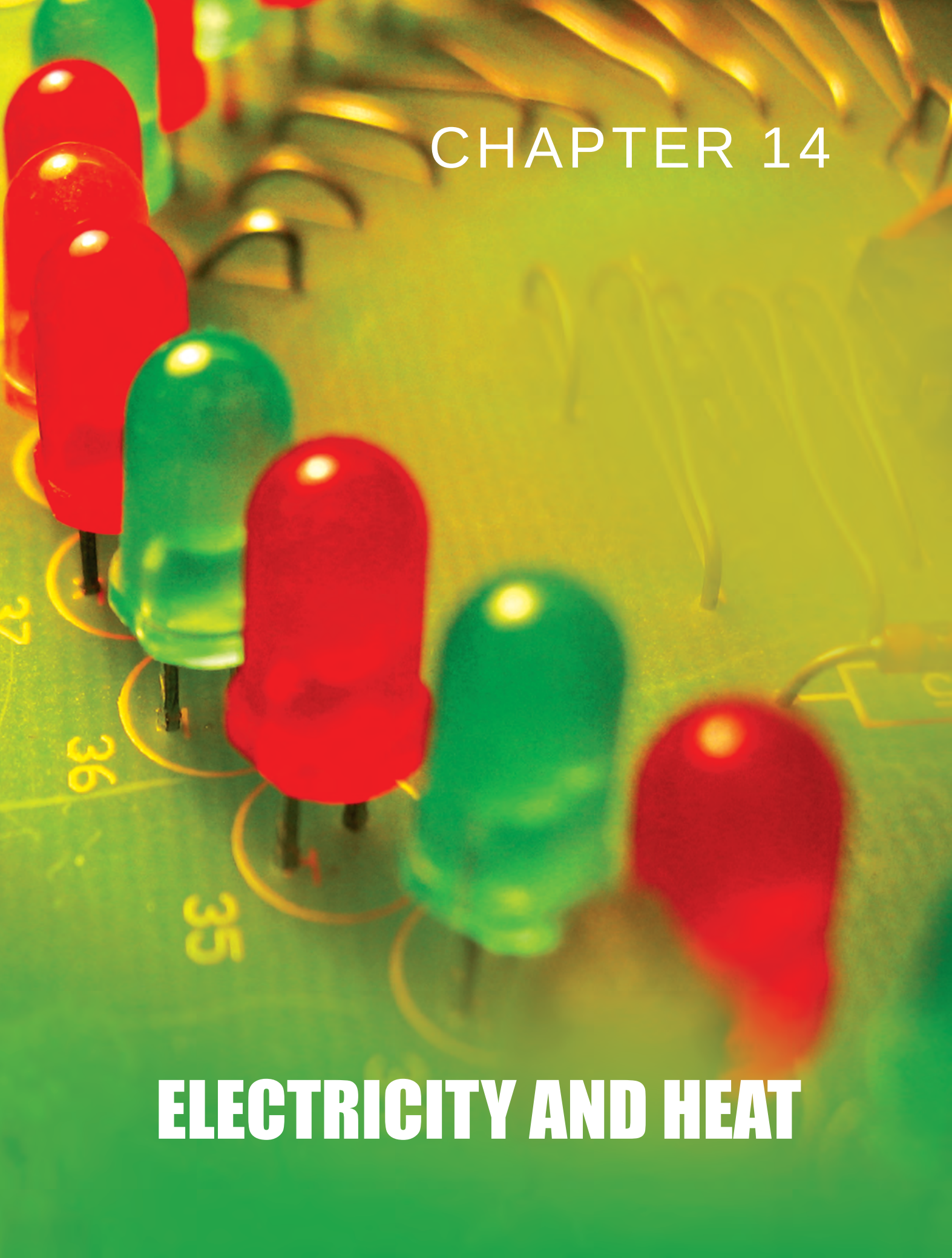
Web sites www.en.wikipedia.org/wiki/pressure

www. starwars.wikia.com/wiki/the force

www.powermasters.com/heat energy.html

www.thetech.org/exhibits/online/topics/lla.html

www.kidwind.org



CHAPTER 14

ELECTRICITY AND HEAT

14. ELECTRICITY AND HEAT

Murugan went to Anand's house last Sunday. He rang the calling bell and waited. Anand opened the door and they went inside the house. What murugan saw inside the house is shown in the picture. What do you see in the picture? Can you imagine how their life would be without electricity?

Electricity plays a very important role in our daily life. It is a form of energy that helps us in many ways. Most of the charm of modern life would not be there, if there is no electricity.

MORE TO KNOW

We are often advised to avoid handling electrical appliances with wet hands. Why? Water, with dissolved salts in it, is a good conductor of electricity. Our body is made of 70% water with dissolved substances. That makes us good conductors, too.This is why we should not touch live electric wires with bare hands.

Using rubber gloves and shoes will protect us to a certain extent.

The electricity that we use in our houses, schools and factories is obtained through power stations. (A power station is a place where electricity is produced in large scale by using various sources of energy like water, wind, heat etc.,). We get a small amount of electricity through batteries and cells.

The electric power thus produced is used through circuits and controlled by switches .

14.1. THREE KINDS OF CIRCUITS

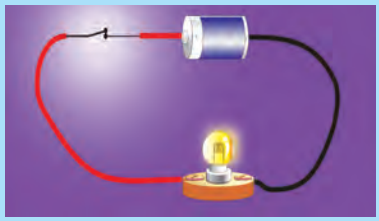
Flow of current requires a closed conducting path. This path is made by connecting a cell or a battery, a switch (key) and a bulb, by means of wires. This closed conducting path is known as an electric circuit. Recall your experience of drawing a circuit with symbols of the components.

Simple circuit

A circuit made up of a cell, a switch and a bulb is known as a simple circuit . When the switch is put on, the bulb glows. This is because there is a continuous or closed path for the electric current to flow.

ACTIVITY 14.1

Take a battery, bulb, switch and wires. Connect them as shown in figure to make a simple circuit.

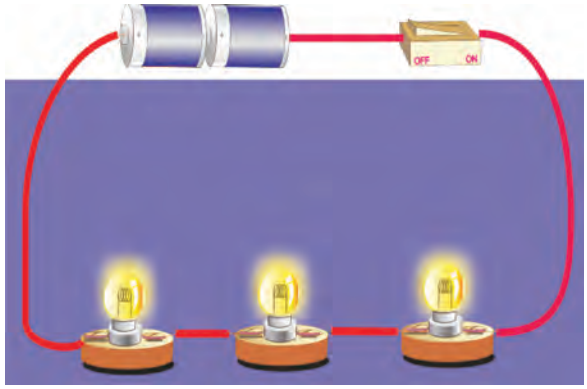


Series and Parallel Circuits

Murugan and Ramu are friends. One day they were discussing about constructing a circuit. They were very eager to construct a circuit with two or more bulbs. They tried and constructed a circuit with three bulbs in two different ways.

Series Circuit

One of the circuits constructed by them is given here. When you look at the circuit, it is obvious that the bulbs are connected end to end. This type of circuit is known as series circuit. Here the current can flow only in one direction and the same amount of electric current flows through all the bulbs.

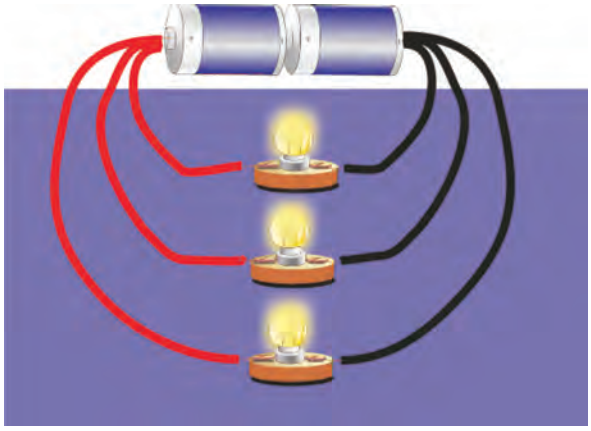


What happens when one of the bulbs in the circuit is removed or fuses off? The other bulbs will not glow because the circuit is not complete now.

Parallel Circuit

Observe the second circuit. here each bulb is connected with the battery terminals, by separate wires. This type of circuit is known as parellel circuit.

In this circuit different amount of current passes through the bulbs.



What happens when one of the bulbs in the circuit is removed or fuses off? The other bulbs will glow because they will have separate conducting paths.

MORE TO KNOW

The electrical appliances of our houses are all connected in a parallel circuit. It is done because only in a parallel circuit every appliance gets current separately. If we switch off any of the appliance, the others will continue to work.

14.2. CONDUCTION OF ELECTRICITY IN LIQUIDS

We know that metals like Copper, Aluminium, Iron, Gold, etc., allow electric current to pass through them and they are called conductors.

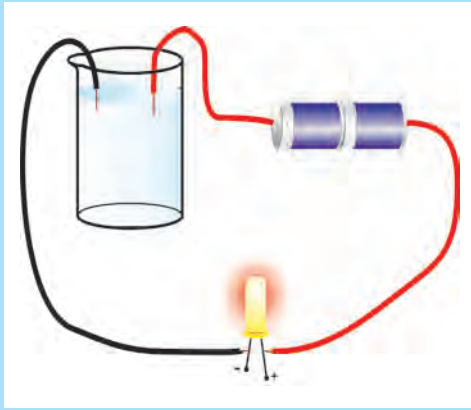
Materials like Wood, plastic, rubber, glass etc do not allow electric current to pass through them and they are called Insulators.

ACTIVITY 14.2

1.. Draw a series and a parellel circuit with three bulbs in it using only symbols of the components.

2. Draw one series and one parellel circuit diagram with two cells and four bulbs.

ACTIVITY 14. 3



Construct a Circuit using two cells, a LED and connecting wires. Immerse the two free ends of the wires into a beaker containing water or any liquid without touching each other. If the LED glows, the liquid conducts electricity. If the LED does not glow; the liquid does not conduct electricity.

If the brightness of LED glow is high, the liquid is a good conductor. If the LED brightness is low, it means less current is flowing through the liquid. These liquid are known as poor conductors of electricity.

PHYSICS

What about liquids. Do they conduct electricity? Let us verify this by doing an activity.

Repeat the experiment with the following liquids and check their conductivity.

S. No.	Liquid	Good Conductor	Poor Conductor
1.	Common salt solution		
2.	Hydro chloric acid		
3.	Lime juice		
4.	Petrol		

From the above table we find that some liquids are good conductors of electricity and some are poor conductors.

Repeat the experiment to test the conduction of electricity through distilled water. What do you find? Does distilled water (pure water) conduct electricity? No, because it is a poor conductor. When a pinch of salt is dissolved in distilled water, you obtain a salt solution. It becomes a good conductor of electricity.

