Unit 2 Forces and Motion

ATSKF9

Learning Outcomes

- Identify push or pull or both is involved when there is a motion
- Understand that some forces act on contact and some are non-contact forces
- When a force is applied, it can make things move, change direction or change its shape and size
- Distinguish rest and motion and understand that they are relative
- Infer motion is caused by application of force
- Classify the different types of motion
- Deduce the definition of average speed
- Use and understand the unit of speed
- Distinguish uniform and non-uniform motion
- Compute time, distance and speed

Introduction

We had studied in our earlier classes that push or pull results in some motion of the object. When we open the door, kick a football, lift our school bag, all involve motion and there is some push or pull.

2.1 Motion and Rest

2.1.1 What is rest? What is motion?

Suppose there is a book on your table right in the middle. Is the book moving? You will say "it is not moving; it is at rest". If you push the book to one side of the table to clear space for keeping your notebook, then you will say the book is moving.

When the book was at the same place with respect to the table, you say the book was at rest; but when it was pushed from one place on the table to another place, you say it was moving.

Activity 1

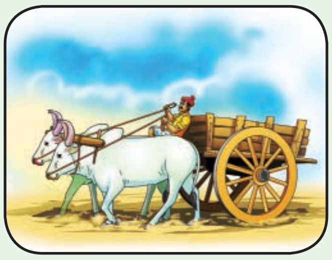
Can you identify whether it is push or pull that results in motion in the following cases?

Push / Pull

Push / Pull

Push / Pull

Push / Pull



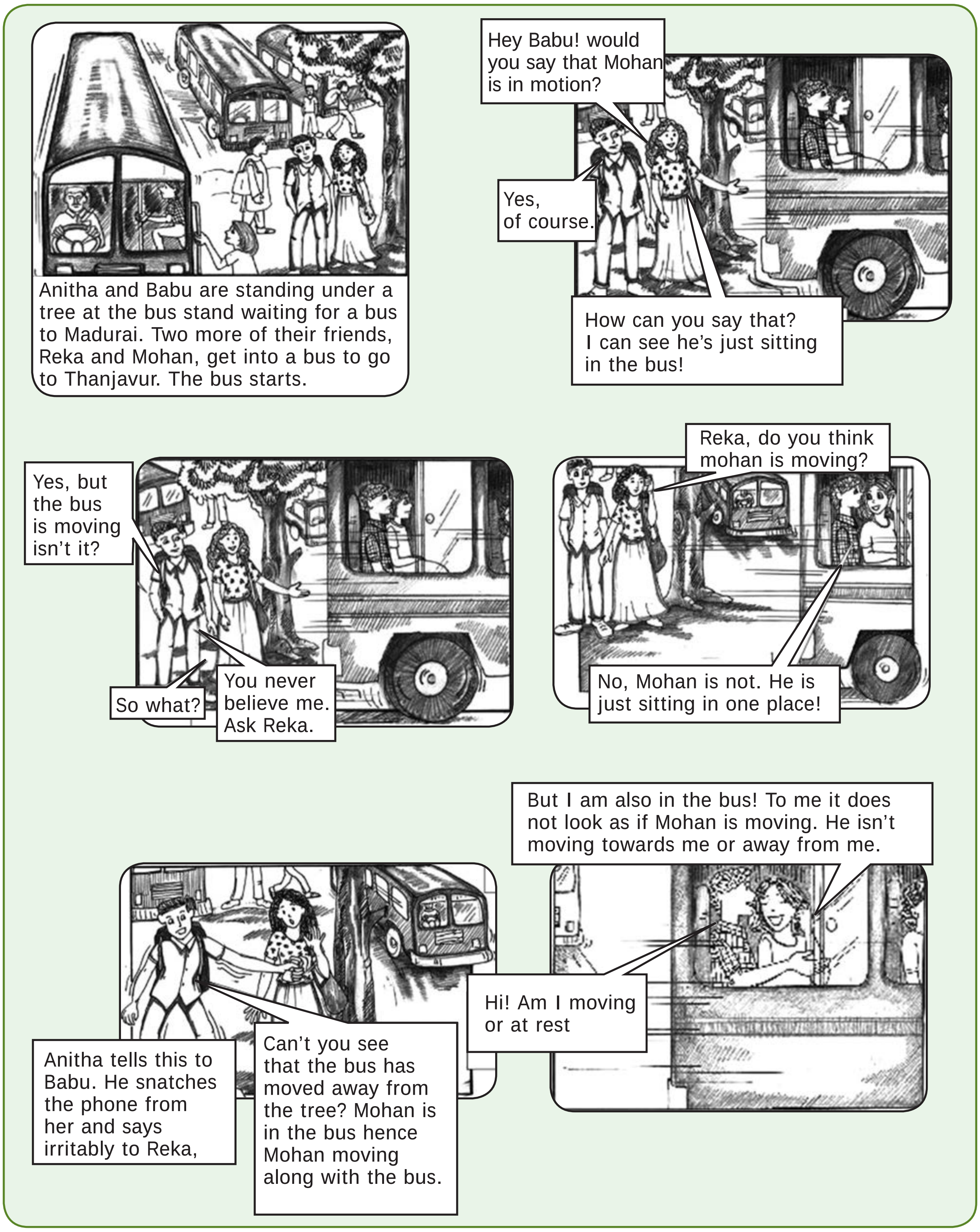
Push / Pull

Push / Pull

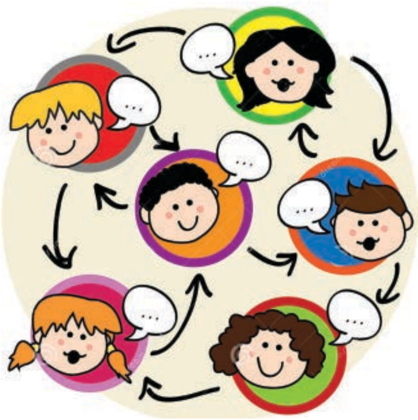
When there is a change of position of an object with respect to time, then it is called motion, if it remains stationary it is called rest.

2.1.2 Is Mohan in motion?

Observe the following pictures and say whether Mohan is in motion or at rest



Discuss: Who is correct? Is Mohan really in motion?



We can readily observe that both Reka and Babu are correct. From the point of view of Babu, Mohan along with the bus is in motion; but for Reka who is sitting beside him, he is at one place; therefore stationary. So, according to Babu, Mohan is in motion; Mohan is at rest from Reka's observation. Can you think any other examples?

Hi! Please answer honey by observing the situation in the picture

Event 1: The man in the boat is **moving** with respect to the bank of river. He is at **rest** with respect to the boat.

Event 2:

The girl on the swing is ___________ with respect to the seat of the swing.

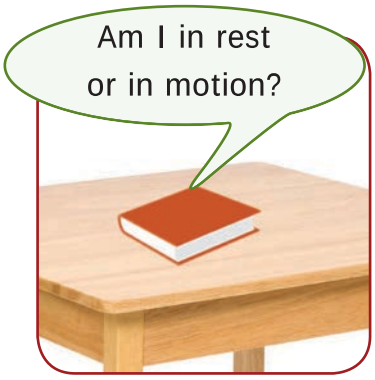
She is ________ with respect to the garden.

Event 3: Nisha is going to her grandmother's house by bicycle. The girl on the bicycle is ________________ with respect to the road.

She is ________________________________ with respect to the bicycle.

Take the case of a book on a table at rest. Is it really without any motion? We know that Earth is rotating on its axis; therefore the table along with the book must be rotating. Is it not? We are also moving along with the earth. Therefore, from the point of view of ground on which we stand, the book is at 'rest'. Similarly,

while travelling in a speeding bus, we feel that the poles and trees seem to move backwards, and the things inside the bus are stationary.



An object may appear to be stationary for one observer and appear to be moving for another. An object is at rest in relation to a certain set of objects and moving in relation to another set of objects. **This implies that rest and motion are relative.**

Activity 2

Moon or Cloud?

Observe the moon on a windy night with a fair bit of cloud cover in the sky. As a cloud passes in front of the moon you sometimes think it is the moon which is moving behind the cloud. What would you think if you were to observe a tree at the same time?

DO YOU KNOW?

Aryabatta, an ancient Indian astronomer, said that like the banks of the river appear to move back to a person in a boat floating gently in a river, the night sky studded with stars appear to move from east to west while Earth rotates from west to east. Learn more by asking others and reading up on your own.

2.1.3 How things move?

When we kick a ball it moves. When we push the book on the table, it moves. When a bullock pulls the cart moves. Motion occurs when the object is pulled or pushed by an agency.

In daily life, we pulled out water from the well, with bucket or "the animal pulls a bullock cart". It is a person or animal, that is an animate agency that does the pushing or pulling.

Sometimes we see a tall grass in the meadow dancing in the wind, a piece of wood is moving down a stream. What pushes or pulls them? We know that blowing wind and flowing water is the cause. Sometimes the push or pull can be due to the inanimate agency.

Forces are push or pull by an animate or inanimate agency.

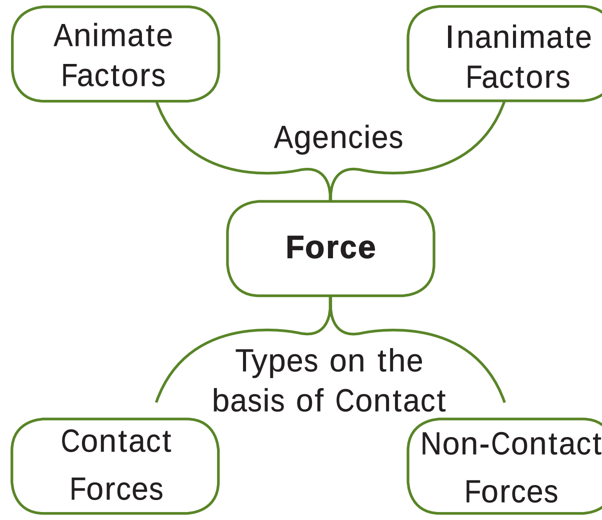
Contact, Non-Contact Forces

In all the above cases, the force is executed by touching the body. so, these type of force is called Contact Force.

Mysteriously ripen coconut falls to the ground. What pulls it to the ground? We would have heard of the 'force of gravity' of Earth. Gravity pulls the ripen coconut from the tree to the ground.

Bring a magnet near the small iron nail. Suddenly the nail jumps into the air and sticks with the magnet. Observe that the magnet and the nail did not touch each other. Still, there was a pulling force that made the nail to jump towards the magnet. In these two examples, the force is applied without touching the object. Such forces are known as "non-contact forces"

Forces can be classified into two major types; contact and non-contact forces. Wind is making a flag flutter, a cart pulled by a bullock are contact forces. Magnetism, gravity are some examples of non-contact forces.

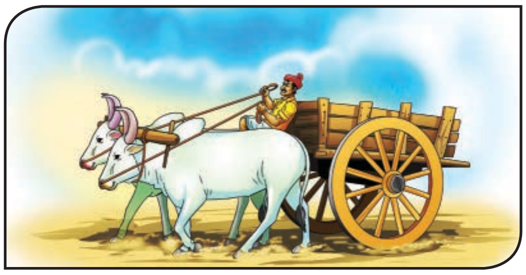


2.1.4 What happens when we apply a force on an object?

What happens when you apply a force on an object? Say you push a book on the table. The book moves. Application of force in an object results in motion from a state of rest.

What happens when a batsman hit a ball? The ball is already in motion, but with the strike, the speed of the ball increases. Moreover the direction of the ball changes. Application of force on object results in a change in its speed and change in its direction.

Crush a balloon, apply force on roti dough, pull a rubber band. In these cases the shape of the object change on application of force. Application of force in object results in expansion or contraction.



Look at this picture. The person is applying force to stop the cart from moving. When the force is applied against the direction of the motion, the speed can be reduced, or even the motion stopped completely.

Discuss what happens when you apply break in a speeding bicycle.

In a nutshell, the applied force is an interaction of one object on another that causes the second object to move from rest, or speed up, slow down, stop the motion, change the direction, compress or expand.

Forces can

1. Change the states of body from rest to motion or motion to rest.
2. Either change the speed or direction or both of the body.
3. Change the shape of the body.

Activity 3

Fill in the empty spaces

FORCE can
- move from rest
- ______
- Change the Speed
- ______
- ______
- compress or expand

Can you give example for contact and non-contact forces?

FORCES

CONTACT FORCES	NON-CONTACT FORCES
Examples	Examples
Kick a football	Magnet attracts nails
______	______

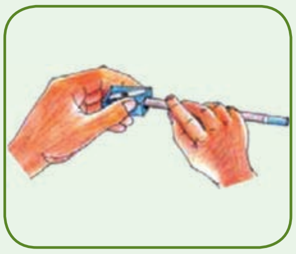
2.1.5 Types of motion

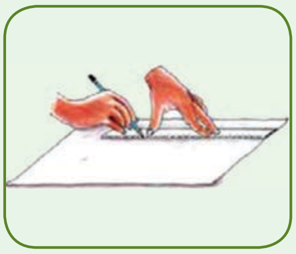
Activity 4

Play with pencil

Please do what Shanthi did...

(i) Shanthi took a pencil and sharpened it with a sharpener. (ii) Then she drew a circle using the pencil and a compass. (iii) Later she took her ruler (scale) and drew





a straight line in another paper. (iv) Then she kept the pencil between her finger and moved it back and forth.

Now, look at the motion of the pencil in all these four cases. How was it?

(i) In the first case, the pencil **rotated in its axis.**

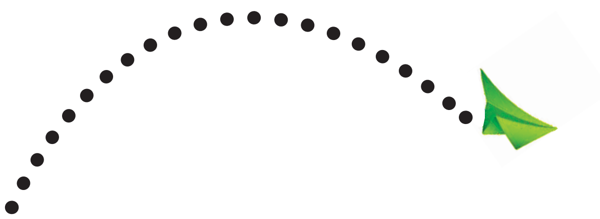
(ii) In the second case, it went in **a circle.**

(iii) In the third case, the pencil travelled in **a straight line.**

(iv) Fourth case, the pencil tip moved **back and forth,** that is it oscillated like a swing.

That is its motion was 'rotational' and then 'circular' 'straight line or linear' and later 'oscillatory'.

Throw paper aeroplanes or paper dart. Watch its flight path when you throw it at an angle. The path curves i.e the paper flight is moving ahead but direction is changing while moving such paths are called curvilinear.



2.1.6 Periodic and non-periodic motions

A fly buzzing around the room is a combination of all these and flight path is zigzag.

You can classify the motion according to the path taken by the object.

a. Linear- moving in a straight line, like a person walking on a straight path, free fall.

b. Curvilinear - moving ahead but changing direction, like a throwing ball.

c. Circular -moving in a circle, swirling stone tied to the rope.

d. Rotatory -The movement of a body about its own axis, like a rotating top.

e. Oscillatory -coming back to the same position after a fixed time interval, like a pendulum.

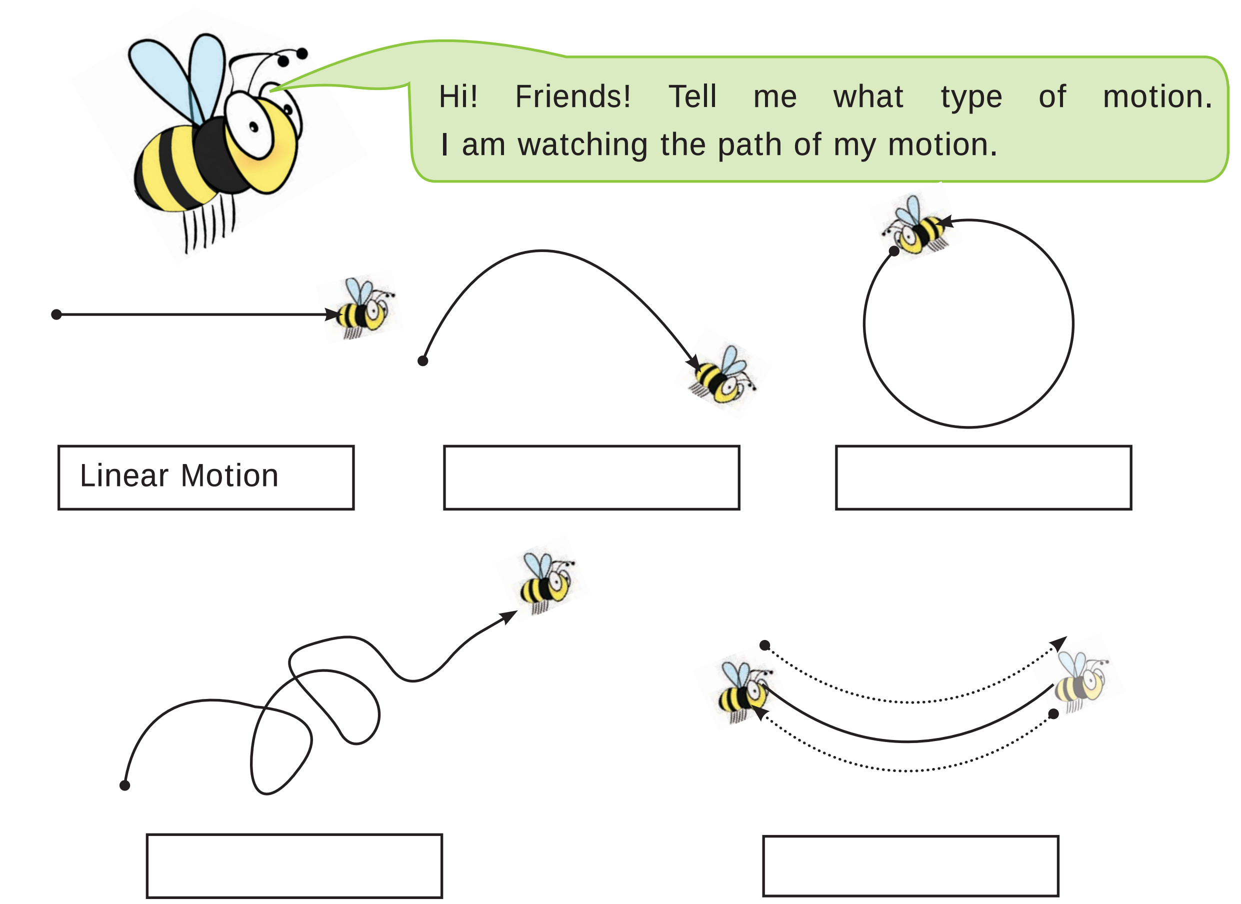
f. Zigzag (irregular)- like the motion of a bee or people walking in a crowded street.