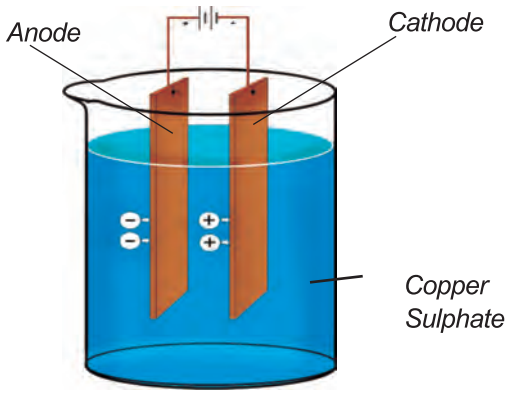
Water we get from sources such as taps, hand pumps, wells and ponds is not pure. It contains a small amount of salts which are naturally present in it. Thus this water is a good conductor of electricity.

Therefore liquid that conduct electricity are solutions of acids, bases and salts. But the conductivity varies from one liquid to another.

14.3. CHEMICAL EFFECTS OF ELECTRIC CURRENT

What happens when current is passed through liquids (solutions)? The current will produce a chemical change when it is passed through solutions. This is known as chemical effect of current.

Let us take copper sulphate solution in a beaker. Immerse two copper plates into the solution. One plate is connected to the positive end of a



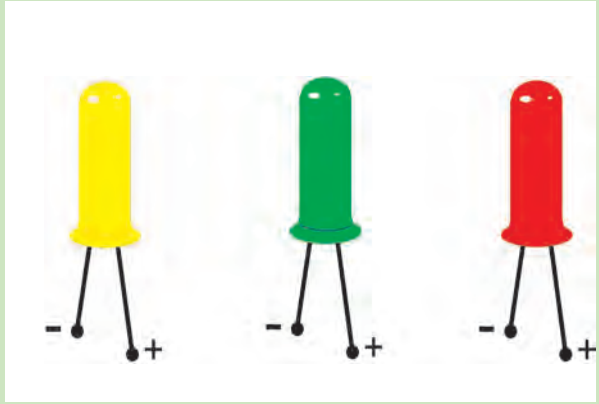
battery (known as anode) and the other plate is connected to the negative end of the battery (known as cathode).

When current passes through the solution, it splits up into positive copper ions and negative sulphate ions. The positive copper ions are

MORE TO KNOW

LIGHT EMITTING DIODE (LED)

An electric bulb is used in the electric circuit to confirm the flow of current in the circuit. However, the electric bulb may not glow if the electric current is weak. So that we use an LED in place of the electric bulb LED is Light Emitting Diode, made up of semiconductor materials. A very small amount of current is sufficient to make and LED glow. LEDs are available in electrical shops. They have two legs, one short and one long. The Short leg is to be connected to the negative terminal and the long leg to the positive terminal. LEDs are available in many colours such as red, green, yellow, blue, white and are increasingly being used for many applications. LEDs are increasingly being used for lighting.



attracted towards the cathode and gets deposited on the cathode. The negative sulphate ions are attracted towards the anode and reacts with copper in the anode converting it into copper sulphate.

This shows that electric current has a chemical effect on copper sulphate and it brings about a chemical change. This process is known as electrolysis.

The two conductors that are immersed in the solution where the current enters and leaves the solution are called **electrodes** (copper plates in the above activity).

A substance which conducts current either as a solution or in the fused state is called an **electrolyte** (copper sulphate solution in the above activity).

The process by which an electrolyte is decomposed with the help of electricity is called as **electrolysis.**

14.4. APPLICATIONS OF CHEMICAL EFFECTS OF ELECTRIC CURRENT

Electroplating is the most common application of the chemical effects of electric current.

14.4.1. Electroplating

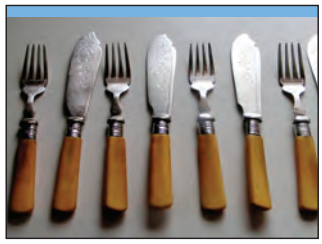
Have you ever seen gold plated jewellery (covering jewellery). They are made by electroplating gold on cheaper metals to make it more

attractive? What is electroplating? The process of depositing a thin layer of a metal on any conducting surface by the process of electrolysis is known as **electroplating.**

In electroplating the metal to be coated is taken as cathode. The article (metal) to be coated is taken as anode and an appropriate solution is taken as the electrolyte.

Uses of Electroplating

Look at the pictures. What do you find? Electroplating is very useful and widely used in industries. For example chromium plating is employed on many objects like car parts, wheel rims, bath taps. Silver plating is used on tableware and electrical contacts; it has also been used on engine bearings.



The most extensive use of gold plating is on jewellery and watch cases. Zinc coatings prevent the corrosion of steel articles, while nickel and chromium coated articles are used in automobiles and household appliances.

MORE TO KNOW

Zinc coated iron is called Galvanized Iron (GI). This iron is used in water taps (GI pipes), since they have high resistance to corrosionUsing rubber gloves and shoes will protect us to a certain extent.

14.5. ELECTRIC CHARGES AT REST

The most dramatic natural phenomena we observe on earth is lightning. The lightning is an electric spark. We also see sparks on an electric pole when wires become loose. These phenomena are quite common. How do they occur? What is

To be electroplated	Cathode	Anode	Electrolyte
Zinc	Iron	Zinc	Zinc sulphate
Silver	Iron	Silver	Silver nitrate
Gold	Silver	Gold	Gold chloride

Silver Ring (before and after Gold Plating)

the reason behind it? Actually in ancient times people did not understand the cause for the lightning. But now, we understand that lighting is caused by the accumulation of charges in the cloud. Let us learn about electric charges.

One day Murugan was getting ready to go to school. He combed his hair (before applying oil) with a plastic comb and placed it on the table. Suddenly he saw that a small piece of paper that was lying on the table was attracted towards the Comb. He wondered why the comb attracted the paper?. He repeated this and found that it happend again. He also noticed that comb did not attract the paper without combing the hair. Murugan was surprised and after going to school, he asked the science teacher about it. The teacher explained it with different activities.Let us do them and learn .

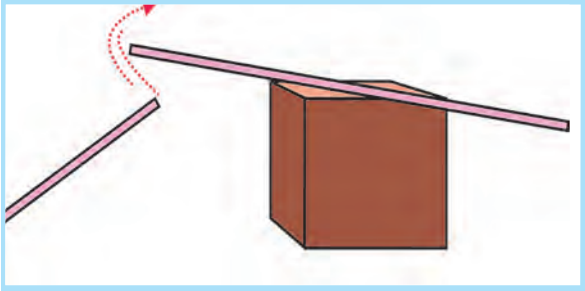
ACTIVITY 14. 4

Take a few bits of paper on a table. Bring an inflated balloon or comb near the paper bits. What happens?

Nothing happens. The bits are at rest. Rub the balloon or the comb with a piece of wool and bring it near the bits of paper. What do you find? The paper bits jump up and stick to the balloon.

ACTIVITY 14. 5

Take a plastic straw, rub it with a piece of wool and place it on a wooden block. Take another straw and rub it with a piece of wool and bring it near the first straw. What happens? The straws are repelling each other.



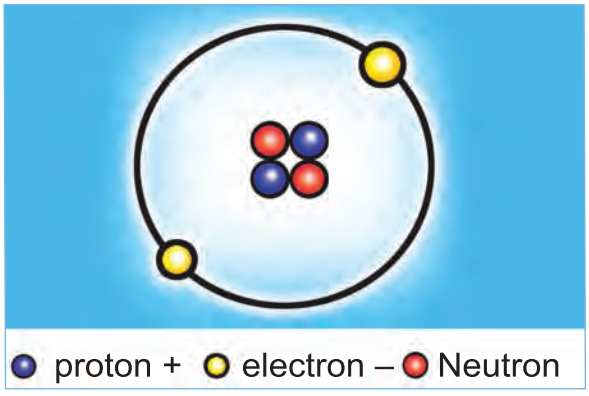
From the above activities we can easily find out that the balloon and the straw undergo some change when they are rubbed on a woollen material. They acquire a property known as an electric charge. This is because there is a transfer of charges between themselves due to friction. ie., in each case the object is charged by rubbing. These objects are called charged objects.

All these things happen because of Static electricity. Static electricity is the accumulation of electrical charges on the surface of a non conducting material. It is called “static” because there is no current flowing. What is a charge? To understand charge we have to look at things on an extremely small scale. Everything we see around us is made of atoms.

The atom is made of 3 types of particles. They are (i) electron (ii) proton and (iii) neutron. The electron is negatively charged, the proton is positively charged and the neutron has no charge, it is neutral.

Atoms usually have equal number of positive and negative charges(protons and electrons). Hence an atom is electrically neutral. This is why most objects around us are electrically neutral.

An atom is said to be electrically charged when the number of protons and the number of electrons is not equal. When the number of protons is higher than the number of electrons, the object is said to be positively charged. When the number of



electrons is more than the number of protons, the object is said to be negatively charged. Hence charged objectes can have either positive charge or negative charge.

We must notice that during the process of charging, only electrons are transferred from one object to another while protons and neutrons are tightly bound in the nucleus of an atom and do not come out of the atom.

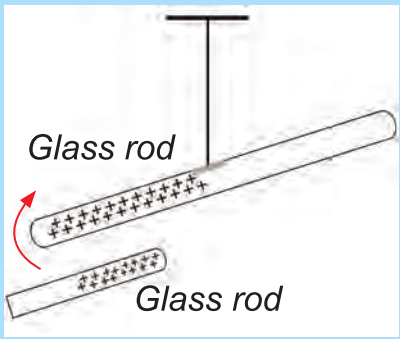
14.5.1. Types of charges

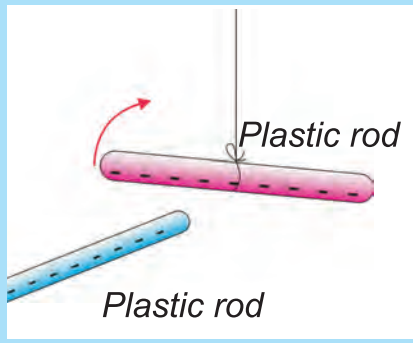
ACTIVITY 14. 6

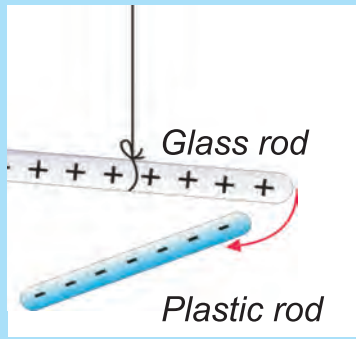
Take a glass rod and rub it with a piece of dry silk. Suspend this glass rod from its middle with a silk thread. Bring it close to this another glass rod which is also rubbed with silk piece. What happens?

Now rub a plastic rod with a piece of wool, suspend the plastic rod from its middle with a silk thread. Bring it close to this another plastic rod that is also rubbed with wool. What happens?

We can observe in the above two cases that the suspended rods are repelled Now bring the rubbed plastic rod near the suspended glass rod and watch what happens? We can notice that the glass rod and the plastic rod get attracted towards each other.







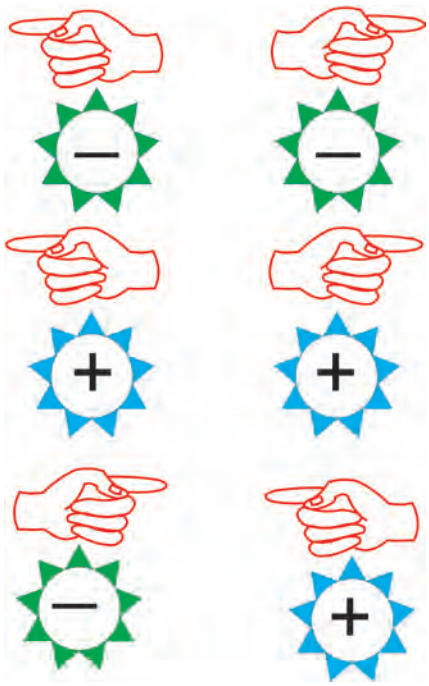
We have learnt that an object can be charged by rubbing. Do all bodies get same kind of charge? Let us answer this question by doing the above activity.

From those activities we can conclude that

1. There are two kinds of charges.

a). Positive charge - the charge is acquired by the glass rod when rubbed with silk

b). Negative charge – the chrage is acquired by the plastic rod when rubbed with wool



2. There is a force between two chrges
3. Like charges (positive and positive) or (negative and negative) repel each other
4. Unlike charges (positive and negative) attract each other.

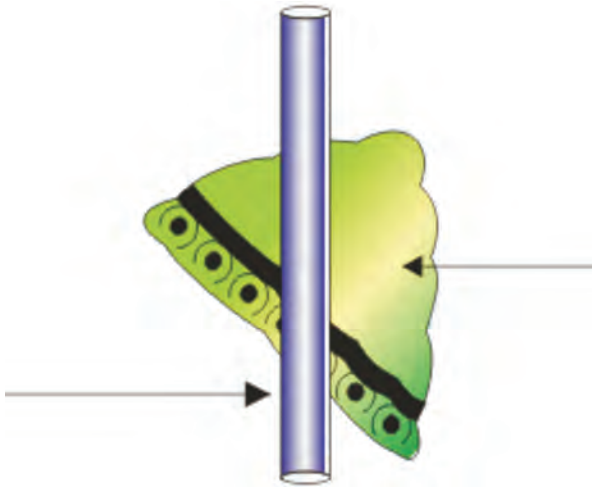
14.5.2. Transfer of Charges

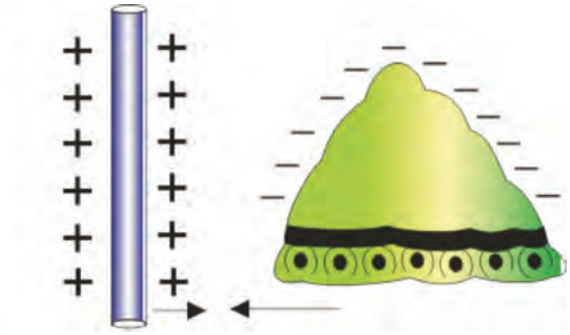
Let us study the methods by which an object can be charged.

Charging by Friction

We have seen in our earlier section that objects get charged when they are rubbed with suitable objects. How do they get charged?

When an object is rubbed with another object, the atoms in the objects get rubbed and a transfer of electrons take place between the atoms of the two objects. One object loses electrons while the other gains the electrons. Thus, the gain of electrons or loss of electrons makes both the objects charged.

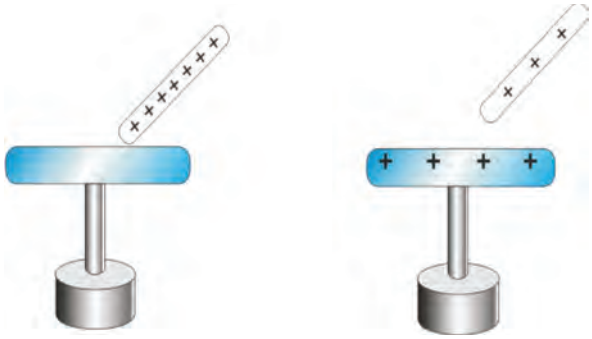




Charging by conduction

An object can also be charged by simply touching it by an electrically charged object. This process of charging is called as charging by conduction.

When a charged body is placed in contact with another body, charges get



transferred to the other body and both get charged.

Charging By Induction

A neutral object can be charged even without touching the neutral body with a charged body. This type of charging is called as charging by induction. This is done by bringing a charged body just close to the neutral body. When this is done, due to redistribution of charges inside the neutral body, the neutral body gets opposite charges on

the side near the charged body. Here no transfer of electrons takes place between the objects.

Electroscope

An electroscope is a device used to detect and measure electric charges. It works on the principle of transfer ofcharges by conduction or Induction.

Electroscope

MORE TO KNOW

When a charged body comes into contact with a body which is not charged, the electric charges jump from the charged body to the uncharged body till the charges on the two bodies are equal. This process is called as discharging.

An electroscope is made up of a metallic rod(usually brass) placed inside a glass jar. The upper end of the rod has a metallic knob and the lower end of the rod has two thin metallic leaves hanging parallel to each other. They are called leaves because they are very thin. The early electroscopes used gold leaves and so these were called gold leaf electrocopes.

When a charged object touches the knob of the electroscope, the charge is transferred to the knob because of conduction. This charge is then transferred to the gold leaves through the metal rod.

The leaves, now repel each other (because they have similar charges) and separate out. By observing this we can check if a body carries charge.

MORE TO KNOW

Connecting a charged object to the earth with the help of conducting wires or physical contact is called as Earthing. The earth is considered to be huge reservior of electrons. Depending upon the charge on the object, the earth provides or accepts electrons from a charged object conneted to it.

Many electrically operated devices in our homes(eg. washing machines, refrigirator wet grinders etc.,) have earth connection. This is done so to save human handling them safely and to save the appliances also.

We can also find the nature of the charge by changing the gold leaf electroscope by induction.

14.5.3. Story Of Lightning And Thunder

Lightning is an awe-inspiring display of electricity in nature. You might have seen lightning during thunderstorms. lightning occurs because of a massive electric charge flowing from cloud to cloud, from one part of the cloud to another or from the cloud to the ground.

Thunder clouds (rain clouds) carry electric charges and these charges separate out within the cloud. The lower portion of a cloud generally carries negative charges and the upper portion carries positive charges.

These charges inside the clouds build up but they cannot flow from one cloud to another or to the ground because the air between them acts as an insulator. But when huge amount of charges build up, the insulating property of the air suddenly breaks down. As a result, an electric discharge takes place between two oppositely charged clouds or between a charged cloud and the surface of the earth. This causes the flash of lightning that we see in the sky.

The enormous amount of heat produced during lightning causes the air to expand and vibrate suddenly,which is the cause of thunder.

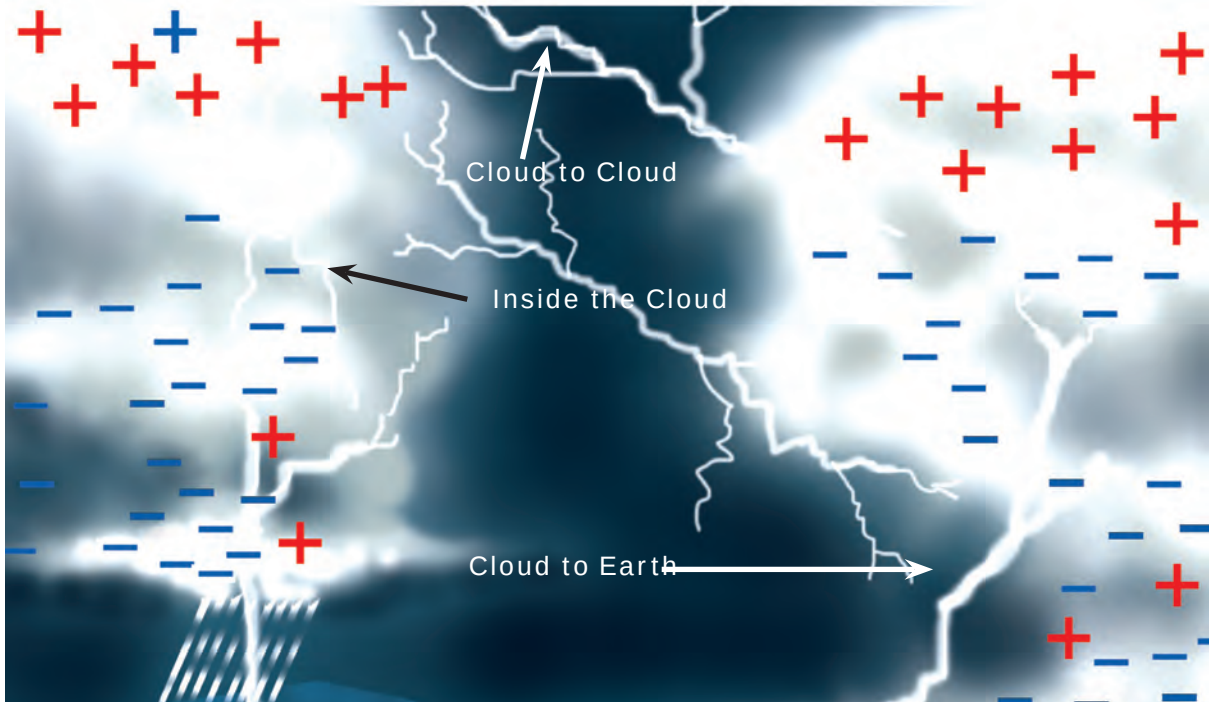
14.5.4. Lightining-Safety

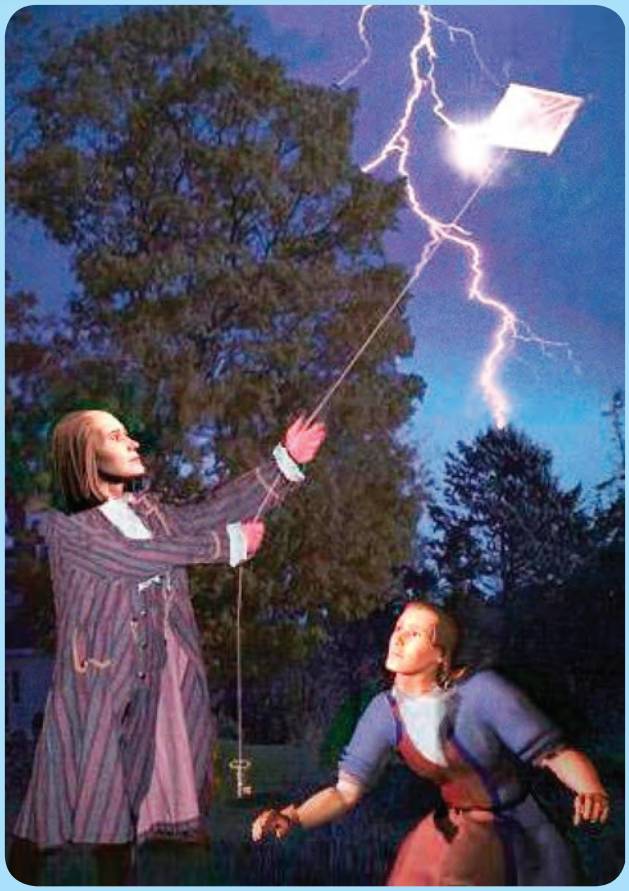
Lightning is a high energy electric discharge. It strikes the earth with a lot of energy and heat. It could be very dangerous. Therefore we must know how to protect ourselves during thunderstorms. Some safety measures that could be taken are

1. Do not shelter under a tree during thunderstorms. If the tree gets struck by the lightning, it could catch fire and cause great harm to you.
2. We can shelter inside our homes, cars or buses.
3. Do not run across a large open fields or high grounds.