Oscillations at Greater Speed

Ask your friend to hold the two ends of a stretched rubber band. Strike it in the middle. Do you see it oscillates very very fast? When the oscillation is very swift, it is called as vibration.

Fast oscillations are referred to as vibrations.

Activity 5



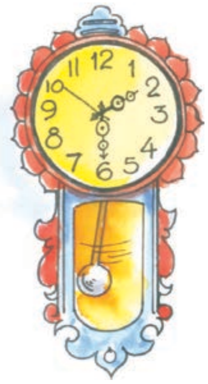
Activity 6

Classify the following according to the path it takes.

Linear ,Curvilinear, Circular,Rotatory,Oscillatory, Zigzag (irregular)

• A sprinter running a 100 m race	
• A coconut falling from a tree	
• striking a coin in a carom board game	
• Motion of flies and mosquitoes	
• Beating of heart	
• Children playing in a swing	
• The tip of hands of a clock	
• Flapping of elephant's ears	
• A stone thrown into the air at an angle	
• Movement of people in a bazaar	
• Athlete running around a track	
• Revolution of the moon around the earth	
• The movement of a ball kicked in a football match	
• Motion of a spinning top	
• Revolution of the earth around the sun	
• Swinging of a pendulum	
• Children skidding on a sliding board	
• Skidding down a playground slide	
• Wagging tail of a dog	
• Flapping of a flag in wind	
• A car driving around a curve	
• Woodcutter cutting with a saw	
• Motion of water wave	
• Motion of piston inside a syringe	
• Bouncing ball	
[add five motions you observe to this list]	

2.1.7 Speed Vs Slow ?



Take the case of the hour-hand of a clock. In one day it makes two rounds. Look at a bouncing ball. It bounces a certain number of times for a given time interval or period. Look at the water waves, in a given period that is a time interval; a fixed number of waves hit the shore.

Motion repeated in equal intervals of time is called as periodic motion.

Let us take the example of sabing swing in wind. This motion is not in uniform interval. Such Motions are called non-periodic motion.

Can you notice an interesting fact?

Do you notice that all oscillatory motions are periodic, but not all periodic are oscillatory?

Revolution of the moon around the earth is periodic but not oscillatory. However, the children playing in a swing is both periodic and oscillatory.

Look at the tall tree. When the wind is gentle, its branches are dancing slowly; but if the gentle wind becomes strong, the branches shake violently, and if the speed increases further, the branch may even break and fall. That is the motion can be slow or fast.

Can we say a motion is slow or fast without comparing anything?

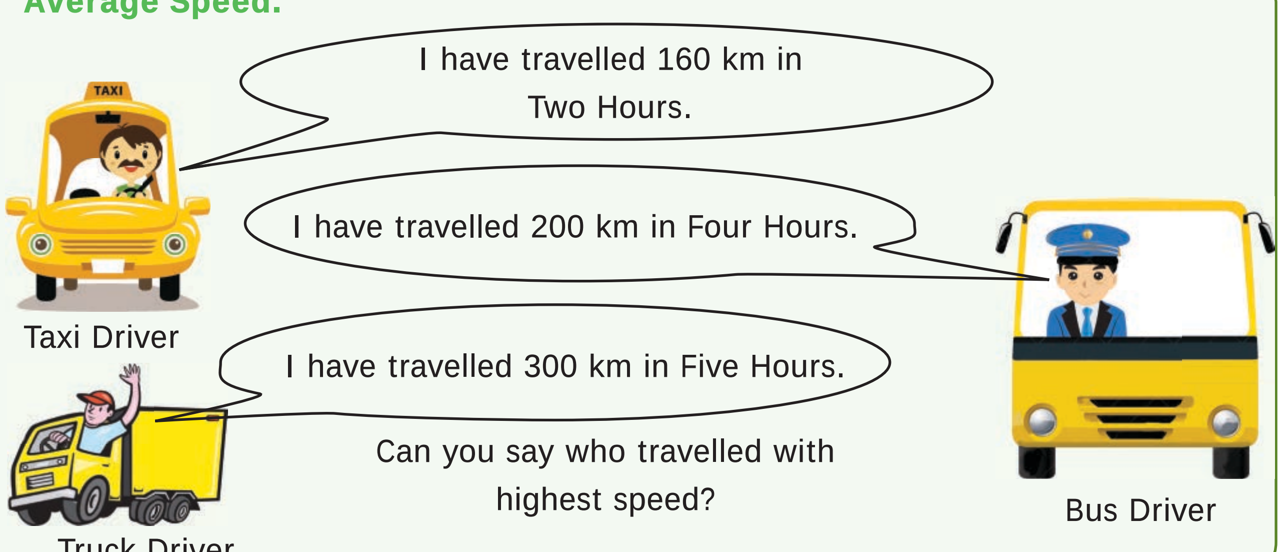
Compared to walking, cycling is fast, but a bus is faster than a cycle.

The aeroplane is much faster than a bus.

So, slow or fast is a relative concept which depends upon the motions we are comparing.

Then how to we say a body moves in a particular Speed?

Average Speed.



Can you say who travelled with highest speed?

How do we say? Let us calculate how long they travelled in One Hour?

Distance travelled by the Car in One Hour = ___80___ Km (160/2)

Distance travelled by the Bus in One Hour = __________ Km

Distance travelled by the Truck in One Hour = __________ Km

Have you found out? say now.

Fastest ________, Slowest __________

Have you noticed that saying who is fast and slow? is easy when we calculate the distance they travelled in one hour.

> The distance travelled by an object in unit time is called average speed of the object.
>
> If an object travelled a distance (d) in time (t) then its
>
> Average speed (s) is = distance travelled / time taken = d/t.

In other words, you divide the distance travelled by the time taken to get the speed.

Suppose a car travels 300 km in one hour. Then we say the speed of the car is '300 kmph' (we read it as 'three hundred kilometres per hour').

If an object travelled 10 metre in 2 seconds, then

Average speed (s)

= distance travelled (d) / time taken (t)

= 10 metre/ 2 second

= 5 metre / second

bus takes three hours to cover this distance of 180 kilometres. Then its average speed is

Average speed (s)

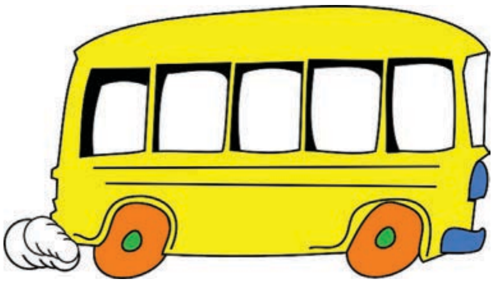
= distance travelled (d) / time taken (t)

= 180 kilometre/ 3 hour

= 60 kilometre / hour

Please note that metre/second or kilometre/hour comes next to our answer for average speed. What is it?

Observe the formula for average speed. If we denote the distance in metre and time by seconds then the unit of average speed is metre/second.



If we denote the distance in kilometre and time in hour then the unit of average speed is kilometre/hour.

Some times we use units like centimetre/second.

In science we generally use SI units. In SI units the unit of distance is metre and the unit of time is second. So, the SI unit of average speed is metre/second.

Let us Calculate

1. A cat travelled 150 metres in 10 seconds, what is its average speed?
2. Priya ride her bicycle 40 km in two hours. what is her average speed?

Our Speed...

Let us play a small game. Go to the playground with your friends. Mark 100 metre distance for a race. Conduct a friendly running race and calculate the time they taken to complete the distance by stopwatch. Now fill up the following table.

S. No	Name of the student	distance	Time taken (in seconds)	average speed = distance travelled/ time taken	average speed (m/s)
1	Murugesan	100 m	12 sec	100 metre / 12 sec	8.3 m/s
2		100 m			
3		100 m			
4		100 m			
5		100 m			

Usain Bolt crossed 100metre in 9.58 seconds and made a world record. If you have the hope to run in a speed above that speed. Then Olympic Gold Medal is waiting for you.

DO YOU KNOW?

If you know the speed and the time taken by the object travelled, then we can compute how much distance it had travelled?

Speed = distance travelled / time taken

(s = d/t)

s = d/t or st = d

therefore the distance travelled is speed × time.

If a ship travelled at a speed of 50 kmph and it sailed for five hours, how much distance it had travelled.

s = 50 kmph; t = 5 therefore

s × t = 50 kmph × 5 h = 250 km

If we know the speed and distance travelled we can compute the time taken.

s = d/t that is t = d/s

time taken = distance travelled / speed

Suppose a bus travels at a speed of 50 kmph and has to cover a distance of 300 km. How much time will it take?

t = d/s that is 300 km/50 kmph = 6 h.

Compute the following Numerical Problems.

1. If you travel 10 kilometres in 2 hours, your speed is ______ km per hour.
2. If you travel 15 kilometres in 1/2 hour, you would travel ______ km in one hour, and your speed is ______ km per hour.
3. If you run fast at 20 kilometres per hour for 2 hours, you will cover ______ km

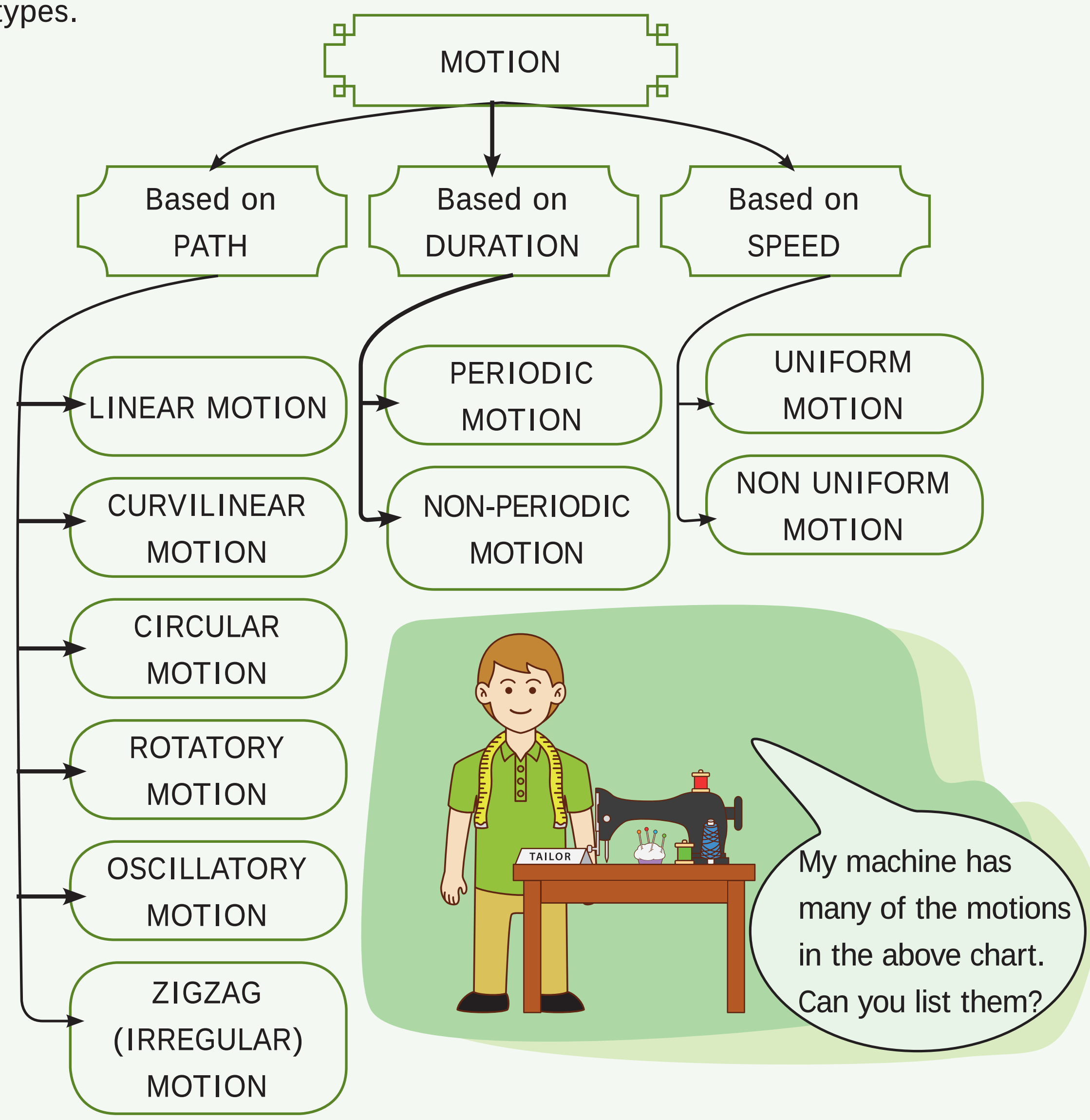
FACT FILE

A Cheetah is the fastest land animal running with an average speed of 112 km/h

2.1.8 Uniform and non-uniform motion

Suppose a train leaves Thiruchirapalli and arrives at Madurai. Is the train travelled in an uniform speed? First, the train was stationary. When the train left the station, the motion was slow and only after it left some distance that it gathered speed. After that it slowed down while crossing bridges and stop at intermediate stations for passengers. Finally, as the train approached Madurai, again, it slowed and finally came to a halt. That is the speed was not same all through the journey time. That is the speed was non-uniform. This motion is said to be non-uniform motion.

In a nutshell, we can classify the motion in terms a) path b) if it is periodic or not c) if the speed is uniform or not. However, in real life, the motions are combinations many types.



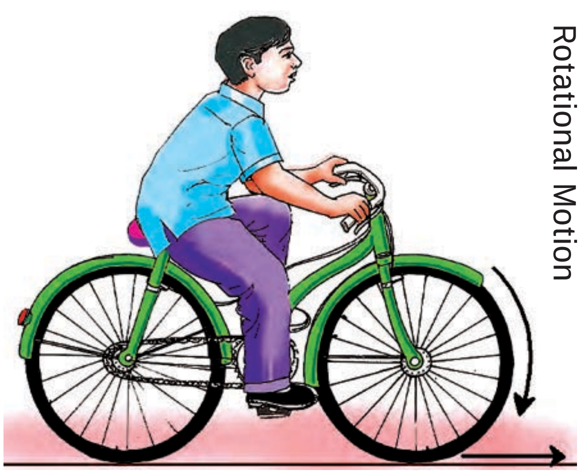
However, in between the journey, there may have a stretch where in the train might have been going at a constant speed. During that interval the train was moving at uniform speed, that is uniform motion.

If an object covers uniform distances in uniform intervals then the motion of the object is called Uniform Motion. Otherwise the Motion is called Non-Uniform Motion.

Many motions we see in our day to day life are non-uniform. We will learn more about uniform and non-uniform motion in later classes.

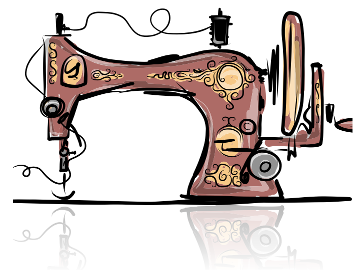
Multiple Motion

Look at the bicycle. What type of motion does the wheel perform? What type of motion does the cycle in total perform?



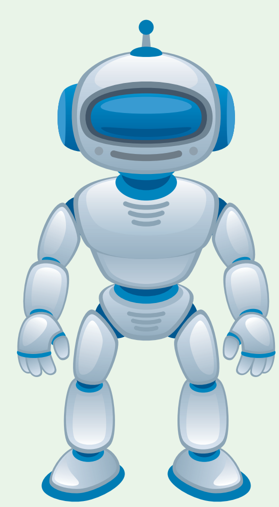
The tyres rotate and make a rotatory motion, but the cycle as such moves forward in a linear path.

Multiple Motion in a Sewing Machine



- Motion of the needle
- ____________ ____________
- Motion of the wheel
- ____________________
- Motion of footrest
- ____________________

2.2 Science Today - Robot



A bipedal humanoid robot.

Robots are automatic machines. Some robots can perform mechanical and repetitive jobs faster, more accurately than people. Robots can also handle dangerous materials and explore distant planets. The term comes from a czech word, 'robota' meaning 'forced labour'. Robotics is the science and study of robots.

What Can Robots Do?

Robots can sense and respond to their surroundings. They can handle delicate objects or apply great force-for example, to perform eye operations guided by a human surgeon, or to assemble a car. With **artificial intelligence**, robots will also be able to make decisions for themselves.

How Do Robots Sense?

The quadrupedal military robot

Electronic sensors are a robot's eyes and ears. Twin video cameras give the robot a 3-D view of the world. Microphones detect sounds. Pressure sensors give the robot a sense of touch, to judge how hard to grip an egg. Heavy luggage built-in computers send and receive information with radio waves.

Artificial Intelligence

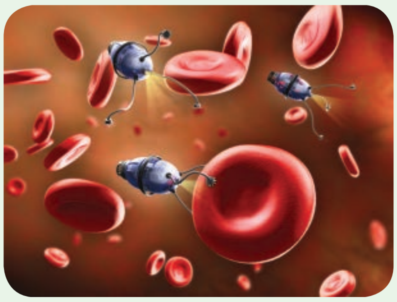
Artificial intelligence attempts to create computer programs that think like human brains. Current research has not achieved this, but some computers can be programmed to recognize faces in a crowd.

Can Robots Think?

Articulated welding robots (industrial)

Robots can think. They can play complex games, such as chess, better than human beings. But will a robot ever know that it is thinking? Humans are conscious-we know we are thinking-but we don't know how consciousness works. We don't know if Robots can ever be conscious.

Nanorobotics



Future of Nanorobotics

Nano-robots or nanobots are robots scaled down to microscopic size in order to put them into very small spaces to perform a function. Future nanobots could be placed in the blood stream to perform surgical procedures that are too delicate or too difficult for standard surgery. Imagine if a nanobot could target cancer cells and destroy them without touching healthy cells nearby.

Summary

- Motion and rest are relative.
- All things that are at rest can be seen as in motion from a different point of view, and all motion can be seen as rest from a different perspective.
- Application of forces is implemented by a push or pull. Forces can be applied by animate as well as inanimate agency.
- Application of forces result in motion from rest, increase or decrease in speed, change in direction, and distortion of the shape.
- Some forces act only in contact; there are some which can even effect at a distance.
- Average speed = distance travelled / time taken (s= d/t)
- The motion can be classified according to the path, periodic or non-periodic as well as if the speed is uniform or non-uniform.
- Unit of speed is m/s.