Safe position during lightning

4. If we can't find a safe place, squat down in a low-lying place.





Benjamine Franklin carried out the famous Kite experiment' to show that lightning was an electrical phenomenon. He flew a kite in the sky on a stormy day and tied the other end of the Kite string made up of metal to a metal key. Lightning struck and got transferred to the metal key.Frankline was fortunate enough to have been saved from a massive electric shock.

Lightning Arrester

In order to protect tall buildings from lightning, Lightning arresters are used. It was invented by Benjamin Franklin. It is a metal rod with pointed edges. It is fixed at the top of the buildings to be protected. This rod is connected to the ground with the help of a conducting cable. The lower end of the cable is connected to a copper plate buried deep into the earth. Lighting strikes the rod and the electric charges are carried harmlessly to ground through the cable.

14.6. HEAT

Ram, who lives in Ooty invited Murugan, who lives at Chennai to spend a few days during summer. When Murugan went to Ooty they conversed about the weather. Now read the conversation between the two.

Murugan : Ram! It is too hot in Chennai and the temperature is about 40°C.

Ram: Even in Ooty we feel that it is hot and the temperature is about 27°C.

Murugan: Oh! that's not too hot Ram

Ram: Ofcourse. It is. Normally we experience an average of 17°C throughout the year. So, considering that 27°C is hot for us.

Murugan : But for people living in Chennai 27°C is a normal temperature and I enjoy the climate here. Thank you for inviting me to spend my holidays with you in Ooty.

From the above conversation you can realise that what appears to be hot for Ram does not seem so hot for Murugan. Similar is the case with cold. What appears cold to one person may not seem so cold to the other. Thus, we can say that the terms hot and cold are relative. We can usually get a rough idea of how hot or cold an object is by touching it. Our own estimate of measuring is not accurate. Scientist have defined the quantity temperature which gives the measure of the degree hot or coldness of a body.

Heat is defined as a form of energy which flows from a body with a higher temperature to a body with a lower temperature. Temperature is measured by using thermometers.

14.6.1. Effects of heat:

The sun is a major source of heat. Without the heat from the sun it would be difficult for any form of life to survive on this earth. We see many effects of heat in our daily life: Wet clothes drying in the sun, burning candle or oil lamp, ice melting in a glass of water and food cooked.

Let us study each of these effects

(i) Rise of temperature

The temperature of the body rises when it is heated. On the other hand the temperature falls when heat is taken away from the body. Hence heating changes the temperature of a substance. Different substances require different amount of heat for the same rise in temperature. Example oil gets heated up faster than water.

(ii) Change of state

When we heat a solid it begins to melt at a certain temperature, known as melting point and becomes liquid. Similarly when a liquid is heated it begins to boil at a particular temperature called its boiling point and become gas. Hence change of state occurs when substances are heated.

(iii) Change in physical properties

Heat changes the physical propeties of a substance. e.g, Zinc, which is brittle and hard at room temperature becomes soft and flexible at high temperature. Iron on being heated becomes soft and can be easily changed into any shape. The electrical resistance of a conductor increases on heating. A magnet loses its magnetism on being heated.

(iv) Chemical change

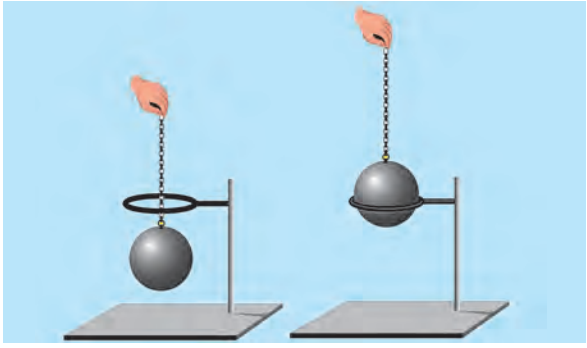
Heat accelerates chemical action. Calcium carbonate decomposes on heating.

(v) Expansion

Substances expand on heating and contract on cooling.

Expansion of solids

You can demonstrate this by a simple activity known as ball and ring experiment. Take a metal ring and a ball. The diameter of the ball should



be in such a way that it can just pass through the ring at room temperature. If the ball is heated in a flame and then placed on the ring, it does not pass through it.

This shows that it has expanded. It will be seen that the ball passes through the ring after it cools.

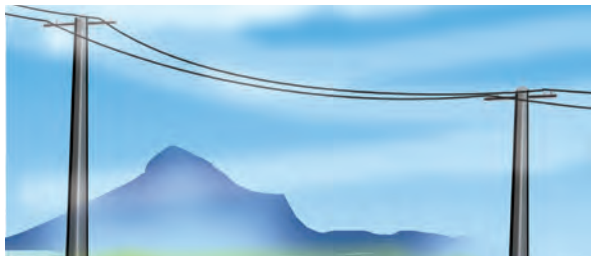
From the above activity we can infer that solids expand on heating. When temperature of a substance is increased, its molecules or atoms, on an average move faster and further apart. The result is an expansion of the substance. This is called 'Thermal Expansion'.

Except a few substances, all solids, liquids and gasses expand. But expansion takes place in all three states of substance. For the same amount of heat given, solids expand the least while gases expand the most.

Thermal expansion finds variety of applications in our daily life.

1. When railway lines are laid some space is left between the two rails (made of iron) to allow for expansion during summer.

If this is not done the rails would expand and bend there by causing derailment of trains.

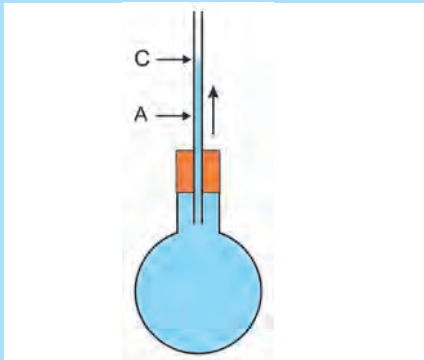


2. The telephone wires between two poles sag in summer and become tight in winter. The wires are laid in such a way that they are allowed to expand or contract.

3. A glass stopper sticking in the neck of the bottle may be made loose by slightly warming the neck of the bottle. The neck expands but not the stopper. Similar is the case with the pen.

4. A thick glass tumbler usually cracks if very hot or cold liquid is poured in it. Since glass is a bad conductor of heat, the inner surface of the glass expands more than the outer surface, when a hot or cold liquid is put in to it. Due to this unequal expansion, the glass cracks.

ACTIVITY 14. 7



Take a glass flask fitted with a one- holed stopper. Insert a thin glass tube and mark the water level in it as A. Now, heat it for a few minutes. There will be a steady rise in the water level. Note the water level and mark it as C. This shows that liquids expand on heating.

Expansion in liquids

Like solids, liquids also expand appreciably when they are heated. A liquid has a definite volume but it has no definite shape. Therefore, only volume expansion is considered. The expansion of liquids is greater than that of solids.

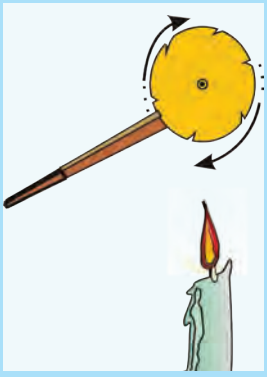
Expansion in gases

When the temperature of a gas increases on heating, its volume increases and it expands. Do you know that tyres filled tightly with air, burst in hot summers? Why? It is because the air inside it expands due to heat.

Let us explain this with an activity

A balloon fixed to the neck of a

ACTIVITY 14. 8



Take a thin metal foil and fix it at the tip of a needle so that it can rotate. Place a burning candle below this set up. Now we can see that the metal foil will rotate.The air above the candle gets heated and the warm air moves up and it rotates the foil.

bottle blows up if the bottle is placed in a bowl of hot water. If it is removed, the balloon keeps contracting. This is mainly due to expansion of air inside due to heating.

14.7.TRANSFER OF HEAT

We have learnt that heat always flows from a higher temperature to a lower temperature. There are three different ways in which heat is transferred from one body to the other.

They are (i) Conduction (ii) convection and (iii) radiation.

Conduction of heat

Heat flows from one object the other when they are in contact with each other. For example a metal spoon left in hot water takes heat from the water and becomes hot. If you touch the metal spoon now, you will feel the heat. This method of transfer of heat from a body at a higher temperature to a body at a lower temperature when they are in direct contact is called thermal conduction.

Convection

When fluids (liquid and gas) are heated the molecules closer to the source of heat get heated first and expand, thereby the density of the liquid decreases. The lighter molecules rise up and cooler and heavier molecules come down. This is called convection.

ACTIVITY 14. 9

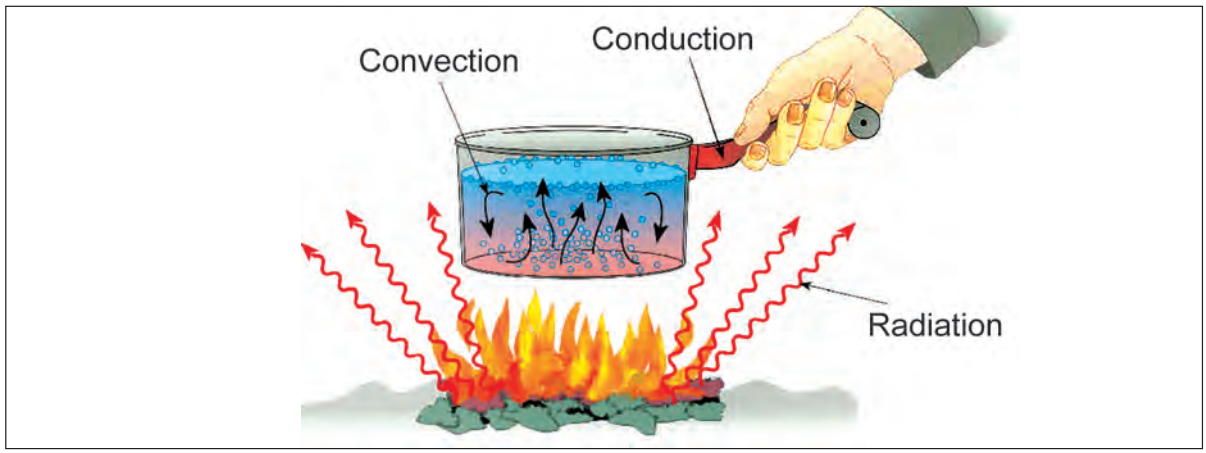
Take a beaker of cold water and put some Potassium Permanganate-crystals in it. Slowly heat the water. You can see the colour rising through the water. It is due to convection

Thus convection is the transfer of heat due to the actual movement of particles.