Activity 7

Simple Spinner

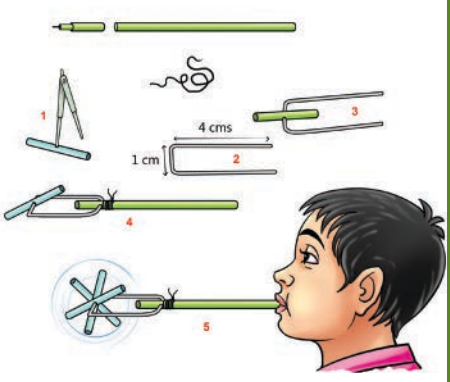
Let us enjoy by making a simple spinner. Make it by the following instruction.

Cut a 2cm long piece from an old ball-pen refill and make a hole in its center with a divider point (Fig 1).

Take a thin wire of length 9cm and fold it into a U-shape (Fig 2).

Weave the refill spinner in the U-shaped wire (Fig 3).

Wrap the two ends of the wire on the plastic refill, leaving enough clearance for the spinner to rotate (Fig 4).



On blowing through the refill, the spinner rotates (Fig 5).

For obtaining maximum speed adjust the wires so that air is directed towards the ends of the spinner.

Have you enjoyed with simple spinner. Do you observe the motions in the toy. Can you answer the following question?

1. Motion of the air in tube is _____________ motion.
2. Motion of the refill stick _____________ motion.
3. The toy converts _____________ motion into _____________ motion.

Think

In simple spinner linear motion is converted in to rotatory motion. Can you make a toy which converts rotatory motion into linear motion.

You will enjoy this activity also. This will let you to understand how steam engine works.

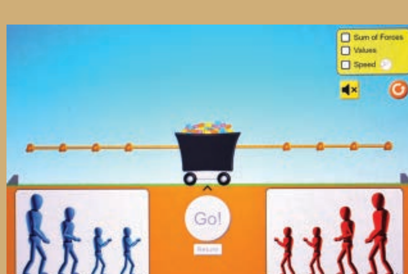
ICT CORNER

Force and motion

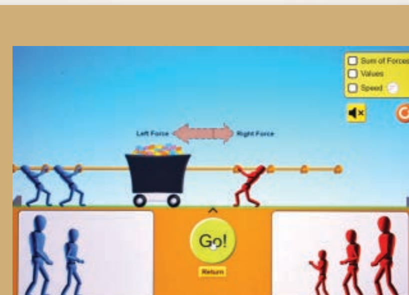
Play with force and motion.

Steps:

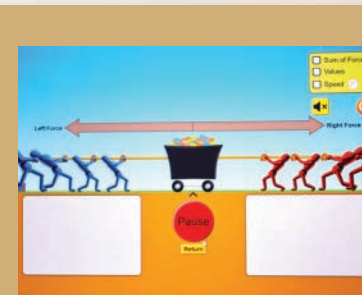
- Lets learn force and motion on **PhET** in Google browser. Download and install.
- Drag any one side and place him in the knot portion of the rope. Now click **go**.
- If placed on the right side then the load will move in that direction. The place of the man and the number of man can be changed. The direction of force and the unit of force will display on the screen.
- If we place equal number of men on both the sides the load will not move.
- By changing the number of men the strength of force can be changed.



Step1



Step2



Step3

URL:

https://phet.colorado.edu/en/simulation/forces-and-motion-basics

Pictures are indicative only

Evaluation

I. Choose the correct answer

1. Unit of speed is

   a. m b. s c. kg d. m/s

2. Oscillatory motion among the following is

   a. Rotation of the earth about its axis

   b. Revolution of the moon about the earth

   c. To and fro movement of a vibrating string

   d. All of these.

3. The correct relation among the following is

   a. Speed = distance × time

   b. Speed = distance / time.

   c. Speed = time / distance

   d. Speed = 1 / (distance × time)

4. Gita rides with her father's bike to her uncle's house which is 40 km away from her home. She takes 40 minutes to reach there.

   Statement 1 : She travels with a speed of 1 km / minute.

   Statement 2 : She travels with a speed of 1 km/hour

   a. Statement 1 alone is correct.

   b. Statement 2 alone is correct.

   c. Both statement 1 and 2 are correct.

   d. Neither statement 1 nor statement 2 is correct.

II . Find whether the following statements are true or false. - if false give the correct answer

1. To and fro motion is called oscill tory motion.
2. Vibratory motion and rotatory motion are periodic motions.
3. Vehicles moving with varying speeds are said to be in uniform motion.
4. Robots will replace human in future.

III. Fill in the blanks

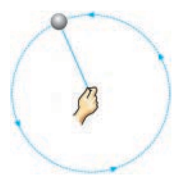
1. A bike moving on a straight road is an example of ___________ motion.
2. Gravitational force is a ______ force.
3. Motion of a potter's wheel is an example of __________ motion.
4. When an object covers equal distances in equal interval of time, it is said to be in ______ motion.

IV. Match the following

1.  a. Circular motion

2.  b. oscillatory motion

3.  c. linear motion

4.  d. rotatory motion

5.  e. linear and rotatory motion

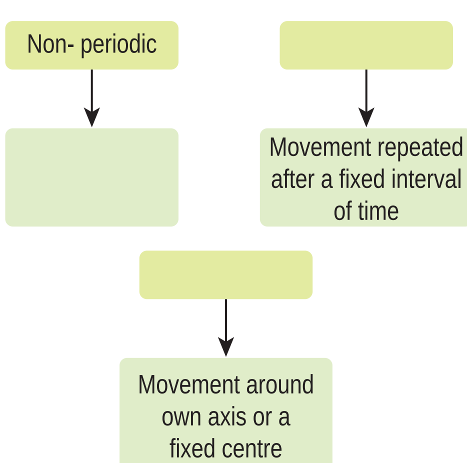
V. Analogy

1. kicking a ball : contact force :: falling of leaf : _______?
2. Distance : metre :: speed : ______ ?
3. circulatory motion :: a spinning top :: oscillatory motion : ___________?

VI Given below is the distance-travelled by an elephant across a forest with uniform speed. Complete the data of the table given below with the idea of uniform speed.

Distance (m)	0	4		12		20
Time (s)	0	2	4		8	10

VII Complete the web chart



VIII Give one word for the following statements

1. The force which acts on an object without Physical contact with it.
   ____
2. A change in the position of an object with time.
   ____
3. The motion which repeats itself after a fixed interval of time.
   ____
4. The motion of an object travels equal distances in equal intervals of time. ______________________
5. A machine capable of carrying out a complex series of actions automatically. ________________

IX Answer the following in a sentence or two

1. Define force.
2. Name different types of motion based on the path.
3. If you are sitting in a moving car, will you be at rest or motion with respect ur friend sitting next to you?
4. Rotation of the earth is a periodic motion. Justify.
5. Differentiate between rotational and curvilinear motion

X. Calculate

1. A vehicle covers a distance of 400km in 5 hour. Calculate its average speed.

XI. Answer in detail:

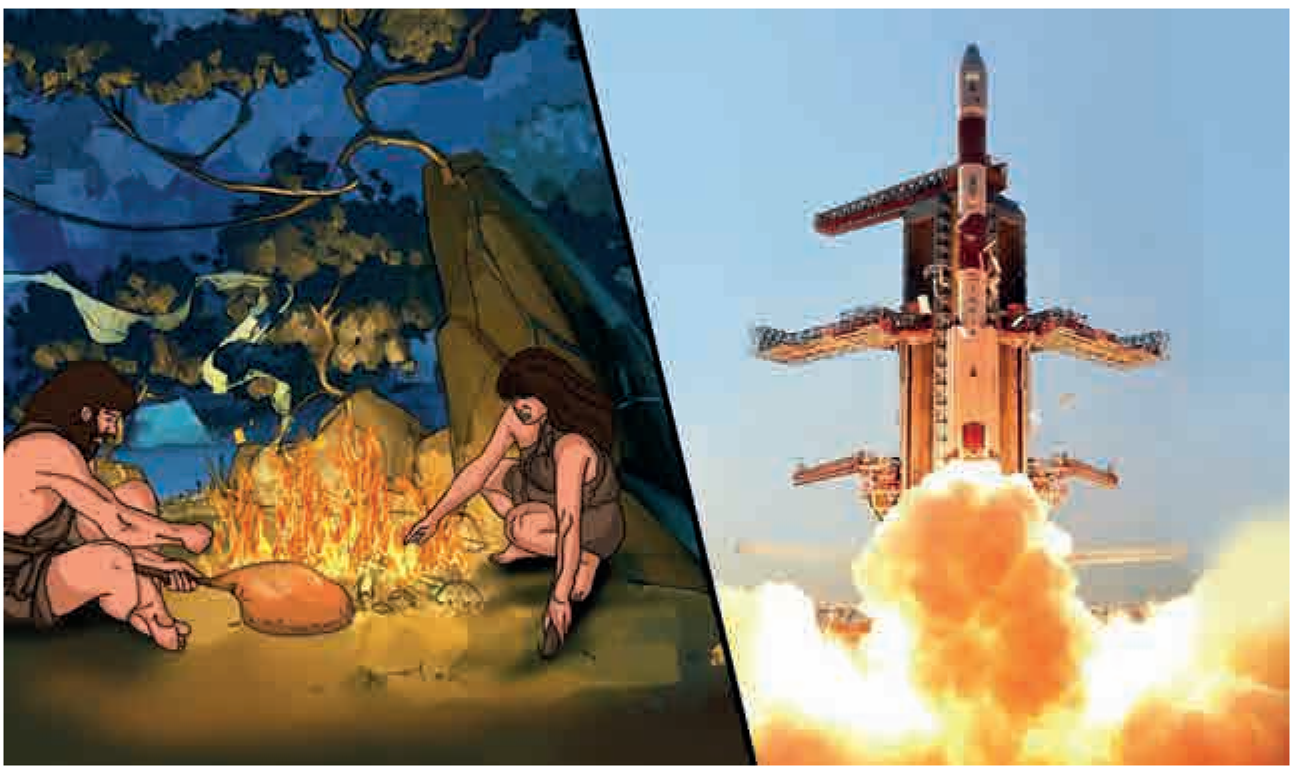
1. What is motion? Classify different types of motion with examples.

XII. Fill with examples

Linear motion	
Curvilinear motion	
Self rotatory motion	Motion of wheel in a cart
Circular motion	
Oscillatory motion	
Irregular motion	

Unit 1 Heat

A14BJX



Learning Objectives

- To list out the sources of heat
- To define heat
- To distinguish hot and cold objects
- To define temperature
- To differentiate heat and temperature
- To understand the conditions for thermal equilibrium
- To understand why thermal expansion take place in solids
- To list out the practical applications of thermal expansion in day - to - day life

Introduction

We are all familiar with heat. We feel it on our body when the sun shines, we use heat for cooking our food, We reduce the heat by adding ice cubes while preparing fruit juice. Let us learn about sources of heat.

1.1 Sources of heat

❖ **Sun**

We all know that the sun gives us light. Does it give us heat? After standing under the sun light for some time, touch your head. Does it feel hot? Yes, it feels hot because the sun gives out heat besides light. Now, You can understand why it is difficult to walk bare-footed on sunny days in the afternoon.

❖ **Combustion (Burning)**

Heat energy can be generated by the burning of fuels like wood, kerosene, coal, charcoal, gasoline/petrol, oil, etc., In your home, how do you get heat energy to cook food?

❖ **Friction**

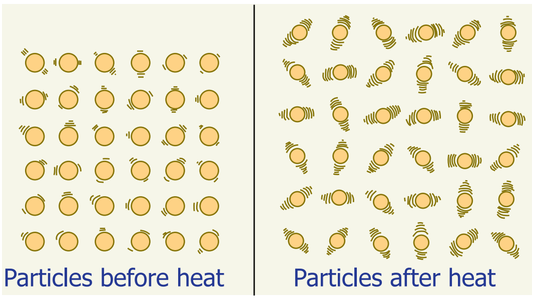
Rub your palms for some time and then hold them to your cheeks. How do you feel? We can generate heat by rubbing two surfaces of some substances. In the past people used to rub two stones together to light fire.

❖ **Electricity**

When electric current flows through a conductor, heat energy is produced. The water heater, iron box, electric kettle etc., work on this principle.

1.2 Heat

Molecules in objects are constantly vibrating or moving inside objects. We cannot see that movement with our naked eye. When we heat the object this vibration and movement of molecules increases and temperature of the object also increases.



Thus, **Heat is an energy that raises the temperature of a thing by causing the molecules in that thing to move faster.**

Heat is not a matter. It doesn't occupy space. It has no weight. Like light, sound and electricity, heat is a form of energy.

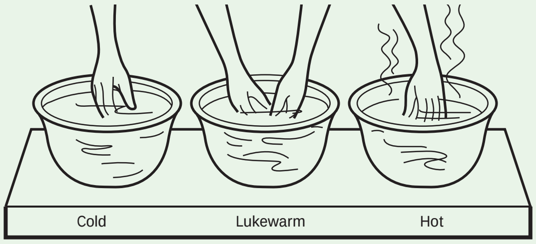
In short, Heat is the total kinetic energy of constituent particles of objects. **SI Unit of Heat is joule**. The unit calorie is also used.

1.3 Hot and cold objects

In our day-to-day life, we come across a number of objects. Some of them are hot and some of them are cold. How do we decide which object is hotter than the other?

We use the tip of our finger to find out whether the tea in a cup has enough heat to drink or whether milk has been cooled enough to set for making curds. We often determine heat by touching the objects. But is our sense of touch reliable?

Activity 1: Take three bowls. Pour very cold water in the first bowl. (you can also add ice cube for cooling). Place luke warm water in the second. Half fill the third with hot water (-not hot enough to burn!) Set them in a row on the table, with the lukewarm water in the center. Place your right hand in the cold water, and your left hand in the hot water. Keep them in for a few minutes. Then take them out, shake off the water and put both into the middle bowl. How do they feel?



Priya says,"My right hand tells me that the water in the bowl is hot and the left hand tells me that the same water is cold."

Write down in your own words what do you experience? Discuss in the class why this happens.

____

____

When you placed your left hand in the hot tub, the heat from the bowl made the molecules on your hand vibrate faster. When you keep the same hot hand in the second bowl the vibrations transferred from your hand to make the particles in the water vibrate. Therefore you feel loss of heat and hence your hand feels cold.

In the same way, your right hand which was placed in cold water, feels hot when you insert it into the lukewarm water. Because it takes heat energy from lukewarm water.

So, the same lukewarm water gives your hands different feeling according to the temperature of your hand. **Measuring temperature by touching is not correct.**

Thermometers are used to measure temperature accurately and quantitatively.

1.4 Temperature

Definition of Temperature

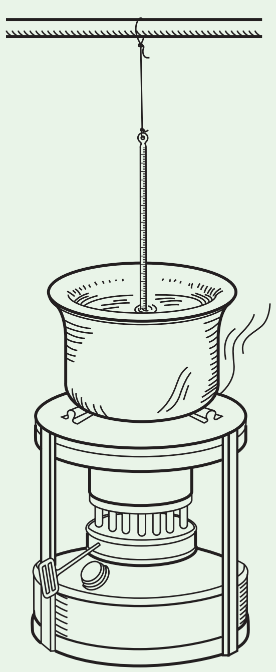
The measurement of warmness or coldness of a substance is known as its Temperature.

SI unit of temperature is kelvin. Celsius and Fahrenheit are the other units used. Celsius is called as Centigrade as well.

It determines the direction of flow of heat when two bodies are placed in contact.

Activity 2: The Temperature of Boiling Water

Take water in a vessel and place the vessel on a stove. Fix the thermometer as shown in figure (Caution: The thermometer should not touch the vessel in which the water is being heated. Otherwise the thermometer will be broken at high temperature.)



All students have to read the temperature of the water and note the reading on the blackboard. Do you notice that the temperature is raising?

What is the temperature of water when it is boiling? ________________

Does the temperature of the boiling water rise further after that? ____________

When boiling water is heated for some time, the water continues to receive more heat, but it's temperature does not rise further. The point at which the water boils and temperature becomes stable is called the **boiling point** of water.

Guess and Write:

(Check your assumption with the help of a thermometer.)

❖ Approximate temperature of the tea when you drink ____________

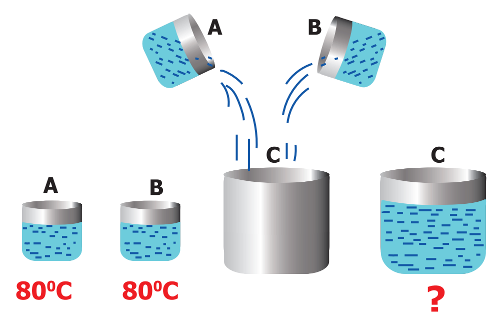
❖ Approximate temperature of cool lemon juice when you drink ____________

Normally, the room temperature of water is approximately 30°C. When we heat water, its temperature raises and it boils at 100°C. If we cool the water, it freezes at 0°C.

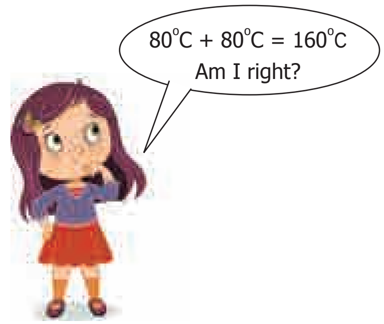
(Note : you have to say 30°C as 30 degree celsius or 30 degree centigrade)

Is Neela correct?

Beaker A and B has water at 80° C.



Then pour the water of A and B to an empty beaker C. Now, What is the temperature of the water in the beaker C? Neela says it will be 160°C.



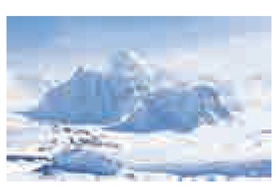
What is your opinion? Does Neela say correctly? Make a guess and verify it experimentally.

____

____

DO YOU KNOW?

One day in 1922, the air temperature was measured at 59°C in the shade in Libya, Africa. The coldest temperature in the world was measured in the Antarctic continent. It was approximately – 89°C. The minus sign (–) is used when the temperature falls below the freezing point of water, which is 0°C. If water becomes ice at 0°C, you can imagine how cold – 89° C would be. Our normal body temperature is 37°C. Our body feels cool if the air temperature is around 15 to 20 degree Celsius.



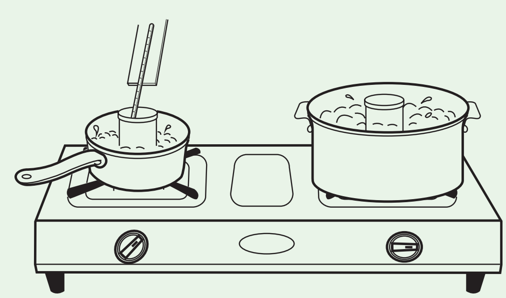
Can you estimate the night temperature in your village or city during winter?

1.5 Heat and Temperature

Heat and temperature are not the same thing, they in fact mean two different things;

- ❖ Temperature is related to how fast the atoms or molecules move or vibrate within the substance.
- ❖ Heat not only depends on the temperature of the substance but also depends on how many molecules are there in the object.
- ❖ Temperature measures the average kinetic energy of molecules. Heat measures the total Kinetic Energy of the molecules in the substance.

Activity 3: Take one litre water in a pan, and heat it on a stove. Calculate the time taken to start boiling. (i.e. the time taken to thermometer reading goes up to 100°C). Take five litre water in another pan and heat it on the same stove. Calculate the time taken by the water to start boiling.



In which pan the water starts to boil earlier?

- ☐ One litre water
- ☐ Five litre water.

Both, however, show a temperature of 100°C at the boiling point. Five litre water takes more time to boil i.e. more heat is needed to boil the larger amount of water. So, five litre boiling water has more heat energy than one litre water.

Place an open can of lukewarm water in each pan. Observe their temperature to find out which can gets hotter.

In which can water shows quick rise in temperature?

- ☐ Can in One litre boiled water
- ☐ Can in five litre boiled water.

You can see that, five litre water pan will raise the can of water to a higher temperature. Though, both pans of boiling water have the temperature of 100°C the five litre water can give off more heat energy than one litre water. Because it has more heat energy, and gives more energy to the water in the can.

Total heat is measured by **calorie,** the amount of heat needed to raise one gram of water by one degree centigrade.

❖ **Which has more heat energy in each pair? Put ✓ mark.**

Let Us Think

Pavithra is having tea while watching the pond near her house. Surely, tea is in higher temperature than the water in the pond. Now, a question is arising in Pavithra's mind. Which one has more heat energy, a cup of tea or the water in the pond? What do you think? ______________________________

____

____

____

Even though the temperature of the tea is higher than that of pond water, the volume of the water in pond is very high, hence the amount of molecules in the water in the pond is higher than the tea in the cup. So, pond has more heat energy than tea cup.

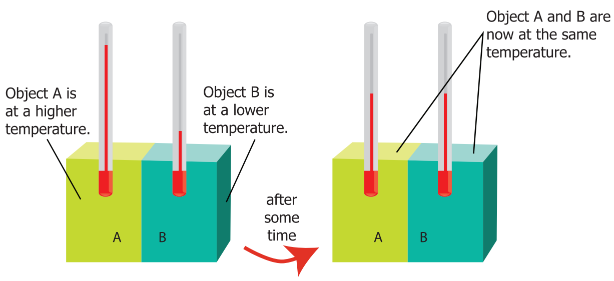
1.6 Flow of Heat

A17Y8U

An analogy between temperature and water level:

Water **'flows'** when there is a difference in the **'levels'** of water in different places. It does not matter if there is more water in one place or another. Water from a puddle can flow into a reservoir or the other way around. The **'temperature'** of an object is like the water level – it determines the direction in which **'heat'** will flow. Heat energy flows from higher temperature to lower temperature.

Thermal contact and Thermal equilibrium

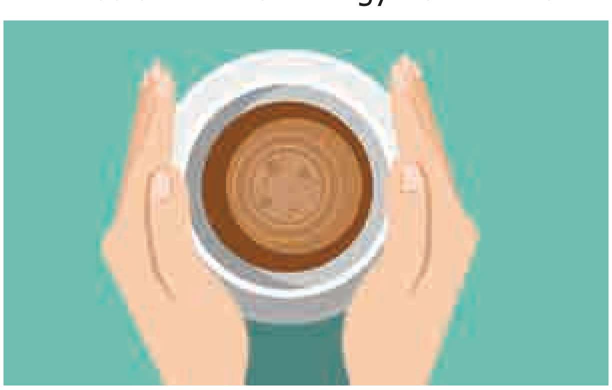


▲Two objects at different temperatures are put together

Consider two bodies A and B. Let the temperature of A be higher than that of B. On bringing bodies A and B in contact , heat will flow from hot body A to the cold body B. Heat will continue to flow till both the bodies attain the same temperature.

The temperature determines the direction of flow of heat.

1. You are holding a hot cup of coffee. Would the Heat energy transfer from



   a. Your body to the coffee, or

   b. The coffee to your body?

2. You are standing outside on a summer day. It is 40°C outside (note that normal body temperature is 37°C). Would the Heat energy transfer from.

   a. Your body to the air particles, or

   b. The air particles to your body?

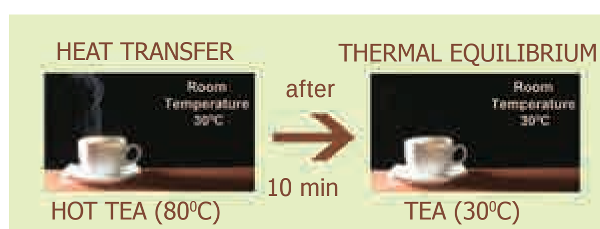
3. You are standing outside on a winter day. It is 23°C outside. Would the heat energy transfer from:

   a. Your body to the air particles, or

   b. The air particles to your body?

Two objects are said to be in **thermal contact** if they can exchange heat energy. **Thermal equilibrium** exists when two objects in thermal contact no longer affect each other's temperature.

For example, if a pot of milk from the refrigerator is set on the kitchen table, the two objects are in thermal contact. After certain period, their temperatures are the same, and they are said to be in thermal equilibrium.

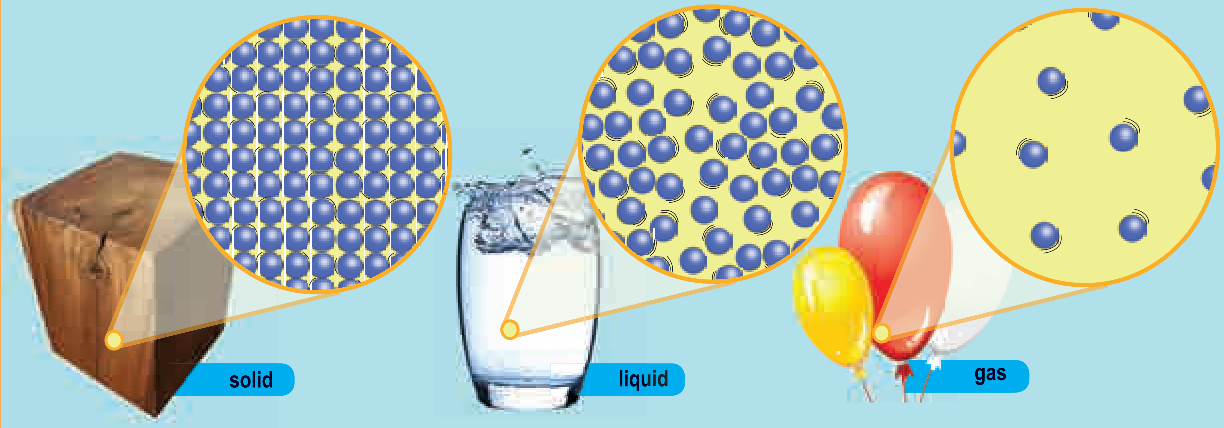


1.7 Expansion in solids

Sam is trying to open a tight jar, but he cannot open it. He asks his uncle to help. His uncle says that pour some hot water on the lid of the jar. Sam does so and tries to open it now. Wow! The jar is opened easily!

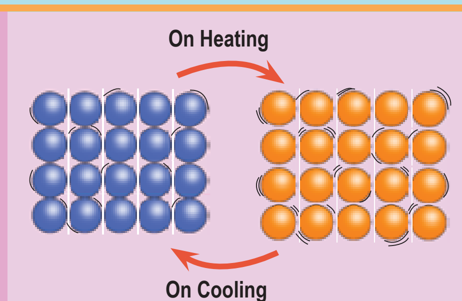
Do you have such experience? How do you open a tightly closed cap of the

HEAT - AN INTERNAL VIEW

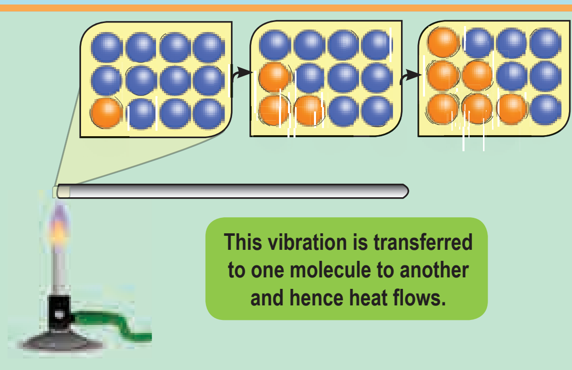


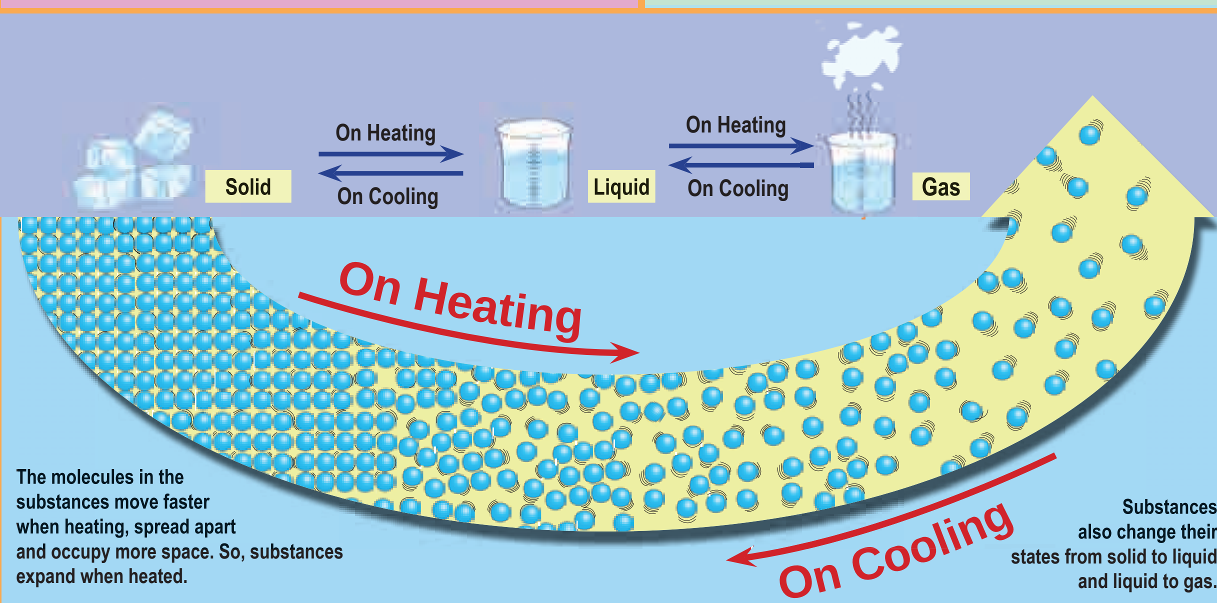
Substances are made up of molecules. The molecules in any object are in a state of vibration or movement. This cannot be seen with our naked eyes

When substances are heated the vibration and movement are increasing



The total number of molecules remain unchanging after heating. Hence, No Change in weight.

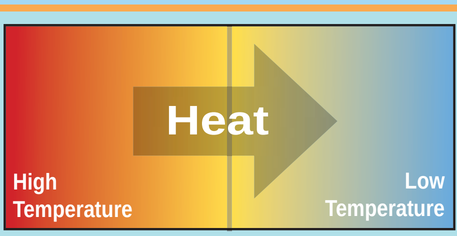




The molecules in the substances move faster when heating, spread apart and occupy more space. So, substances expand when heated.

Substances also change their states from solid to liquid and liquid to gas.

Water 'flows' when there is a difference in the 'levels' of water in different places. The 'temperature' of an object is like the water level – it determines the direction in which 'heat' will flow.



pen which could not be opened by you normally?

Most substances expand when heated and contract when cooled. The change in length / area or volume (due to contraction / expansion) is directly related to temperature change.

The expansion of a substance on heating is called, the thermal expansion of that substance.

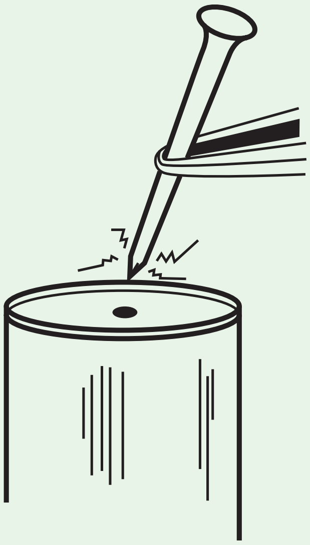
Activity 4:

Hammer a nail into a tin can. Ease the nail out. Put it in again to make sure that the hole is large enough for the nail. Then, holding the nail with a pair of pliers, scissors or forceps, heat the nail over a candle, in hot water, or over the stove. Try to put it into the hole in the can.

I see that:______________________

____

You will see that, now it is hard to put the nail into the hole. Heat expands solids. The molecules in the solid move faster, spread apart and occupy more space.



1.8 Linear and Cubical Expansion

A solid has a definite shape, so when a solid is heated, it expands in all directions i.e., in length, area and volume, all increase on heating.

The expansion in length is called linear expansion and the expansion in volume is called cubical expansion.

Why is the iron rim of a bullock cart wheel heated before it is fitted onto the wheel? Why is a small gap left between two lengths of railway lines?

We can perform an interesting experiment to find out an answer to these questions. All we need to do is to heat a cycle spoke.

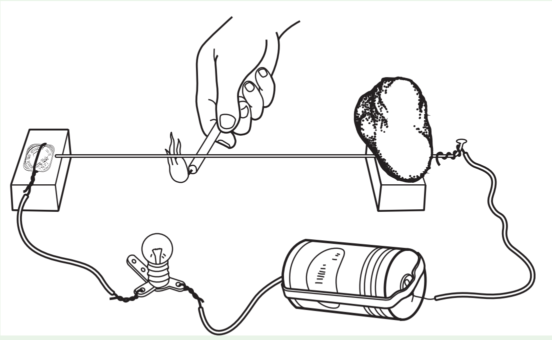
Activity 5: Linear Expansion

Take a bulb, dry cell, candle, cycle spoke, coin (or broad - headed nail) and two wooden blocks.

A1D7LK

Place one end of the cycle spoke on a wooden block and connect an electric wire to it. Put a stone over the spoke to hold it firmly in place on the wooden block, as shown in Figure . The spoke should be parallel to the ground. Place the second wooden block under the free end of the spoke. Wrap some electric wire around the coin (or nail) and place it on the block. You may put a stone over the coin to hold it in place.

Connect a bulb and dry cell to the free ends of the wires connected to the coin and the spoke and make the circuit shown in the figure.



When the tip of the free end of the spoke touches the coin, the circuit is completed and the bulb lights up. Check to ensure this. If the bulb does not light up, it means the circuit is not complete, so check your connections properly. (**Note:** We will learn about electric circuit elaborately in electricity lesson.) Now slide a page of your book between the coin and spoke and then slide it out. That way you would get a gap between the coin and spoke equal to the thickness of the sheet of paper.

❖ Does the bulb light up? If it does not, what could be the reason?

____

____

You saw that the bulb does not light up when the spoke does not touch the coin. Now light the candle and heat the spoke with it.

❖ Did the bulb light up after the spoke was heated for some time?

____

❖ If it did, then explain how the spoke touched the coin after it was heated.

____

____

❖ Why does the bulb go off some time after the candle is taken away from the spoke?

____

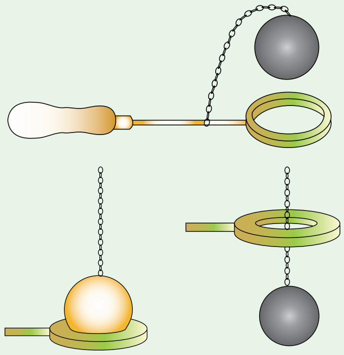
____

❖ What happens to the length of the spoke when it is heated or cooled?

____

Activity 5: Cubical Expansion

Take a metal ring and metal ball of such size that the ball just passes through the ring.



❖ Heat the ball and check whether it passes through the ring.

☐ Passed through

☐ Not passed through

❖ Now let the ball cool down, and check whether it passes through the ring.

☐ Passed through

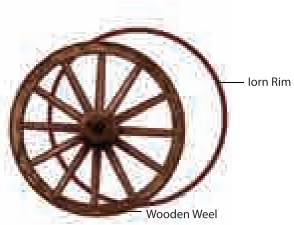
☐ Not passed through

Solids expand due to heat and come back to the original state if heat is removed.

1.9 Uses of Thermal Expansion

Fitting the iron rim on the wooden wheel

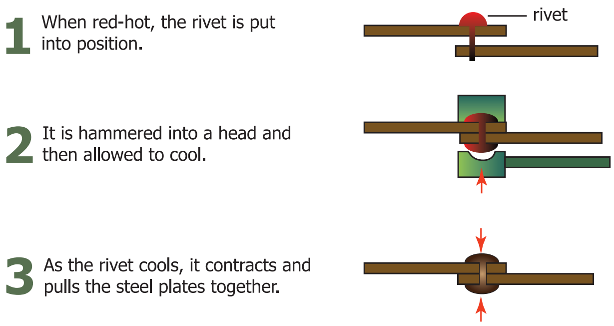
The diameter of the iron ring is slightly less than that of the wooden wheel. Therefore, it cannot be easily slipped on from the rim of wooden wheel.



The iron ring is, therefore, first heated to a higher temperature so that it expands in size and the hot ring is then easily slipped over to the rim of the wooden wheel. Cold water is now poured on the iron ring so that it contracts in size and holds the wooden wheel tightly.

Rivetting

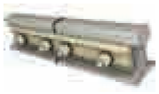
Rivets are used to join two steel plates together. Hot rivet is driven through the hole in the plates. One end of the rivet is hammered to form a new rivet head. When cooled, the rivet will contract and hold the two plates tightly together.



1.10 Thermal Expansion Examples

Give Reasons for the following

1. Gaps are left in between rails while laying a railway track.



____

____

____

2. Gaps are left in between two joints of a concrete bridge.

____

____

____

Cracking of a thick glass tumbler

Glass is a poor conductor of heat. When hot liquid is poured into the tumbler, the inner surface of the tumbler becomes hot and expands while the outer surface remains at the room temperature and does not expand. Due to this unequal expansion, the tumbler cracks.