Radiation

The sun is far away from earth and most of the space between the sun and the earth is empty. But still the warmth of the sun reaches the earth. The heat of the sun cannot reach us by conduction or convection as there are practically no molecules between the sun and earth to carry the heat through.

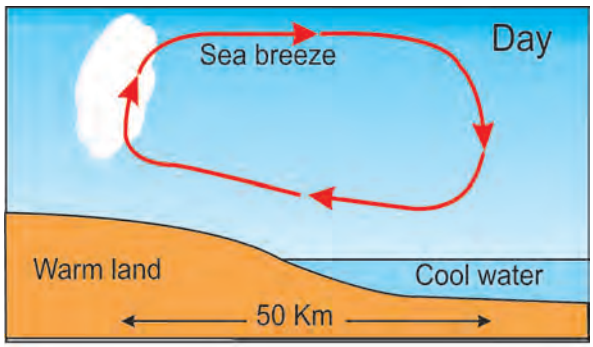
The process by which heat is transferred without the help of any material or medium is called **radiation**

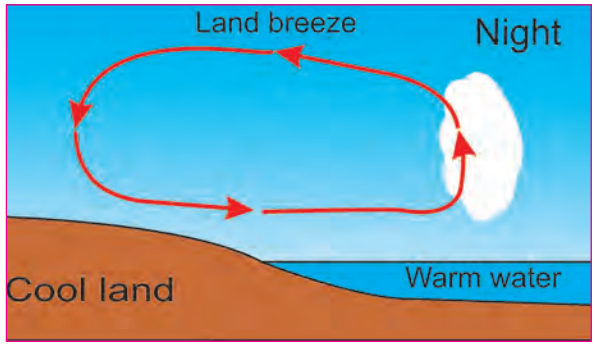


MORE TO KNOW

Winds are caused by convection currents. During the day, the land warms up more than the sea. The warm air over the land rises and cold air from the sea moves in to replace it. So during the day, breeze blows from the sea to the land. This is sea breeze.

At night, the land cools down faster than the sea. The warmer air over the sea rises. Cold air over the land moves in to replace it . So during night breeze blows from the land on to the sea. This is land breeze.





EVALUATION

1. Fill in the blanks.

i. The current produces _____ change, when it is passed through solutions (physical / chemical).

ii. The device used to detect and measure electric charges is _____. (electroscope/spectroscpoe)

2. Match the following:

i) Lightning	___	transfer of heat
ii) weak electric current	___	attract each other
iii) conduction	___	lightning arrestor
iv) opposite chargers	___	LEDs can be used

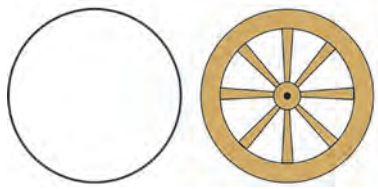
3. Standing on a steel chair, Prem tried to change the fused bulb in his house. His father advised him to stand on a wooden chair. why ?

4. Based on the property of conduction of current, find the odd one out

   1. Silver,Platinum,Sodium,wood
   2. Plastic, Match stick, Paper, SafetyPin
   3. Salt solution,Purewater,Lemonjuice,Hydrochloric acid

5. Swetha rubbed a Plastic ruler on her hair,then took the ruler close to bits of paper. The bits of paper got attached towards the ruler. But when Geetha tried the same with a metal ruler, the bits of paper did not stick to the ruler. Could you expalin why ?

6. It was a cold winter moring Geetha went for a walk. She saw some people sitting around a fire built of the waste materials around them why were they sitting ? Explain the process of heat transfer occuring here?



7. It was a heavy rain with thundertstorms Vijay was sitting with his brother in the house vijay said to his brother that the thunder is caused because of big collision between two clouds Do you think Vijay is right? why?

8. Jaya wants to fix an iron ring on a wooden wheel but the wooden wheel is the same size as the iron ring. Could you help Jaya to fix the ring ?

9. Children are playing in the play ground. Suddenly clouds gathered over the sky and there is a big thunder and lighting .What should they do now? Select the correct one . The children should

a. Run to their houses b.Stand under a tree
c. Just stand at their places d.Squat down

10. Petrol tankers plying on highways often have metal chains attached that drag along the road.could you say why?

Project work

Make your own electroscope

Take a glass bottle,a piece of stiff card,a thin alumuinium foil of 4cm x 1/2 cm,cellotape,10cm long thick insulated copper wire, a comb, a piece of silk or cotton cloth. Cut out a circular piece of stiff paper to fit the mouth of the bottle.

Remove about one inch of insulation from both ends of the wire.Bend one end of the wire by 90°. Fold the aluminium foil and hang it inside the bottle as shown.

push the wire through the centre of the stiff card such that it fits tightly. Now tape the card into position over the bottle as shown.

Rub the comb vigorously on your hair. It becomes charged now. Gently touch the top of the wire with the comb and then move it away.we can see the thin leaves of the foil diverge.

This is because the charges from the comb are carried by the wire to the foil. since both the leaves of the foil get same kind of charge, they repel.

Remember all the experiments with electroscopes work well on a cold, dry day.

FURTHER REFERENCE

Books
Electricity and Magnetism - D.C.Tayal-Himalaya Publishing house 1998
Fundamentals of physics - David Halliday, Robert Resnick and Jeart Walker- John Wiley India Pvt.Ltd (2001) (Sixth edition)

Websites
http://www.powermasters.com/heatenergy.html
http://www.arvindguptatoys.com
http://www.kidwind.org

CHAPTER 15

LIGHT AND SOUND

15. LIGHT AND SOUND

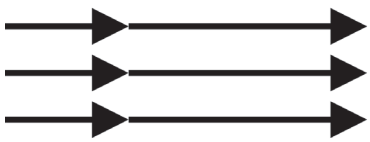
INTRODUCTION

Meera and her friends were enjoying themselves on a picnic. They had a wonderful time visiting new places. Suddenly Meera felt a flash of light falling on her face. She looked around and saw her friend holding a mirror in her hand. From where did that light come from? How?

We are familiar that the light can be made to fall on the face of a person or any object using a plane mirror. The sunlight falling on the mirror is sent back and it fell on Meera's face.

The bouncing of light from a surface of a body is known as **reflection** Everything that is around us is seen by our eyes because of the phenomenon of reflection of light.

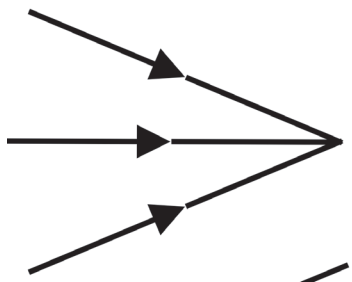
A Ray



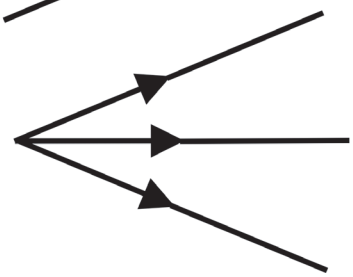
Parallel Rays (Beam)

Light travels along a straight line.

The path taken by the light is known as ray and is represented by a straight line with an arrow mark. The arrow mark denotes the direction of light.



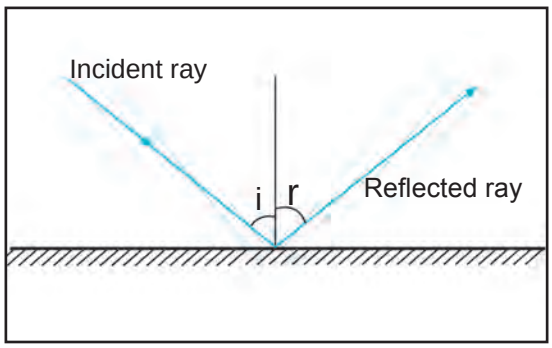
Convergent Beam



Divergent Beam

Two or more rays form a beam. When the rays are parallel. This is known as Parallel beam.

If the rays meet at a point (converging), they form a convergent beam. If the rays move away from a point it is called as divergent beam.



A light ray which strikes the surface is called as an **incident ray.**

The light ray that comes out from the reflecting surface after reflection is called **reflected ray.**

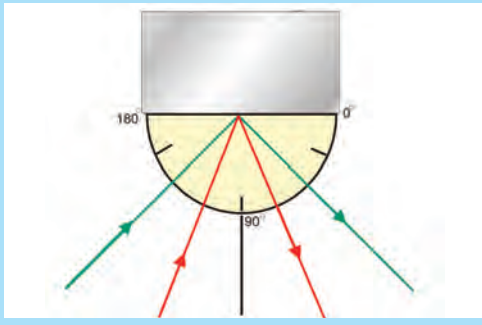
The perpendicular line drawn to the surface at the point of incidence is called a **normal.**

The angle in which the incident ray makes with the normal at the point of incidence called as the angle of **incidence.**

The angle which the reflected ray makes with the normal drawn point of incidence is called **angle of reflection.**

ACTIVITY 15.1

Arrange the drawing sheet, protractor and a plane mirror as shown in the diagram. Using a protractor, draw the normal,incident rays at different angles. Make a ray of light fall on the mirror along the surface of the sheet at different angles. Everytime draw the path of the reflected ray. Measure the angle of incidence and the angle of reflection and tabulate it.



Is there any relation between the two paths of light?

Is there any relation between the angles made by the incident ray and the reflected ray with the normal ?.

When light falls on the mirror as shown in the diagram, what happens?

The angle of incidence i = _____

The angle of reflection r = _____

The light ray will be sent back along the same path or the light ray will retrace the path.

Inference

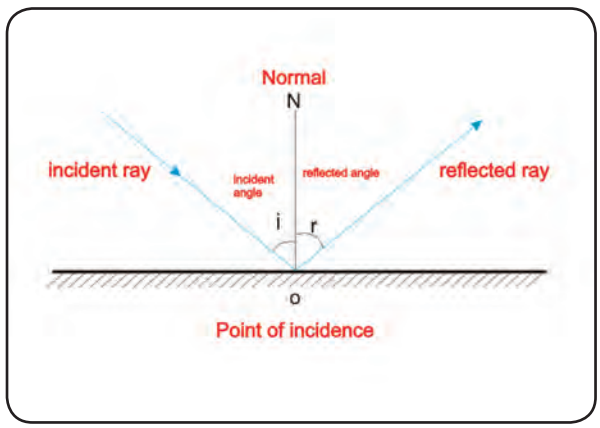
1. The incident ray, the normal at the point of incidence and the reflected ray lie on the same plane.
2. The angle of incidence = angle of reflection. These are known as the Laws of reflection. These laws are true for all reflecting surface.

15.1. LAWS OF REFLECTION

1. The angle of incidence is equal to the angle of reflection.

$$\angle i = \angle r$$

2. The incident ray, the reflected ray and the normal to the surface at the point of incidence lie in the same plane.



If you stand before a wall, can you see your face? No.

On the other hand, if you stand before a mirror, you can see your face. Why?

Though light is reflected from the entire surface, we can see image of the object only from highly polished surfaces.