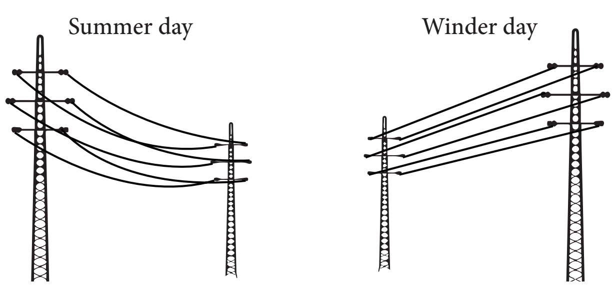
Electric wires

Electric wires between electric posts contract on cold days and sag in summers. To solve this problem, we leave wires slack

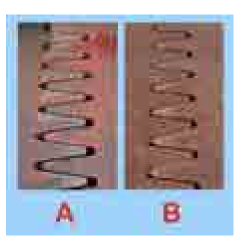
DO YOU KNOW?

Glassware used in kitchen and laboratory are generally made up of Borosilicate glass (pyrex glass). The reason is that the Borosilicate glass do not expand much on being heated and therefore they do not crack.

so that they are free to change length.



❖ The photographs below show an expansion joint at the end of a bridge in winter and in summer. Which season is shown in each picture? Explain how do you know?



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1.11 Numerical problems

1. I put a kettle containing 1 litre of cold water on the gas stove, and it takes 5 minutes to reach the boiling point. My friend puts on a small electric kettle, containing ½ litre of cold water, and it takes 5 minutes to get up to boiling point. Which gives more heat in 5 minutes?

a. the gas supply; or

b. the electricity supply?

Can you say how many times as much?

2. One calorie heat energy is needed to raise the temperature of the water from 30°C to 31°C. How much heat energy is needed to raise the temperature of the water from 30°C to 35°C.

Points to remember

❖ The main source of heat is sun, we can obtain heat from combustion, friction, and electricity.

❖ Heat is an energy that raises the temperature of a thing by causing the molecules in that thing to move faster

❖ Heat is the total Kinetic energy of constituent particles of objects.

❖ SI unit of Heat is joule (J).

❖ The measurement of warmness or coldness of a substance is known as its temperature.

❖ SI unit of temperature is kelvin.

❖ Temperature determines the direction of flow of heat when two bodies are placed in contact.

❖ Two objects are said to be in thermal contact if they can affect each other's temperature.

❖ Thermal equilibrium exists when two objects in thermal contact no longer affect each other's temperature.

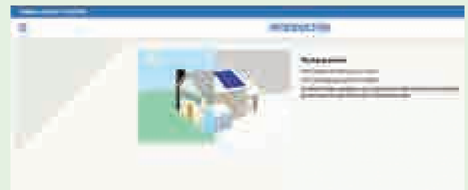
❖ Most substances expand when heated and contract when cooled. The expansion of a substance on heating is called the thermal expansion of that substance.

❖ A solid has a definite shape, so when a solid is heated, it expands in all directions i.e., in length, area and volume, all increase on heating.

ICT Corner

Heat

Through this activity you will be able to understand the 'Thermal Energy Transfer'.



Step 1: Use the given URL in the browser. 'THERMAL ENERGY TRANSFER activity page will open.

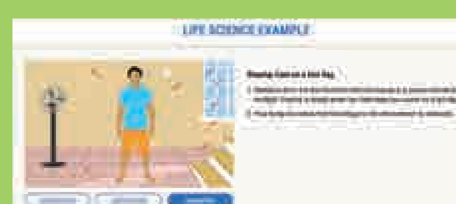
Step 2: Click the = icon on the top left of the activity window, a list will drop down, from the list select a title.

Step 3: A small flash video window will open, click the play icon to play the video and observe.

Step 4: From the list select any title under the 'Example" list, a small flash activity window will open, click anyone of the tab given under the window to know the process of thermal transfer. Repeat the activity with different titles from the menu.

Step 1

Step 2



Step 3

Step 4

THERMAL ENERGY TRANSFER URL:

http://d3tt741pwxqwm0.cloudfront.net/WGBH/conv16/conv16-int-thermalenergy/index.html#/intro

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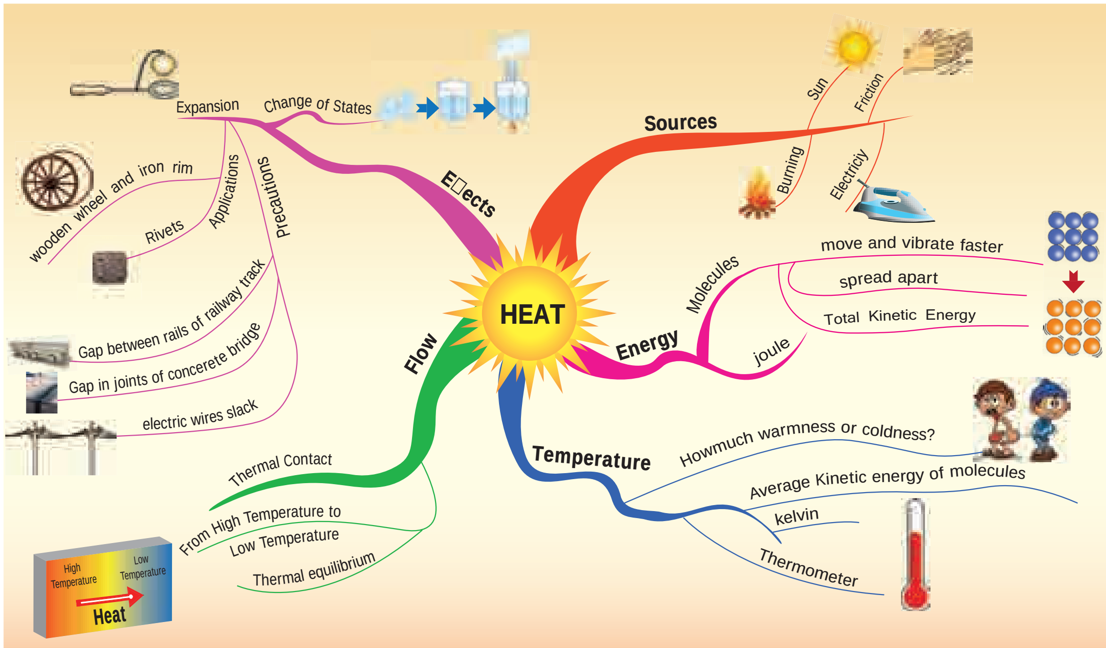
*Pictures are indicative only



Evaluation

A1GUAH

I. Choose the appropriate answer

1. When an object is heated, the molecules that make up the object

   a. begin to move faster

   b. lose energy

   c. become heavier

   d. become lighter

2. The unit of heat is

   a. newton

   b. joule

   c. volt

   d. celsius

3. One litre of water at 30°C is mixed with one litre of water at 50°C. The temperature of the mixture will be

   a. 80°C

   b. More than 50°C but less than 80°C

   c. 20°C

   d. around 40°C

4. An iron ball at 50°C is dropped in a mug containing water at 50°C. The heat will

   a. flow from iron ball to water.

   b. not flow from iron ball to water or from water to iron ball.

   c. flow from water to iron ball.

   d. increase the temperature of both.

II. Fill in the blanks

1. Heat flows from a ____________ body to a ____________ body.

2. The hotness of the object is determined by its ______________

3. The SI unit of temperature is ________

4. Solids_______________ on heating and______________ on cooling.

5. Two bodies are said to be in the state of thermal______________ if there is no transfer of heat taking place.

III. True or False. If False, give the correct statement

1. Heat is a kind of energy that flows from a hot body to a cold body.
2. Steam is formed when heat is released from water.
3. Thermal expansion is always a nuisance.
4. Borosilicate glass do not expand much on being heated.
5. The unit of heat and temperature are the same.

IV. Give reasons for the following

1. An ordinary glass bottle cracks when boiling water is poured into it, but a borosilicate glass bottle does not.
2. The electric wire which sag in summer become straight in winter.
3. Rivet is heated before fixing in hole to join two metal plates.

V. Match the following

1.	Heat	-	0^oC
2.	Temperature	-	100^oC
3.	Thermal Equilibrium	-	kelvin
4.	Ice cube	-	No heat flow
5.	Boiling water	-	joule

VI. Analogy

1. Heat : Joule :: Temperature : ______________
2. ice cube : 0^oC :: Boiling water :______________
3. Total Kinetic Energy of molecules: Heat :: Average Kinetic Energy : __________

VII. Give very short answer

1. Make a list of electrical equipments at home which we get heat from.
2. What is temperature?
3. What is thermal expansion?
4. What do you understand by thermal equilibrium?

VIII. Give short answer

1. What difference do you think heating the solid will make in their molecules ?
2. Distinguish between heat and temperature.

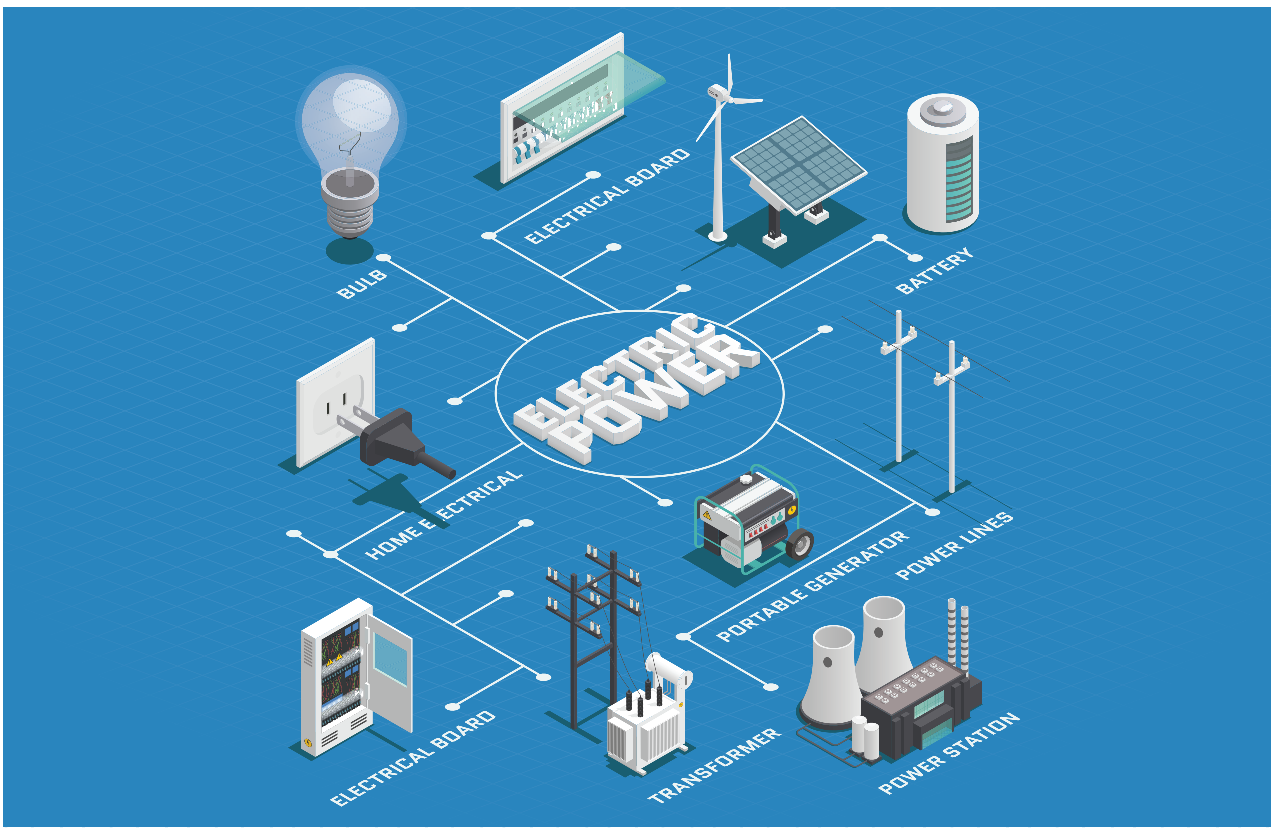
IX. Answer in detail

1. Explain thermal expansion with suitable examples.

X. Questions based on Higher Order Thinking Skills

1. When a window is accidentally left open on a winter night, will you feel uncomfortable because the cold is getting in, or because the heat is escaping from the room?
2. Suppose your normal body temperature were lower than what it is. How would the sensation of hot and cold change?
3. If you heat a circular disk with a hole, what change do you expect in the diameter of the hole? Remember that the effect of heating increases the separation between any pair of particles.

Unit 2 Electricity



Learning Objectives

- ❖ To know the sources of electricity
- ❖ To be aware of the equipments working on electricity
- ❖ To know the different kinds of electric cells and understand their applications
- ❖ To be able to use different types of cells in different applications
- ❖ To understand the symbols of circuits and apply them in different circuits
- ❖ To identify conductors and insulators
- ❖ To be able to make their own batteries

Introduction

We use electricity in our day to day life. Have we ever wondered from where do we get this electricity? How does this electricity work? Can we imagine a day without electricity? If you ask your grandfather, you can come to know a period without electricity. They used oil lamps for light, cooked on fires of wood or coal. By the advent of electricity, our day to day works are made easy and the world is on our hands. What are the appliances those work on electricity? What are the materials those allow electricity to flow through? What are electric circuits? What are electric cells and batteries? Come on, let us descend into this lesson to know more about electricity.

Activity 1:
List out the electrical appliances used in your home.

____

____

____

____

2.1 Sources of Electricity

Selvan and Selvi are twins. They are studying in sixth standard. They visited their grandparent's village during summer vacation. At 6 O'clock in the evening Selvan's Grandfather switched on the light. The whole house was illuminated. Seeing this Selvan asked his grandfather "How do we get light by switching on the switch?" So, his grandfather took him to the nearest electricity board and enquired about the electricity.

Let us look in to the conversation given below.

Selvan: Sir, How do the electric bulb lighten up when we switch on the switch?

Engineer: Due to electricity.

Selvan: Oh! From where do we get this electricity?

Engineer: We get electricity from *thermal power, hydel power, tidal power, wind power, solar power* etc., as sources of electricity.

Selvan: Sir! Are these plants exist everywhere?

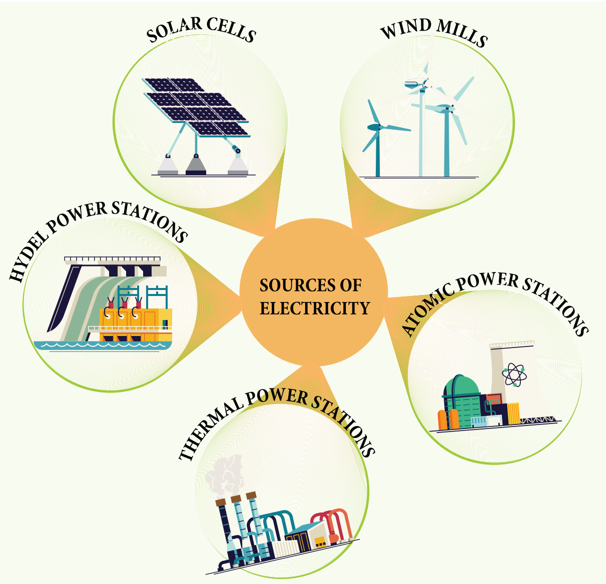
Engineer: No, these plants are constructed depending upon the natural resources available at that particular place. For example, we have thermal power plant in Neyveli, Tamilnadu as lignite is available there.

Selvan: Yes, I have seen wind mills near the hills of Tirunelveli District which has potential wind resource. Thank you sir, for your valuable information.

Grandfather: (while walking back to home) Do you think we get electricity only from the above mentioned sources.

Selvan: (while entering into the home, noticing the clock on the wall) Grandpa! look at that wall clock, How does it work?.

Grandfather: It needs electrical energy to work. Apart from the above mentioned sources, we get electricity from cells, and batteries.



Selvan: Yes, Grandpa , now I am going to discuss about all these with Selvi.

What do you infer from the above dialogue? **Any device from which electricity is produced is called the source of electricity.** We get electricity from different sources.

The Major Electric power stations in Tamilnadu are: Thermal stations (Neyveli in Cuddalore District, Ennore in Thiruvallur District), Hydel power stations (Mettur in Salem District, Papanasam in Tirunelveli District), Atomic power stations (Kalpakkam in Kanchipuram District, Koodankulam in Tirunelveli District), and Wind mills (Aralvaimozhi in Kanyakumari District Kayatharu in Tirunelveli District). Apart from these Solar panels which are prevalent in many places are used to produce electricity.

Let us discuss in shortly about working power stations.

1. Thermal Power stations

In thermal power stations, the thermal energy generated by burning coal, diesel or gas is used to produce steam. The steam thus produced is used to rotate the turbine. While the turbine rotates, the coil of wire

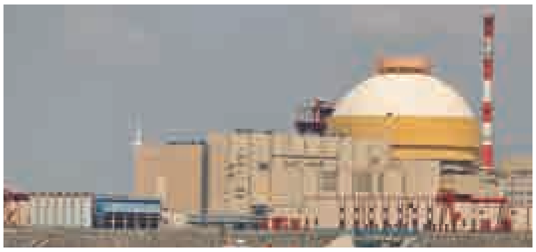
kept between the electromagnet rotates. Due to electro magnetic induction electricity is produced. Here heat energy is converted into electrical energy.

2. Hydel power stations

In hydel power stations, the turbine is made to rotate by the flow of water from dams to produce electricity. Here kinetic energy is converted into electrical energy. Hydel stations have long economic lives and low operating cost.

3. Atomic power stations

In atomic power stations, nuclear energy is used to boil water.



The steam thus produced is used to rotate the turbine. As a result, electricity is produced. Atomic power stations are also called as nuclear power stations. Here nuclear energy is converted into mechanical energy and then electrical energy.

4. Wind mills

In wind mills, wind energy is used to rotate the turbine to produce electricity. Here kinetic energy is converted into electrical energy.

2.2 Cell

A1QQC5

A device that converts chemical energy into electrical energy is called a cell.

A chemical solution which produces positive and negative ions is used as electrolyte. Two different metal plates are inserted into electrolyte as electrodes to form a cell. Due to chemical reactions, one electrode gets positive charge and the other gets negative charge producing a continuous flow of electric current.

Depending on the continuity of flow of electric current cells are classified in to two types. They are primary cells and secondary cells.

Primary Cells

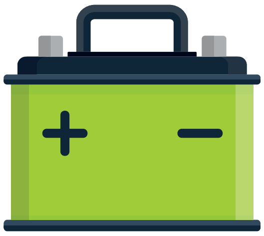
They can not be recharged. So they can be used only once. Hence, the primary cells are usually produced in small sizes.

Examples

cells used in clocks, watches and toys etc., are primary cells.

Secondary Cells

A cell that can be recharged many times is called secondary cell. These cells can be recharged by passing electric current. So they can be used again and again. The size of the secondary cells can be small or even large depending upon the usage. While the secondary cells used in mobiles are in the size of a hand, the cells used in automobiles like cars and buses are large and very heavy.



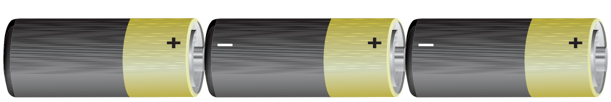
Examples

Secondary Cells are used in Mobile phones, laptops, emergency lamps and vehicle batteries.

Activity 2: From the following pictures, identify those use primary cell and secondary cell. Mark Primary cell as **'P'** Secondary cell as **'S'**.

Battery

Often, we call cells as 'batteries'. However only when two or more cells are combined together they make a battery. A cell is a single unit that converts chemical energy into electrical energy, and a **battery is a collection of cells**.



Battery

Activity 3: Take a dry cell used in a flashlight or clock. Read the label and note the following

1. Where is the '+' and '–' symbol?

2. What is the output voltage?

Look at the cells that you come across and note down the symbols and voltage.

Warning

All experiments with electricity should only be performed with batteries used in a torch or radio. Do not, under any circumstance, make the mistake of performing these experiments with the electricity supply in your home, farm or school. Playing with the household electric supply will be extremely dangerous!

2.3 Electric Circuits

Grandfather asked Selvi to bring torchlight. While taking the torchlight, it fell down and the cells came out. She puts the cells back and switched it on (Fig. A)

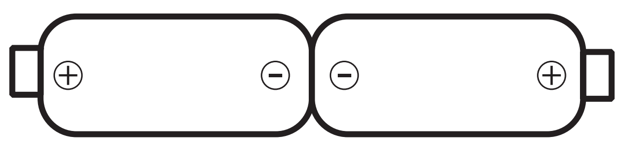


Fig: A

The torchlight did not glow. She thought the torchlight was worn out. She was afraid that grandfather might scold her. She started crying. Her uncle came there and asked the reason for crying. She conveyed the matter. Her uncle removed the cells and reversed them (Fig B)

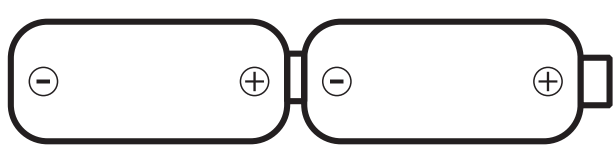
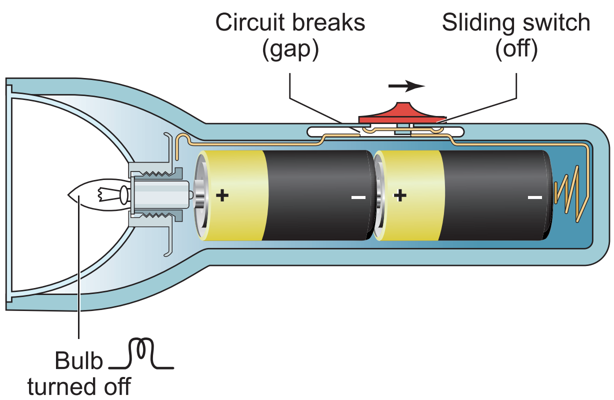


Fig: B

Now, the torch glows. Selvi's face also glows. Uncle told her the reason and explained her about electric circuits.

Inside view of torch



An **electric circuit** is the continuous or unbroken closed path along which electric current flows from the positive terminal to the negative terminal of the battery. A circuit generally has:

a) **A cell are battery**- a source of electric current

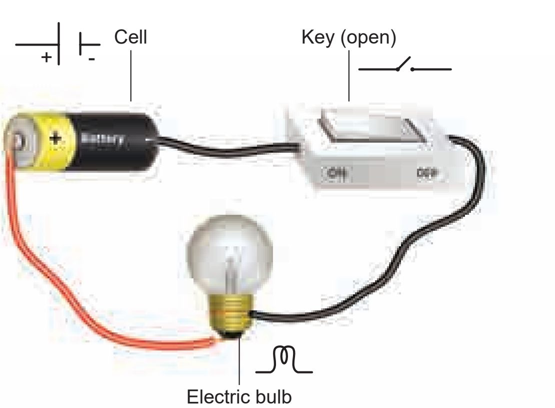
b) **Connecting wires**- for carrying current

c) **A bulb**- a device that consumes the electricity

d) **A key or a switch**- this may be connected anywhere along the circuit to stop or allow the flow of current.

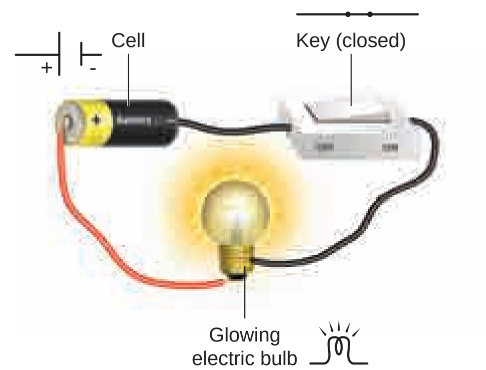
a. Open Circuit

In a circuit if the key is in open (off) condition, then electricity will not flow and



the circuit is called an open circuit. The bulb will not glow in this circuit.

b. Closed Circuit



In a circuit if the key is in closed (on) condition, then electricity will flow and the circuit is called a closed circuit. The bulb will glow in this circuit.

Can you make a simple switch own by simple things available to you?

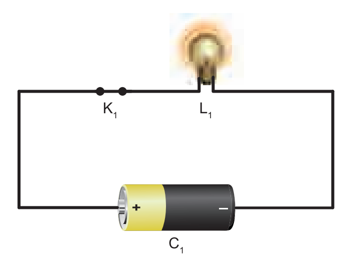
Types of Circuits

1. **Simple Circuit**
2. **Series Circuit**
3. **Parallel Circuits**

A1VYPV

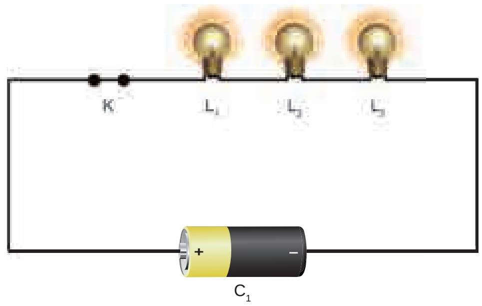
1. Simple Circuit

A circuit consisting of a cell, key, bulb and connecting wires is called a simple circuit.



2. Series Circuit

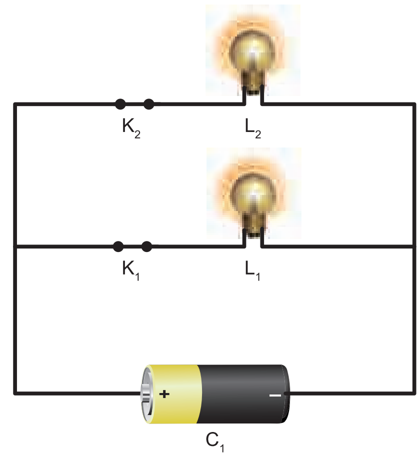
If two or more bulbs are connected in series in a circuit, then that type of circuit is called series circuit. If any one of the bulbs is damaged or disconnected, the entire circuit will not work.



3. Parallel Circuit

If two or more bulbs are connected in parallel in a circuit, then that type of circuit is called parallel circuit.

If any one of the bulb is damaged or disconnected the other part of the circuit will work. So parallel circuits are used in homes.

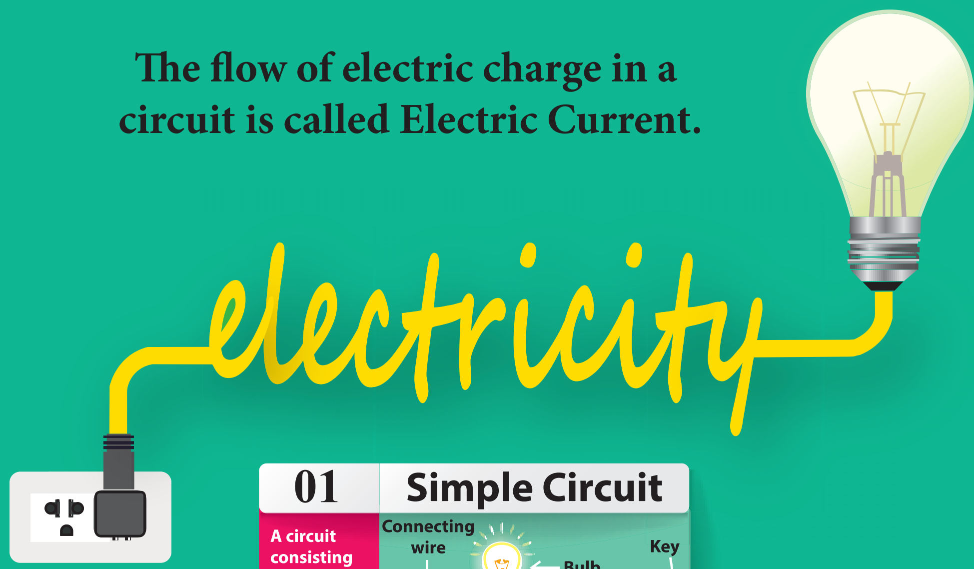


Symbols of Electric Components

In the circuits discussed above, we used the figures of electric components. Using electric components in complicated circuits is difficult. So, symbols of the components are used instead of figures. If these symbols used in electric circuits, even complicated circuits can be easily understood.

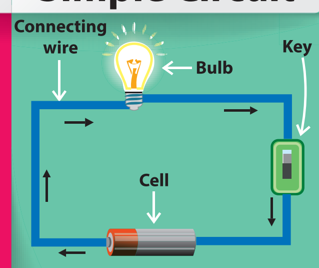
Sl.no.	Electric component	Figure	Symbol	Remarks
1	Electric cell	Cell	+ -	Longer terminal refers positive and shorter terminal refers negative.
2	Battery	Battery	+ -	Two or more cells connected in series
3	Switch-open	OFF ON	Open	Switch is in off position
4	Switch-closed	OFF ON	Closed	Switch is in on position
5	Electric bulb			The bulb does not glow
				The bulb glows
6	Connecting wires			Used to connect devices.

The flow of electric charge in a circuit is called Electric Current.



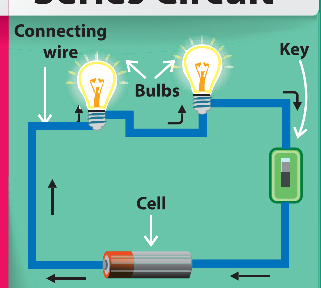
01 Simple Circuit

A circuit consisting of a cell, key, bulb and connecting wires is called a simple circuit



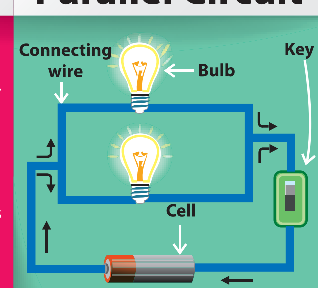
02 Series Circuit

A circuit consisting of a battery, key, bulbs and connecting wires connected in series is called a series circuit



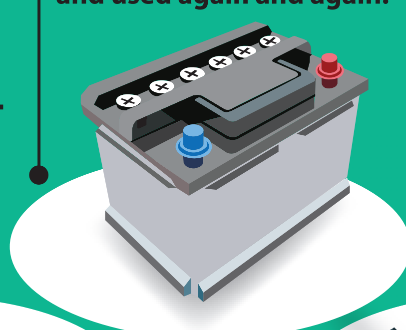
03 Parallel Circuit

A circuit consisting of a battery, key, bulbs and connecting wires connected in parallel is called a parallel circuit



SECONDARY CELL

Secondary cells can be recharged by passing current and used again and again.



CONNECTING WIRE

Connecting wires are made up of conductors & covered with insulators

PRIMARY CELL

Primary cells can be used only once.

DO YOU KNOW?

Electric Eel is a kind of fish which is able to produce electric current. This fish can produce an electric shock to safeguard itself from enemies and also to catch its food.

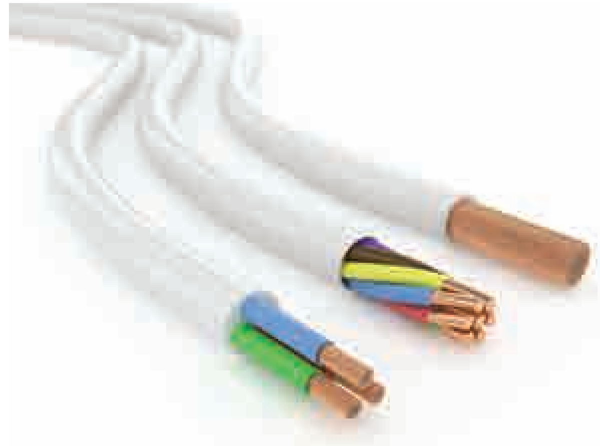
More to Know

Ammeter is an instrument used in electric circuits to find the quantity of current flowing through the circuit. This is to be connected in series.

2.4 Conductors and Insulators

Will electric current pass throw all materials?

If an electric wire is cut, we could see a metal wire surrounded by another material. Do you know why it is so?



Conductors

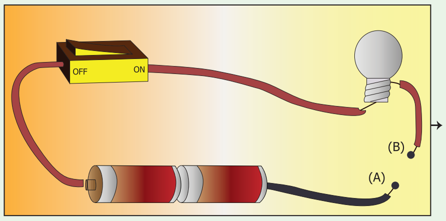
The rate of flow of electric charges in a circuit is called electric current. **The materials which allow electric charges to pass through them are called conductors.** Examples: Copper, iron, aluminum, impure water, earth etc.,

Insulators (Non-Conductors)

The materials which do not allow electric charges to pass through them are called insulators or non-conductors.

Examples: plastic, glass, wood, rubber, china clay, ebonite etc.,

Activity 4: Connect the objects given in the table between A and B and write whether the bulb glows or not.



Sl. No.	Objects	Materials of the objects	Glow or not glow
1.	Pin		
2.	Match stick		
3.	Safety pin		
4.	Pencil		
5.	Metal spoon		
6.	Rubber		
7.	Pen		
8.	Wooden scale		
9.	Hairpin		
10.	Glass piece		

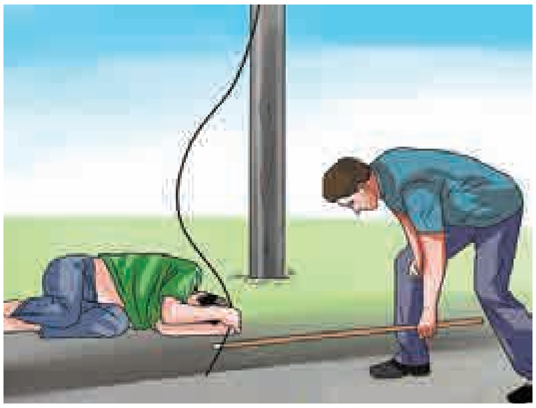
Safety measures to safeguard a person from electric shock

I. Switch off the power supply.

II. Remove the connection from the switch.

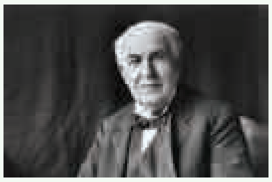
III. Push him away using non - conducing materials.

IV. Give him first aid and take him to the nearest health centre.



More to Know

Thomas Alva Edison (February 11, 1847 – October 18, 1931) was an American inventor. He invented more than 1000 useful inventions and most of them are electrical appliances used in homes. He is remembered for the invention of electric bulb.



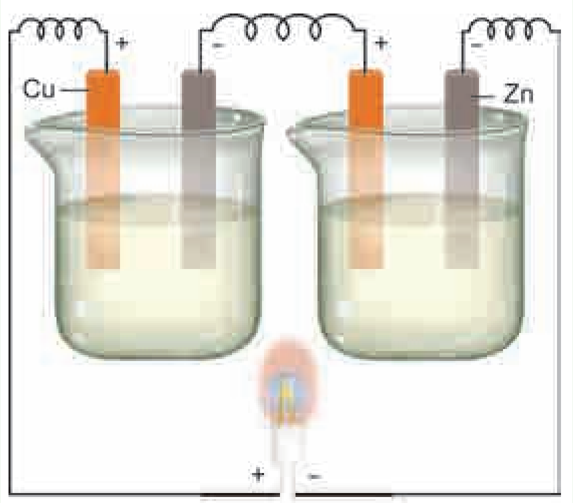
Thomas Alva Edison

Activity 5:

Produce electricity using copper plates, zinc plate, connecting wires, key, beaker and porridge (rice water) [the older the porridge the better will be the current]

Arrange copper and zinc plates in series as shown in the figure. Half fill two beakers with porridge. Connect the copper plate with the positive of and LED bulb and zinc to the negative. Observe what happens.

Now you can replace porridge with curd, potato, lemon etc.