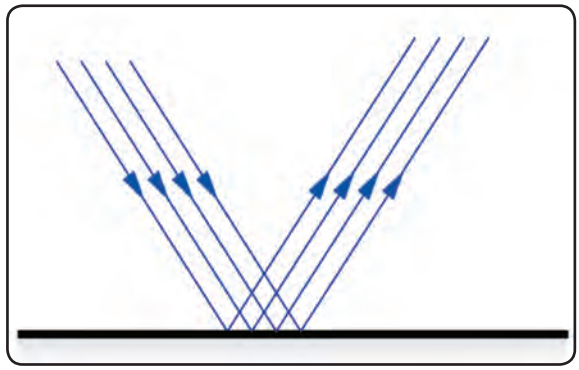
The mirror is a highly polished surface and hence we can see our face. But the wall is not a polished surface. So we cannot see face.

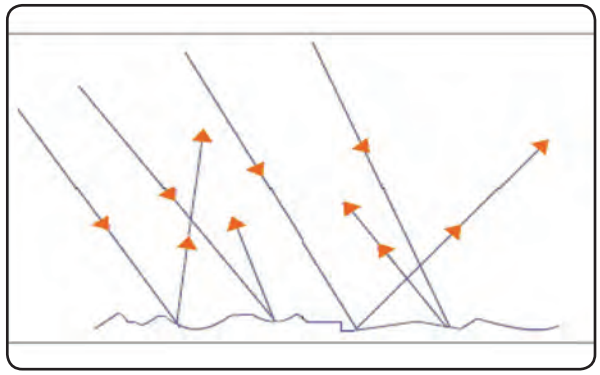
15.1.1. Regular and Irregular Reflections

Reflection from a polished surface is called **Regular reflection**.

Reflection from a rough (unpolished) surface is called irregular or diffused reflection

In the case of a rough surface, light is not reflected in one direction, it is scattered in all directions. This is called a diffused or **irregular reflection.**





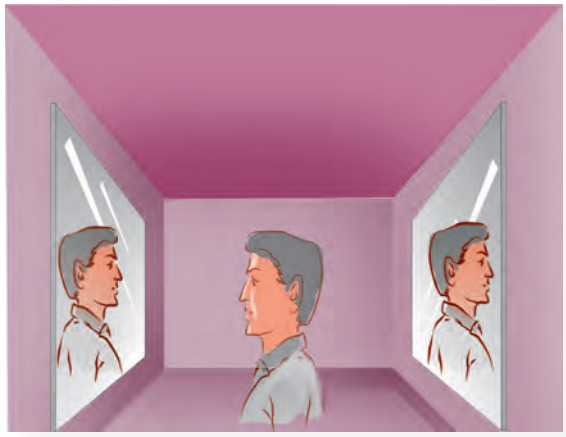
PHYSICS

15.1.2. Multiple reflection

What do we see when we enter into a jewellery shop, a barber shop, hotel, bakery?

We can see number of images. How does this happen? It is just a trick using mirror.

How are the mirrors to be arranged so as to get maximum number of images Have you ever tried to look at the back of your head in a mirror?



If you have, you may know that you need two mirrors to see the back of your own head. This is because of multiple reflections.

15.1.3. Multiple Images

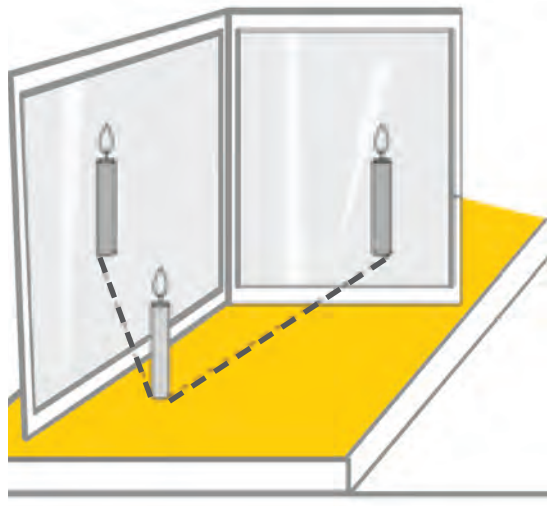
You are aware that a plane mirror forms only a single image of an object.

ACTIVITY 15.2

Make a list of various objects around you like walls, window pans, table tops, polished granite surface, trees, car etc.,

Look at yourself through the surface of all these objects. If you see your image, then it is due to regular reflection.

If you cannot see your image, then it is diffused reflection.



Multiple reflections
and
Multiple Images

ACTIVITY 15.3

Keep a burning candle before a plane mirror and hold another plane mirror at an angle to the first mirror. Do the same for various angles between the mirrors?

Count the number of images formed each time?

DO IT YOURSELF

A garden in a chalk box.

Place the mirrors on opposite sides of a chalk box so that the reflecting surfaces face each other.Keep two or three flowers of different colours in the chalk box. Make a hole on any one of the sides with the mirror and remove the coating on the mirror in front of the hole. Now look into the box through the hole.

Place mirrors on all sides of the chalk box and repeat the experiment. What do you see?

ACTIVITY 15.4

The students are divided into groups. Each group is provided with two mirrors. The two mirrors are fixed using cellophane tape so that thay can be arranged in different angles.

The mirrors are fixed at a particular angle and an object is placed between them. Now note the number of images formed. Complete the table by observing the number of images formed.

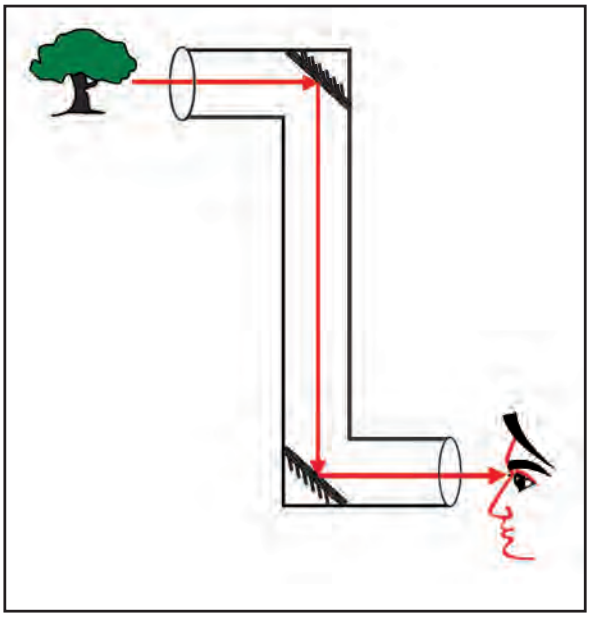
Angle	Number of images
30^0	
45^0	
60^0	
90^0	
120^0	

Is there any relation between the number of images and the angle between the mirrors ?.

$$\text{Number of images} = \frac{360}{\text{angle}} - 1$$

When the mirrors are placed parallel to each other,maximum number of images will be formed.

Based on the principle of multiple reflections we can make the Kaleidoscope and Periscope.

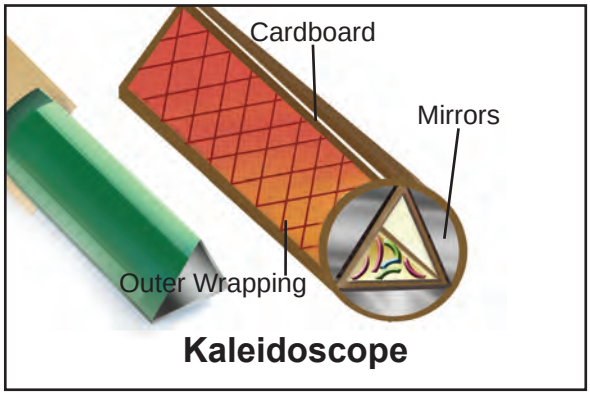


Mirror Periscope

The working of a periscope is based on the principle of successive reflections from two plane mirrors.It consists of two plane mirrors facing each fixed at 45^0 to the frame work of a tube. Fix the two mirrors at an angle of 45^0 as shown in the figure. Observe through one end.

ACTIVITY 15.5

Take three equal mirror strips and join them as shown in the figure. Now place few pieces of broken bangles between the mirrors. Fix them in a circular cardboard tube. Close one end of the tube having a hole in the centre through which we can see. Close the other end completely. See through hole. What do you observe?



Kaleidoscope

15.2. REFRACTION

When light rays pass from one medium to another medium the path of the ray will be changed This is **refraction**.

ACTIVITY 15.6

- Can you bend a pencil without breaking it?
- You can make a pencil look as if it has been bent. How?

Take a glass beaker. Fill half of the beaker with water. Place a pencil inside

it. Look at the water from the side, the pencil will look bent. Now take the pencil out of the water. We will not see the bent. Why did the pencil look bent when it was in the water?

Light rays change the direction before reaching our eyes. This makes the pencil look bent. How is light deviated?

The direction of deviation depends on the densities of the two media. The medium of greater density is known as denser medium and the medium of lower density is known as rarer medium.

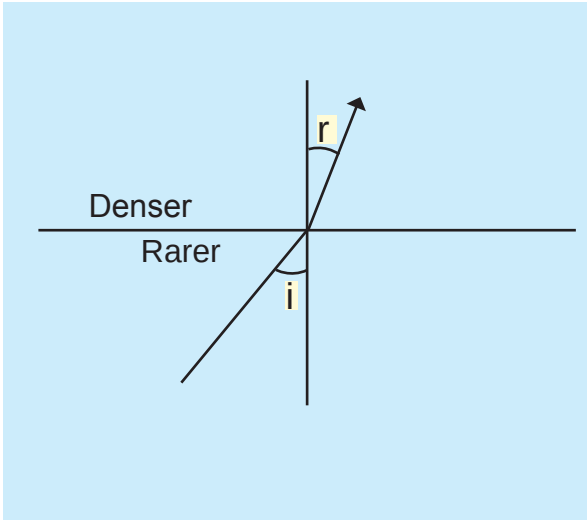
Classify the pairs of media as denser and rarer.

a. Air, water

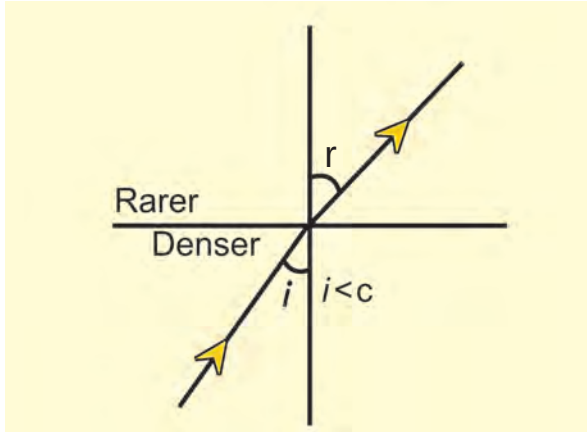
b. Air, glass

c. water, glass

1. When light travels from a rarer medium and enters into a denser medium, it will be deviated towards the normal.



2. The light will be deviated away from the normal when it passes from a denser into a rarer medium.



Every day Effects of Refraction

1. Fruit appears to be bigger in a glass of water due to refraction.
2. Printed letters appear to be raised when a glass block is placed over it.
3. A swimming pool appears shallower than its actual depth.