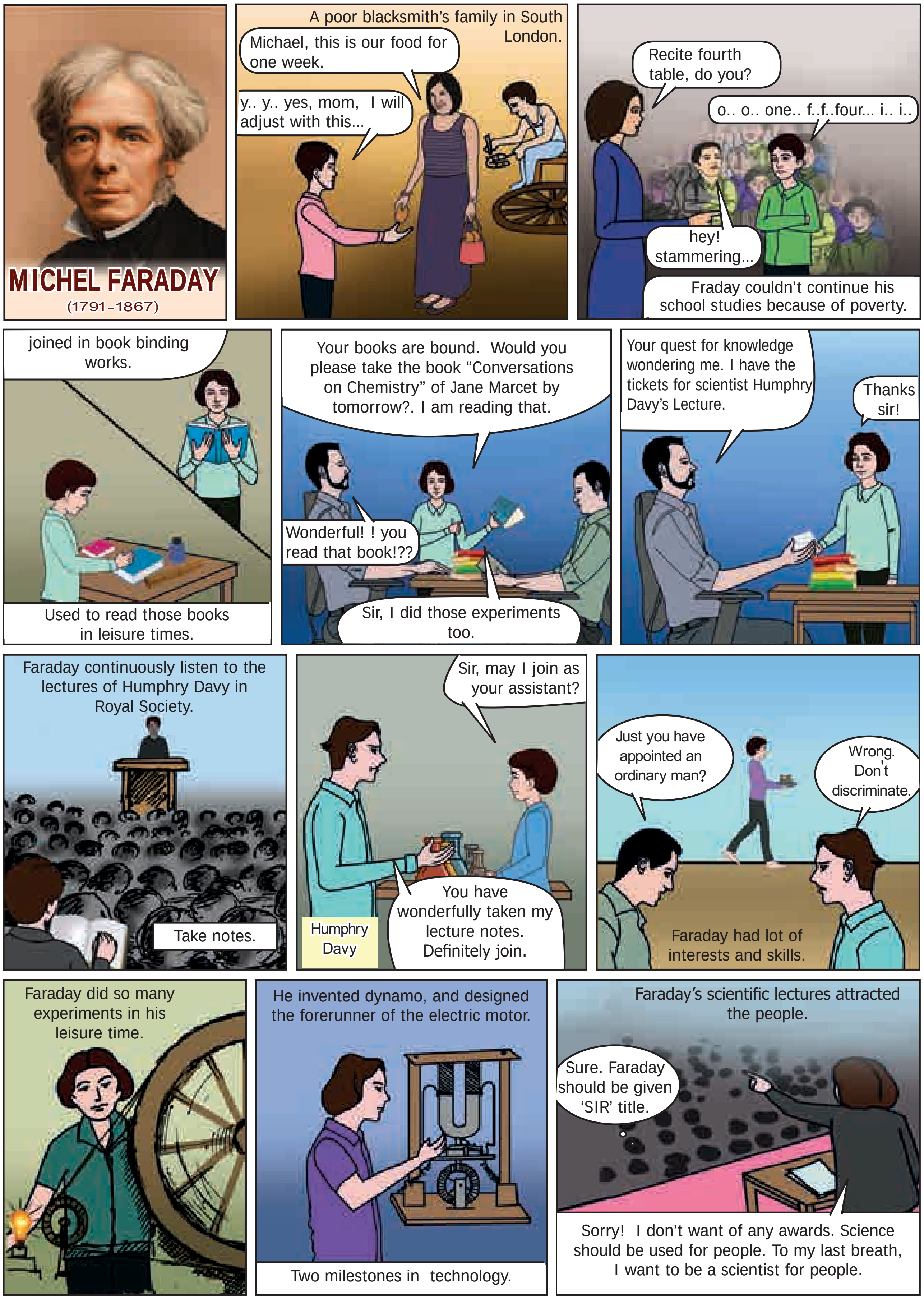


A1ZLDS

Points to remember

- ❖ Any device from which electricity is produced, is called the source of electricity.
- ❖ There are many sources of electricity such as thermal power stations, hydel electric power stations, wind mills, atomic power station etc.
- ❖ Device that converts chemical energy into electrical energy is called a cell.
- ❖ Electric cells are of two types depending on the continuity of flow of electric current.
- ❖ Primary cell is a cell that is designed to be used once and discarded.
- ❖ A cell that can be recharged many times is called secondary cell.
- ❖ Two or more cells combined together to make a battery.
- ❖ An electric circuit is a combination of cells, key, bulb and connecting wires arranged in proper manner.
- ❖ A circuit consisting of a cell, key, bulb and connecting wires is called a simple circuit
- ❖ If two or more bulbs are connected in series in a circuit, then that type of circuit is called series circuit.
- ❖ If two or more bulbs are connected in parallel in a circuit, then that type of circuit is called parallel circuit.
- ❖ Symbols of electrical components are used to represent complicated circuits in simple way.
- ❖ The materials which allow electric charges to pass through them are called conductors.
- ❖ The materials which do not allow electric charges to pass through them are called insulators or non-conductors.

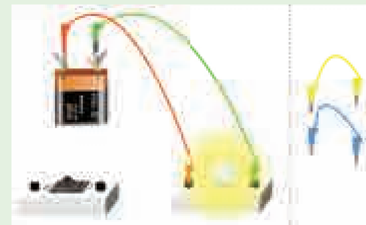
Scientist for the People



ICT Corner

Electricity

Through this activity you will be able to form a simple circuit.



Step 1: Use the given URL in the browser. 'Simple Circuit will open.

Step 2: In right side of the activity window there are diagrams of some wires and in the left side diagrams of a battery, switch and a bulb are given.

Step 3: By using the mouse drag and drop the wires to the battery and switch to make connections. Click on the switch, if the circuit is formed correctly the bulb will glow.

Step 4: Use the second URL to try Series and parallel circuits.

Step 1

Step 2

Step 3

Simple Circuit's URL:

http://www.physics-chemistry-interactive-flash-animation.com/electricity_electromagnetism_interactive/simple_circuit.htm

Series and parallel circuits url

http://www.physics-chemistry-interactive-flash-animation.com/electricity_electromagnetism_interactive/components_circuits_association-series_parallel.htm

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*Pictures are indicative only

Evaluation

A25URI

I. Choose the appropriate answer

1. The device which converts chemical energy into electrical energy is

   a. fan b. solar cell

   c. cell d. television

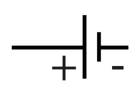
2. Electricity is produced in

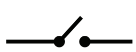
   a. transformer b. power station

   c. electric wire d. television

3. Choose the symbol for battery

a. 

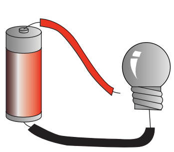
b. 

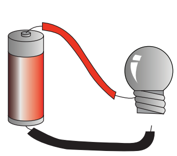
c. 

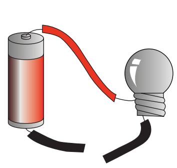
Open

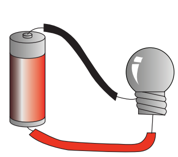
d.

4. In which among the following circuits does the bulb glow?

a. 

b. 

c. 

d. 

5. ______ is a good conductor

   a. silver b. wood

   c. rubber d. plastic

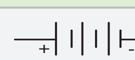
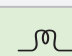
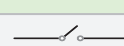
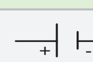
II. Fill in the blanks

1. ____________ are the materials which allow electric current to pass through them.
2. Flow of electricity through a closed circuit is ____________.
3. ____________ is the device used to close or open an electric circuit.
4. The long perpendicular line in the electrical symbol represents its ____________ terminal.
5. The combination of two or more cells is called a ____________.

III. True or False. If False, give the correct statement

1. In a parallel circuit, the electricity has more than one path.
2. To make a battery of two cells, the negative terminal of one cell is connected to the negative terminal of the other cell.
3. The switch is used to close or open an electric circuit.
4. Pure water is a good conductor of electricity.
5. Secondary cell can be used only once.

IV. Match the following

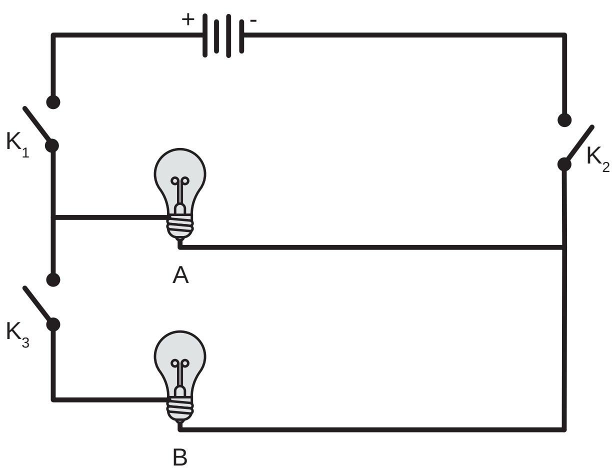
sl.no.	Symbol	Description
1		open key
2		cell
3	 Open	bulb glows
4		battery
5		bulb does not glow

V. Arrange in sequence

A CELL	A DEVICE	ELECTRICAL ENERGY
IS CALLED	IN TO	CHEMICAL ENERGY
THAT CONVERTS		

VI. Give very short answer

1. In the given circuit diagram, which of the given switch(s) should be closed. So that only the bulb A glows.



2. Assertion (A) : It is very easy for our body to receive electric shock.

   Reason (R) : Human body is a good conductor of electricity.

   a. Both A and R are correct and R is the correct explanation for A.

   b. A is correct, but R is not the correct explanation for A.

   c. A is wrong but R is correct.

   d. Both A and R are correct and R is not the correct explanation for A.

3. Can you produce electricity from lemon?

4. Identify the conductor from the following figures.

5. What type of circuit is there in a torch light?

6. Circle the odd one out. Give reason for your choice.

   Switch, Bulb, Battery, Generator.

VII. Give short answer

1. Draw the circuit diagram for series connection.

2. Can the cell used in the clock gives us an electric shock? Justify your answer.

3. Silver is a good conductor but it is not preferred for making electric wires. Why?

VIII. Answer in detail

1. What is the source of electricity? Explain the various power stations in India?

2. Tabulate the different components of an electric circuit and their respective symbols.

3. Write short notes on conductors and insulators.

IX. Question based on Higher Order Thinking Skills

1. Rahul wants to make an electric circuit. He has a bulb, two wires, a safety pin and a piece of copper. He does not have any electric cell or battery. Suddenly he gets some idea. He uses a lemon instead of a battery and makes a circuit. Will the bulb glow?

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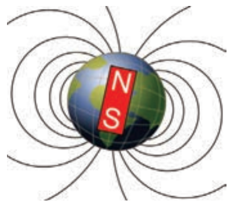
X. Search ten words in the given word grid and classify them as conductors and insulators

A	G	H	R	N	A	E	J	U	R
R	H	A	E	A	R	T	H	M	A
E	R	S	S	A	L	G	U	M	Q
T	P	L	A	S	T	I	C	N	T
A	T	I	R	O	N	A	A	O	N
W	J	A	E	I	W	O	O	D	T
A	B	D	M	C	O	P	P	E	R
E	R	U	B	B	E	R	M	P	T
S	L	R	H	E	S	S	A	I	I
A	T	N	A	S	B	H	N	L	R

S.No.	CONDUCTORS	INSULATORS



Unit 1 Magnetism

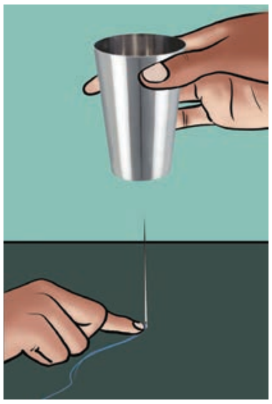
ECYPFH

Learning Objectives

- ❖ To know about the discovery of magnets
- ❖ To identify Magnetic and Non Magnetic Materials
- ❖ To distinguish between north and south poles
- ❖ To list out the properties of magnets
- ❖ To explain the principle of Maglev Train

Introduction

You might have seen magnets. Have you ever enjoyed playing with them?



Take a steel glass. Take a needle through which thread is passed. Press the thread with a finger near the hole of the needle as shown in the figure and raise the glass upward slowly.

What happens?

____

Observe the same activity performed by your teacher and note it.

____

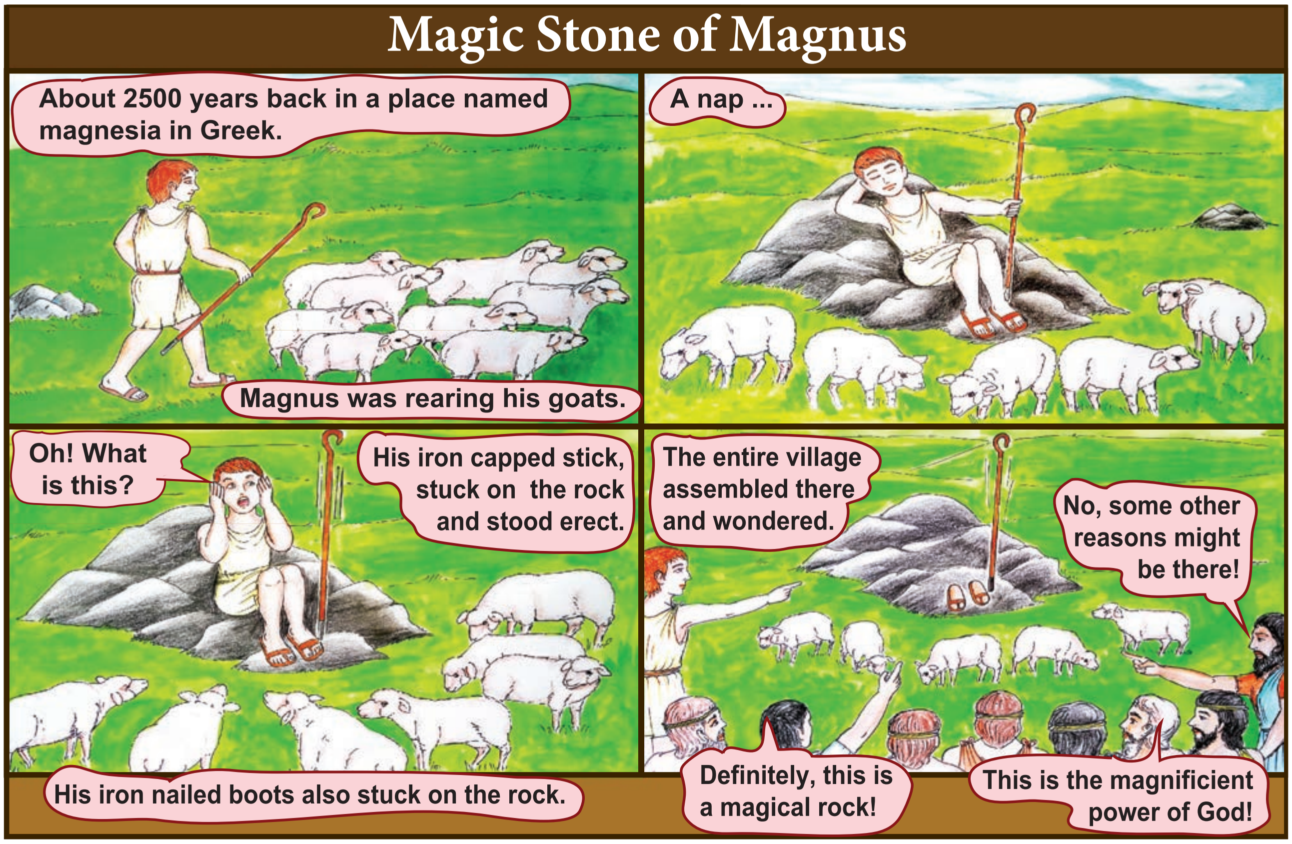
____

Does the needle stand vertically up without touching the glass? Why this happens?

____

____

1.1 Discovery of Magnets



People wondered about this incident, Each and everyone expressed their views. What might be the reason for the stick, to get stuck on the rock?

____

Yes, you are right. That is a magnetic rock. People found it attracting not only for the stick of Magnus, but also for all the materials made of iron. The more rocks of these kinds were found worldwide. These magnetic rocks were named **'Magnets'** and the ore is called as

'Magnetite' after the name of the boy Magnus. The name is also supposed to come after the name of the place (Magnesia) in which it was found.

Magnetite was the ore with attracting property found in that region. Magnetites are **natural magnets**. They are called magnetic stones.

Magnetite

Natural magnets do not have a definite shape. Since, they are used for finding direction, they are also called **'leading stones'** or **'lode stones'.**

1.2 Magnet of different shapes

After learning the method of changing the piece of iron into magnet (magnetization) we have been making and using several kinds of magnets. Such man-made magnets are called **artificial magnets**.

Bar-magnet, Horseshoe magnet, Ring magnet and Needle magnet are generally used artificial magnets.

Bar-magnet

Horseshoe magnet

Ring magnet

Needle magnet

Oval-shape, Disc shapes Cylindrical and magnets are also available.

Oval-shape

Disc shape

Cylindrical shape

Activity 1: Take a magnet. Take the magnet Closer to the objects surrounding you.

What happens? Observe and note.

The objects attracted by the magnet : ______________________

The objects, not attracted by the magnet : ______________________

Which substances are used to make the objects attracted by the magnet?

____

1.3 Magnetic and Non Magnetic Materials

Substances which are attracted by magnet are called **magnetic substances**. Iron, cobalt, nickel are magnetic substances.

Substances which are not attracted by magnet are called **non-magnetic substances.** Paper, plastic are called non-magnetic substances.

1.4 Magnetic Poles

Place some iron filings on a paper. Place a bar magnet horizontally in the filings and turn it over a few times. Now lift the magnet. What do you see? Which part of the magnet has more iron filings sticking to it?

____

Which part of the magnet has almost no filings sticking to it?

____

The parts of the magnet those attract the largest amount of iron filings are called as its poles. **The attractive force of the magnet is very large near the two ends. These two ends are called its poles.**

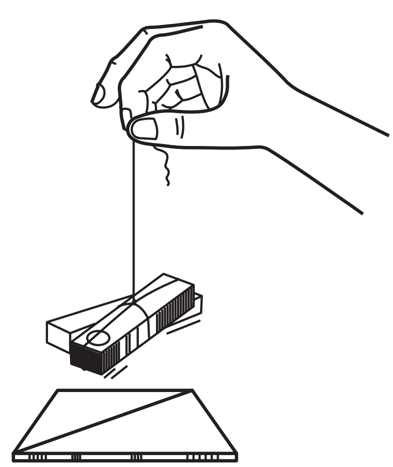
If you have a horseshoe magnet, or any other type of magnet at home, find the position of its poles by this experiment.

In experiments with magnets you will need to use iron filings again and again. You can do this by placing a magnet in a pile of sand and turning it around in the sand. The small pieces of iron present in the sand will stick to the magnet. If you cannot find sand you can look for iron pieces in clayey soil as well.

If you don't have iron filings, you can collect small pieces of iron and they will serve the purpose as well.

1.5 Finding directions with a magnet

Tie a piece of thread to the centre of a bar magnet and suspend it. Note, in which direction the magnet stops. Draw a line on a sheet of cardboard or the table along the direction in which the bar magnet stops



(i.e) a line parallel to the bar magnet). Turn the magnet gently and let it come to stop again. Repeat it three or four times.

Does the bar magnet stop in the same direction each time? ______________________

In which direction does the magnet stop every time? ______________________

This is roughly the north-south direction. The end of the magnet that points to the north is called the **North Pole.** The end that points to the south is called the **South Pole.**

A freely suspended magnet always comes to rest in north-south direction.

The directive property of magnets has been used for centuries to find directions. Around 800 years ago, the Chinese discovered that a suspended lode stone stops in the north-south direction. Chinese used these lode stones to find directions.