15.3. DISPERSION

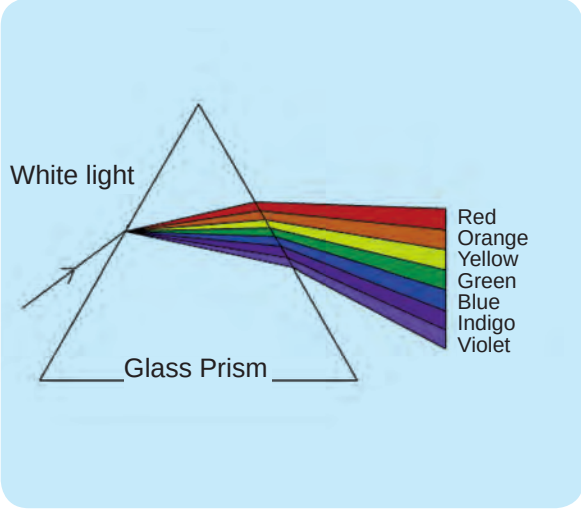
The rainbow is one of the most beautiful sights in nature. Rainbows are seen not only across the sky but also in sprays of water near the water falls. Sometimes the rainbow colours are also seen on soap bubbles and oil films on puddles of water. Where do these colours come from?

Newton passed a narrow beam of sunlight through a prism and obtained a band of seven colours-violet, indigo, blue, green, yellow, orange and red(VIBGYOR) on a white screen

placed on the other side of the prism. Each colour merged into to the next. He called this band of colours as the spectrum.Thus Newton established that white light consists of seven colours.

Do you know why white light splits into seven colours when passed through a prism?

The splitting of white light into its constituent colours (seven colours) is called **dispersion**



When white light is incident on the prism, the different colours of light get refracted or deviated through different angles.

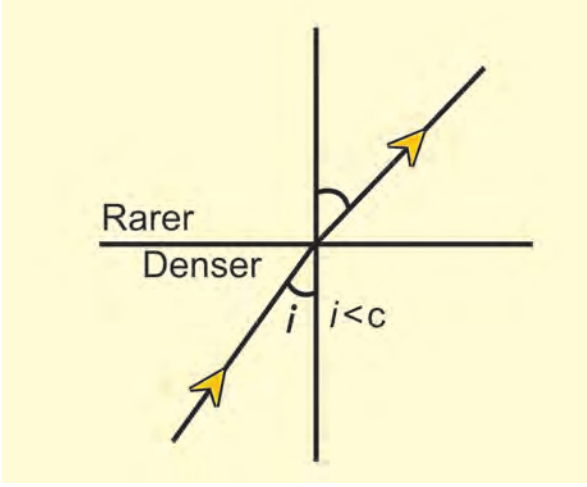
15.4. TOTAL INTERNAL REFLECTION

Consider a ray of light passing from a denser medium to a rarer medium.

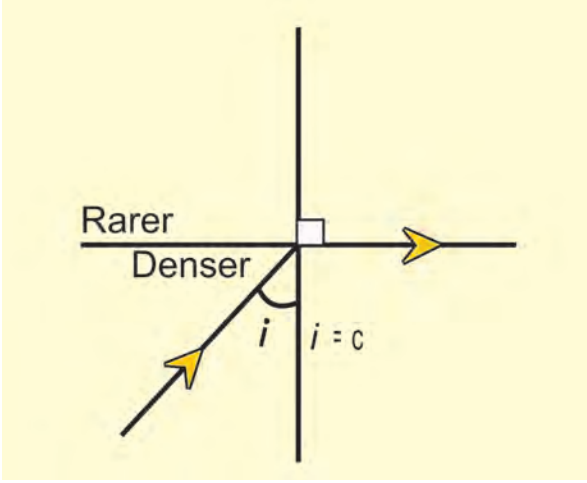
When a ray of light passes from a denser medium to a rarer medium, the refracted ray is bent away from the normal.

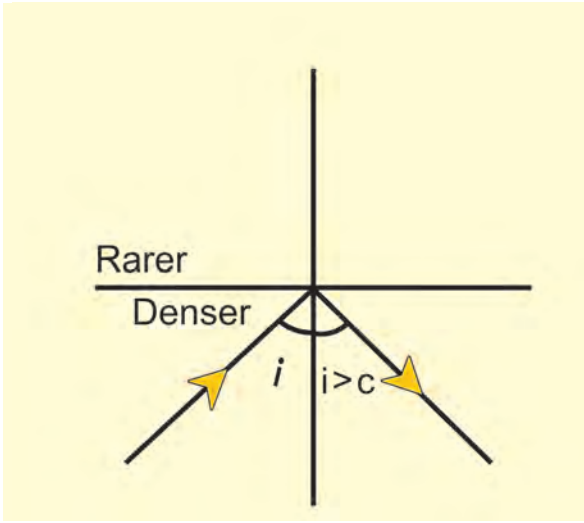
As the angle of incidence increases, the angle of refraction also increases.

At a certain angle of incidence, the angle of refraction becomes 90°. The angle of incidence for which the angle of refraction becomes 90° is called as the critical angle C.



If you further increase the angle of incidence, at one point the ray will be completely reflected back in to the same medium. This is known as total internal reflection.





If the angle of incidence is more than the critical angle, the ray bends inside the denser medium itself. This is total internal reflection.

MORE TO KNOW

Total internal reflection is the main cause of the brilliance of dimonds.

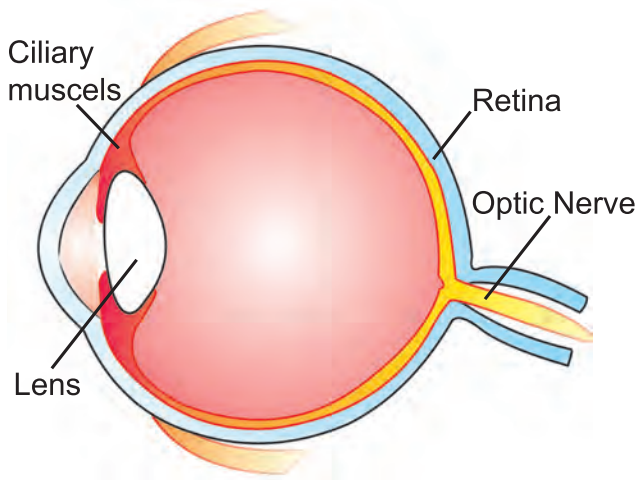
Necessary conditions for total internal reflection

1. The light must proceed from a denser medium to a rarer medium.
2. The angle of incidence in the denser medium must be greater than the critical angle.

15.5. THE HUMAN EYE – IMAGE FORMATION

The human eye has a convex lens. The convex lens of an eye forms an image of the object on the screen called the retina.The retina is covered by large number of nerve fibers sensitive to light. They carry the image by means of optic nerves to the brain.

The human eye focuses the image for different object at different distance by changing its focal length of the lens. This is done by the ciliary muscles, which stretches and relaxes to change the focal length of the lens. This action of the eye is called as power of accommodation of an eye. The most comfortable distance at which one can read with a normal eye is about 25cm. This distance is called least distance of an eye.The minimum distance at which the eye can see objects distinctly varies with age.



15.6. SOUND

We hear many types of sounds around us everyday. Each type of sound is the characteristic of the object producing it.

Sound around us - Different sounds

ACTIVITY 15.7

By observing the picture, list the various sounds produced.

1. ----------
2. ----------
3. ----------
4. ----------
5. ----------
6. ----------

ACTIVITY 15.8

Sound is produced due to vibrations in a stretched rubber band.

Take a rubber band. Put it around a pencil box. Now pluck the rubber band in the middle. Do you hear any sound? Does the rubber band vibrate? So, when it is vibrating, it produces sound.

15.6.1.SOUND NEEDS A MEDIUM FOR PROPAGATION

When you call up your friend Gopal who is standing far away,he is able to hear your voice. How does the sound travel to Gopal?

Sound can travel through solids

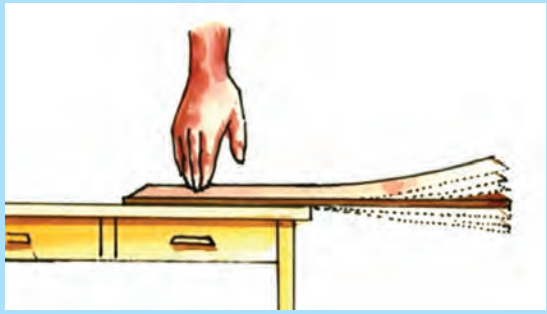
ACTIVITY 15.9

Collect a metal plate, a glass tumbler, a plastic mug, a sheet of paper, a wooden block, a cloth. Now tap them all one by one with a small stick. Do they all make same type of sound?

How is the sound produced? Vibration of bodies produce sound.

ACTIVITY 15.10

Take a scale and hold its one end firmly on the table with one hand as in the fig. Pluck the free end of the scale with your other hand. The scale begins to vibrate. Touch the scale with your finger. It stops vibrating. Does it produce any sound now?



ACTIVITY 15.11

Touch a bell when it is not in use. What do you feel? Now beat the bell with an iron rod. Again touch it when it is producing sound. Can you feel the vibration in your hand? This activity proves that sound can travel through solid.

ACTIVITY 15.12

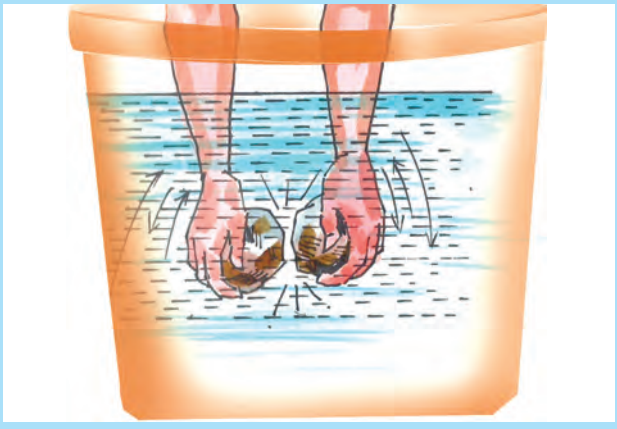
Take a wodden stick and press your ear at one end of it. Ask your friend Mani to gently tap at the other end.

You will be able to hear the sound very clearly.

ACTIVITY 15.13

Make a toy telephone by using two empty ice cream cups. Make a small hole at the bottom of each cup. Pass the ends of a string through the holes. Tie the ends to match sticks to hold them in place. Stand away, ask your friend Gopal to speak into one of the cups. Can you hear your friend's voice?.

ACTIVITY 15.14



Take two stones or marbles and beat them together. Listen the sound. Then submerge them in a bucket of water. Beat the stones or marbles under water. Listen to the sound now. Keep your ear near the bucket. The sound heard is clearer and louder when the stones are submerged in water.

- Sound travels very much faster in solids than liquid and air.

- Sound needs a medium for propagation. It cannot travel through vacuum.

ACTIVITY 15.15

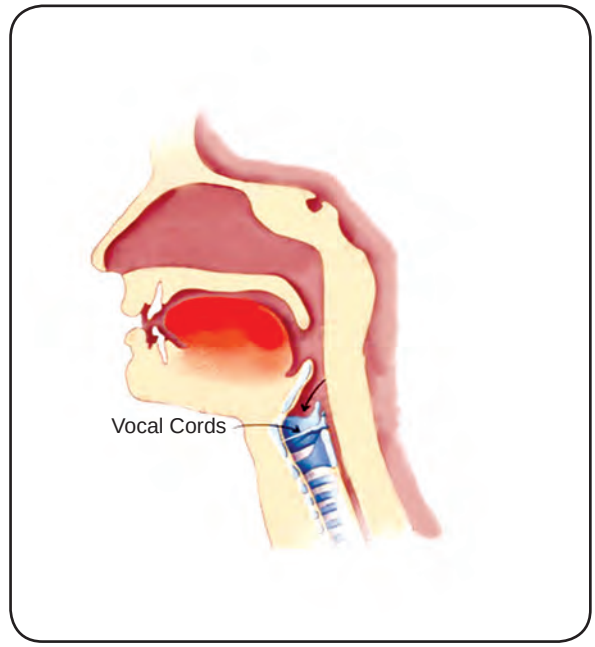
Keep a cellphone in a bell jar and set it ringing. Pump out the air from the bell jar by using a vacuum pump. As more and more air removed from the bell jar, the sound gets feebler and finally it is heard faintly, although the working of the cellphone can be seen. This shows that sound cannot travel through vacuum.

Sound plays an important role in our lives. It helps us to communicate with one another. It is difficult to communicate without talking. Every one and everything around you is making a sound.

15.6.2. Sound produced by humans

Speak loudly or sing a song or buzz like a bee.

In human beings, the sound is produced by the "Voice box" or the



MORE TO KNOW

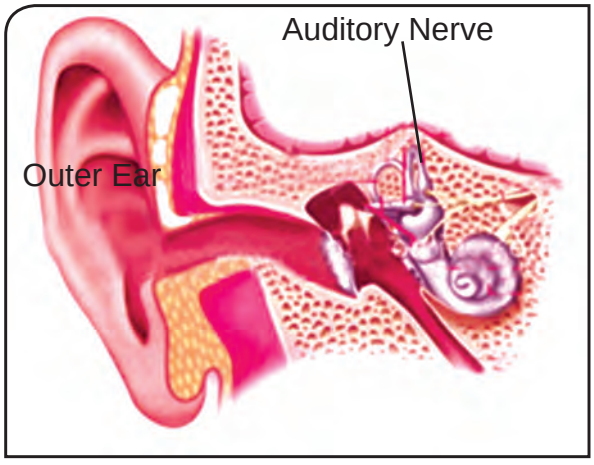
The vocal cords in men are about 20 mm long. In women, these are about 15 mm Children have very short vocal cords.

Larynx. The voice box has two "vocal cords". They are stretched across the voice box in such a way that it leaves a narrow slit between them for the passage of air. When we speak, the lungs force air through the slit and the vocal cards vibrate , producing sound.

15.6.3. Human ear and Hearing

How do we hear sound?

We know that vibrating objects produce sound which is carried in all directions through a medium. Our ears help us to hear sound. Human ear has three important parts. Only one of its parts can be seen and felt by you, which is the outer ear.



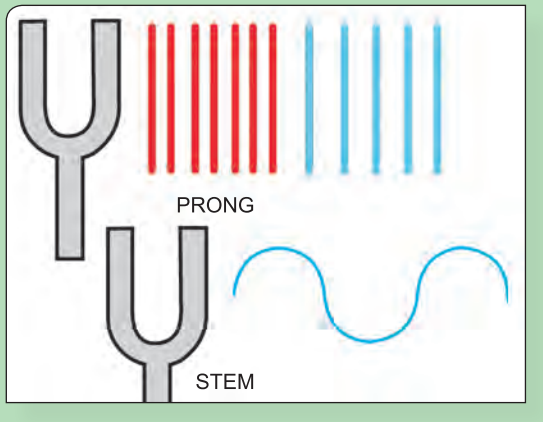
The outer ear consists of the Pinna and the ear tube. The shape of the outer part of the ear is like a funnel. When sound enters the ear, it travels down a canal at the end of which a thin membrane is stretched tightly called **"ear drum"** which performs a very important function.

The middle ear has three tiny interlocked bones. The inner ear has a coiled organ of hearing semi circular canals and the auditory nerve.

A vibrating body causes air molecules to vibrate. These vibrations reach our ear and are collected by the pinna and then funneled into the ear tube. These vibrations strike the eardrum and start vibrating. The ear drum sends vibrations to the inner ear. From there the signal goes to the brain. That is how we hear.

We must never put a sharp or hard object into our ear. It can damage the eardrum. The damaged ear-drum can impair hearing.

15.6.4. Amplitude, Time period and Frequency of a vibration



ACTIVITY 15.16

To demonstrate how vocal cords produce sound:

Take two rubber strips of the same length and width. Put them one above the other. Hold them at both ends and stretch them tight. Blow air through the slit between them. Is sound produced? The structure of vocal cords is similar.

You have learnt that to and fro motion of an object is called vibration. A tuning fork is made of steel. The two upper ends of the tuning fork are called the 'prongs', while the lower end is called the 'stem'.

Strike the prongs against a hard rubber pad and observe the vibrations. Hence, a vibrating tuning fork produces sound.

Frequency (n): The number of oscillations per second is called the frequency. Frequency is expressed by hertz – Hz

Time period (T): The time taken by the vibrating body to complete one vibration or oscillation is called the time period. The unit of period is second(s).

Amplitude (a): The maximum displacement of a vibrating body from its mean position is called amplitude. The unit of amplitude is metre (m)

The relation between frequency (n) and time period (T)

The period of oscillation is the reciprocal of the frequency.

$$T = 1/n$$

We can recognize many familiar sounds without seeing the object producing this sounds. How is it possible? These sounds must be different to enable you to recognize them.

- Amplitude and Frequency are two important properties of sound.
- The loudness of the sound depends on its amplitude.

15.6.5. Audible and Inaudible Sounds

The sounds of frequencies less than 20 vibrations per second (20 Hz) can not be heard by human

ear. They are called inaudible sounds. On the higher side 20000 Hz are also not audible to human ear.

Thus the human ear can hear the range of audible frequencies between from 20 to 20000Hz.

MORE TO KNOW

Sound waves of frequencies above 20,000 Hz are called ultrasonic waves. Bats use ultrasonics waves for their flight.

Some animals can hear the sound of frequencies higher than 20000 Hz. Dogs have this ability.

15.6.6. Noise

The unpleasant sound is called as noise. In the class room, if all the students speak together, what would the sound produced be called? It is noise.

On the other hand, you enjoy sound from musical instruments. Musical sound is one which is pleasing to the ear.

15.6.7. Noise pollution

The unwanted sound from any source that causes discomfort of any kind is called noise pollution.

Harmful effects of noise pollution

- Exposure to sudden high noise level can damage to the eardrum.
- High noise level can also lead to nervous tension and increase of blood pressure.
- It also disturbs sleep, increases stress and causes headache.

To control noise pollution

1. The use of loud speaker at functions should be stopped.
2. Cars and other vehicles should not produce loud sound.
3. T.V and Musical system should be played at low volumes.

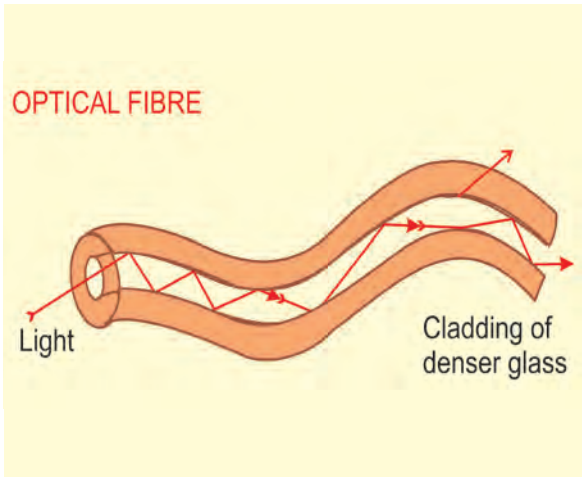
15.7. SCIENCE TODAY

An optical fiber is a device based on the principle of total internal reflection.

Optical fibers are thin, flexible and transparent strands of glass which can carry light along them very easily. A bundle of such thin fibers forms a light pipe.

When light is incident at one end of the fiber at a small angle the light that passes inside undergoes repeated total internal reflections along the fiber. The light finally comes out .

Even if the fiber is bent or twisted, the light can easily travel through the fiber. The method of using optical fibers to carry images and messages is called fiber optics



Uses of optical fibers

1. Optical fibers are used to transmit communication signals.
2. In medicine, optical fibers are used in endoscope and laporoscopes.

ACTIVITY 15.17

Observe the given picture and choose one word for each from the following words. Soft, Loud, Pleasant, Unpleasant

.....

.....

.....

.....

.....

EVALUATION

LIGHT:

1. The objects present in the dark room are not visible. But when the light is switched on, everything present in the room becomes visible.Why?
2. Identify the mistake in the statement and correct them.

   (a) The splitting of white light into its constituent colours is due to multiple reflections.

   (b) The beautiful pattern that we obtain in a kaleidoscope is because of dispersion.
3. Reflection from a smooth surface is called ———————— (Regular, Irregular)
4. If the angle of incidence is 40^0, the angle of reflection is ———————— (0^0, 40^0)

5. Match the following

a) Irregular reflection	____	Glass Slab
b) Multiple reflection	____	Optic fiber
c) Refraction	____	Periscope
d) Total Internal reflection	____	Wood

6. If Raman fixed the two mirrors at an angle of 60^0 to get as many number of images. Could you help to tell the exact number of images produced.

$$\text{Hint } n = \frac{360}{\text{angle}} - 1$$

SOUND:

1. When we touch the ringing bell we can feel the _____ (Vibrations, Air)
2. Sound cannot travel in _____ (Vacuum, Water)
3. We can hear the sound waves of frequency between 20 Hz to 20,000 Hz. This range is known as _____ sound. (audible, inaudible)

4. Correct the wrong statement:
   Unwanted noise from any loudspeaker that causes discomfort of any kind is called Music.

5. Your parents are going to buy a home. They have been offered one on the roadside and another two lanes away from the roadside. Which house would you suggest to your parents considering the peaceful life?

6. Extremely loud sound can make one deaf could you tell the reason? Mention some steps should be taken to minimize noise pollution.

7. Factories should not be constructed in the residential areas. Do you agree or not? Give reason.

8. Veena and Rani are on the moon. Veena calls out to her friend. But Rani does not hear Veena's call eventhough she is near. Why?

FURTHER REFERENCE

Books

1. Fundamentals of Physics - David Halliday, Robert Resnick, Jeart Walker, John wiley. (Sixth edition)
2. A Second course in elementary physics - C.S. Karve and G.Z. Shah.

Website

www.glenbrook.k12.i.us/gbssci/phy/sound/.com

www.glenbrook.k12.i.us/gbssci/phy/optics/planemirror.com

www.arvindguptatoys.com