The navigators of that country used to keep a piece of lode stone suspended in their boats and during a storm or mist, they used the lode stone to locate directions.

1.6 Magnetic compass

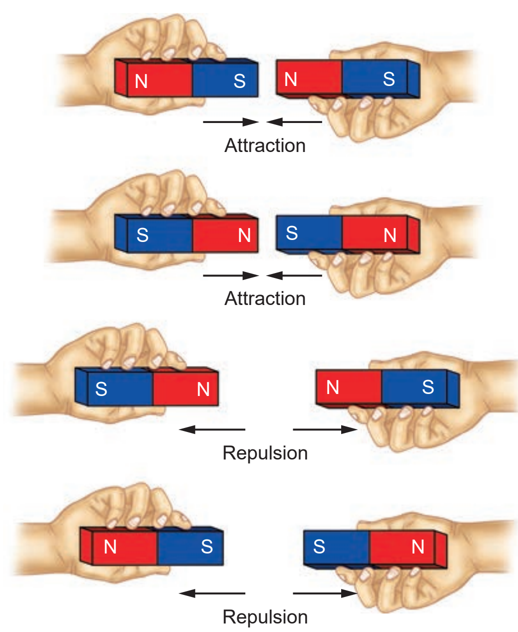
A compass is an instrument which is used to find directions. It is mostly used in ships and airplanes. As a rule, mountaineers also carry a compass with them so that they do not lose their way in unknown places.

The compass has a magnetic needle that can rotate easily. The marked end of the needle is the North Pole of the magnet. **Can you use magnetic compass to find west direction?** Ask your teacher to help you in using magnetic compass.

1.7 Properties of Magnets

Attraction or Repulsion

Take two similar magnets, place them in four different ways as shown in Figure.



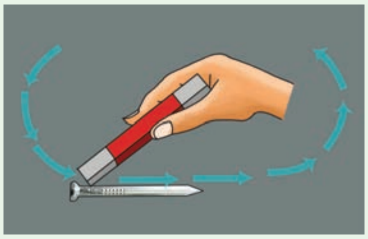
What do you observe? When do the magnets attract each other?

When do the magnets repel each other?

Unlike poles (S-N, N-S) attract each other. Like Poles (N-N, S-S) repel each other.

Activity 2: **LET US MAKE MAGNETS**

Take a nail / a piece of Iron and place it on a table. Now take a bar magnet and place one of its poles near one edge of the nail / piece of Iron and rub from one end to another end without changing the direction of the pole of the magnet. Repeat the process for 30 to 40 times.

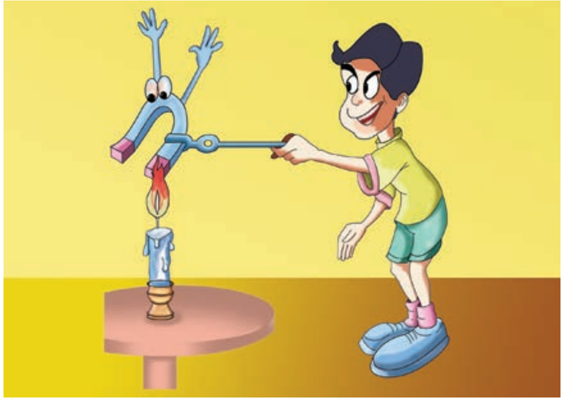


Bring a pin or some iron filings near the nail / piece of Iron to check whether it has become a magnet. Does the nail/ piece of iron attract the pin / iron filings? If not, continue the same process for some more time.

1.8 Do magnets lose their properties ? When?

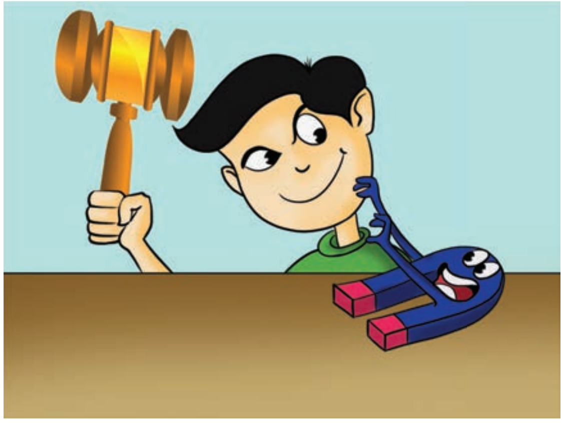
ED8KHA

Magnets lose their properties if they are heated or dropped from a height or hit with a hammer.

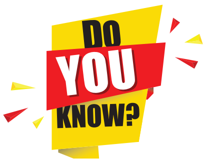


When heated

When dropped

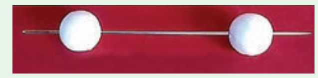


When hammered

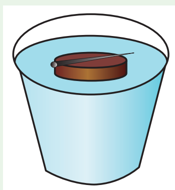


Magnets lose their properties when they are placed near Cellphone, Computer, DVDs. These objects will also get affected by magnetic field.

Activity 3: **Make your own magnetic compass**



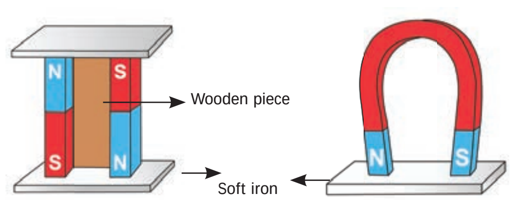
Insert the magnetized needle, that you made in the activity 2, in to two styrofoam balls (Thermocol balls) and place the needle in bowl of water. Test whether the floating needle is always turned in rest on north - south direction.



Note: If you don't have styrofoam balls you can use dry leaf or a cork piece.

1.9 Storage of Magnets

Improper storage can also cause magnets to lose their properties. To keep them safe, bar magnets should be kept in pairs with their unlike poles on the same side. They must be separated by a piece of wood and two pieces of soft iron should be placed across their ends.



For a horse-shoe magnet a single piece of soft iron can be used as a magnetic keeper across the poles.

1.10 Usage of Magnets

We use various equipment with magnets in day to day life.

Discuss with your friends about the usage of the magnets in the following instances.

In speakers

In small electric motors

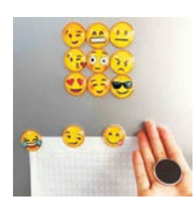
In some door locks

Bags

In some toys

In compasses

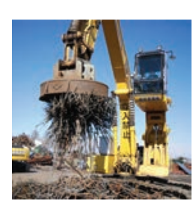
In pencil boxes



Stickers on refrigerators

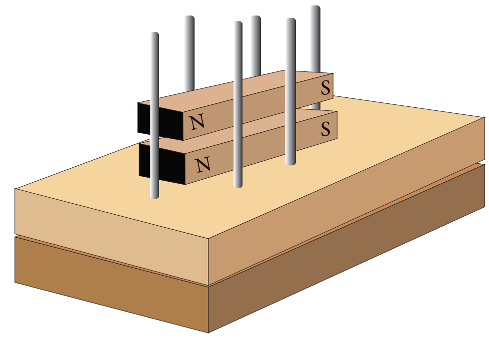
Phone covers

Pin holders



Magnetic crane

1.11 Science Today – Bullet Trains

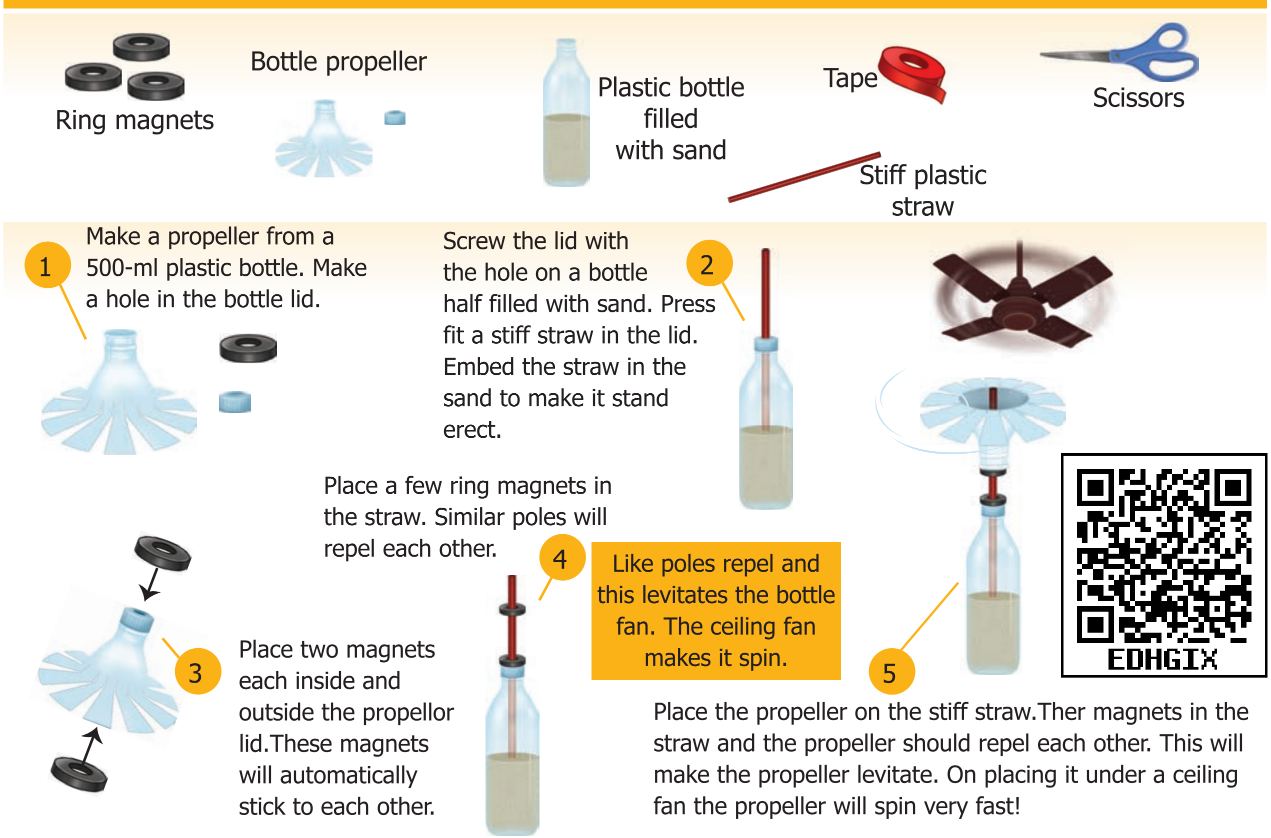


We Know that Like poles of the magnet repel each other. Keep two Bar magnets as shown in the Figure.

What do you observe? ____________________

By using repulsion we can levitate a magnetic object. Let us make a toy and enjoy magnetic levitation.

Levitating propeller

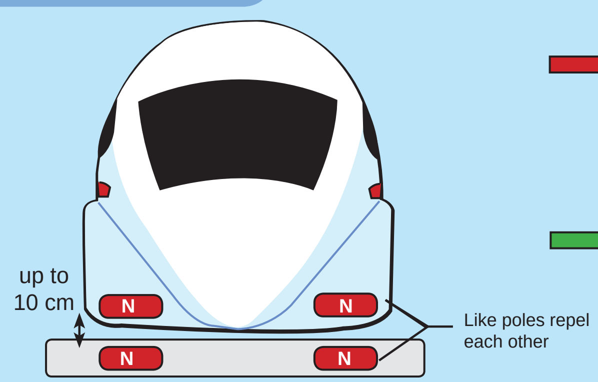


Have you enjoyed with this toy? Electromagnetic train is working in the same principle. Have you heard about it?

Electromagnetic train is called as suspension train and also called as flying train. It does not require diesel or petrol. This technology uses the property of magnetic attraction and repulsion to run these super fast electromagnetic trains.

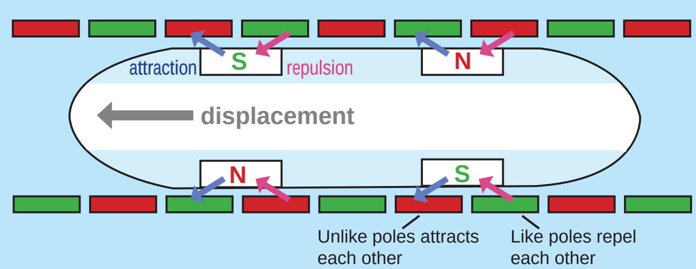
Maglev Train

Levitation

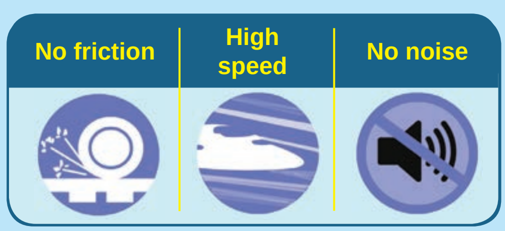


Propulsion

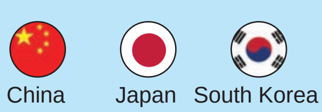
- By using attraction and repulsion at the same time the train move forward. The magnets are controlled by electricity.



Key features



Which Countries?



These three countries are currently using Maglev Trains for public transport. Many countries explore possibilites to use it.

In India

Mumbai-Delhi, Mumbai-Nagpur, Chennai-Bengaluru-Mysuru routes are considered for proposal.

How much Speed?

How does the electromagnetic train work?

EDRCKK

Electromagnets are used in Electromagnetic train. Electromagnets are magnetised only when current flows through them. When the direction of current is changed the poles of the electromagnets are also changed. Like poles of the magnets which are attached at the bottom of the train and rail track repel each other. So, the train is lifted from the track up to a height of 10 cm.

We Know that we can move any magnetic object with the force of attraction or repulsion properties of magnets. This train also moves with the help of the magnets attached on the sides of track and the magnets fitted at the bottom sideway of the train. By controlling the current we can control the magnets and movement of the train.

As there are no moving parts, there is no friction. So, the train can easily attain a speed of 300 km per hour. These trains are capable of running up to 600 km/ hour. They do not make any noise. They require less energy and they are eco-friendly.

Even though, many countries have taken effort to use these trains, such trains are used for public transport only in China, Japan and South Korea. In India the possibilities of introducing these trains are under consideration.

Write the differences between a normal train and an electromagnetic train.

____

____

____

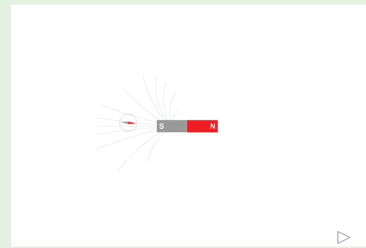
Points to remember

- ❖ Magnetites are natural magnets. They are called magnetic stones.
- ❖ Man-made magnets are called artificial magnets.
- ❖ Substances which are attracted by magnet are called as magnetic substances.
- ❖ Substances which are not attracted by magnet are called non-magnetic substances.
- ❖ A freely suspended magnet always comes to rest in north-south direction.
- ❖ The end of the magnet that points to the north is called the North Pole. The end that points to the south is called the South Pole.
- ❖ A compass is an instrument which is used to find directions.
- ❖ Like Poles (N-N, S-S) repel each other and unlike poles (N-S, S-N) attract each other.
- ❖ Magnets lose their properties if they are heated or dropped from a height or hit with a hammer.

ICT Corner

Magnet

Through this activity you'll be able to understand the properties of magnetic poles and magnetic field lines.



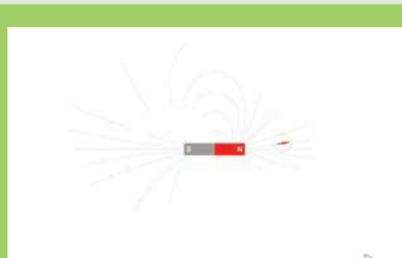
Step 1: Type the URL given or scan the QR code to launch the activity page.

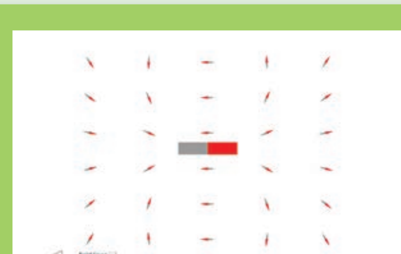
Step 2: A diagram of a bar magnet and a magnetic needle are there. Click and drag the magnetic needle with the use of mouse, around the bar magnet. Observe the position of the magnetic field lines and how the needle rotates according the poles.

Step 3: Click the 'Next navigation icon'. A grid of magnetic needles around a bar magnet will appear. Click and drag the bar magnet. Observe the changes of the needles.

Step 4: Click the 'field lines' check box at the bottom of the activity window to see the magnetic field lines.

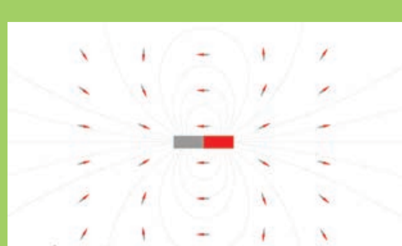
Step 1





Step 2

Step 3



Step 4

Magnet URL:

http://www.physics-chemistry-interactive-flash-animation.com/electricity_electromagnetism_interactive/bar_magnet_magnetic_field_lines.htm

*Pictures are indicative only

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Evaluation

EE18H8

I. Choose the appropriate answer

1. An object that is attracted by magnet.

   a. wooden piece   b. plain pins

   c. eraser   d. a piece of paper

2. People who made mariner's compass for the first time.

   a. Indians   b. Europeans

   c. Chinese   d. Egyptians

3. A freely suspended magnet always comes to rest in the ____________ direction

   a. North - east   b. South - west

   c. East - west   d. North - south

4. Magnets lose their properties when they are

   a. used   b. stored

   c. hit with a hammer   d. cleaned

5. Mariner's compass is used to find the

   a. speed   b. displacement

   c. direction   d. motion.

II. Fill in the Blanks

1. Artificial magnets are made in different shapes such as __________, __________ and ____________.

2. The Materials which are attracted towards the magnet are called________.

3. Paper is not a ______ material.

4. In olden days, sailors used to find direction by suspending a piece of ___________.

5. A magnet always has __________ poles.

III. True or False. If False, give the correct statement

1. A cylindrical magnet has only one pole.

2. Similar poles of a magnet repel each other.

3. Maximum iron filings stick in the middle of a bar magnet when it is brought near them.

4. A compass can be used to find East-West direction at any place.

5. Rubber is a magnetic material.

IV. Match the following

1.	Compass	-	Maximum magnetic strength
2.	Attraction	-	Like poles
3.	Repulsion	-	Opposite poles
4.	Magnetic poles	-	Magnetic needle

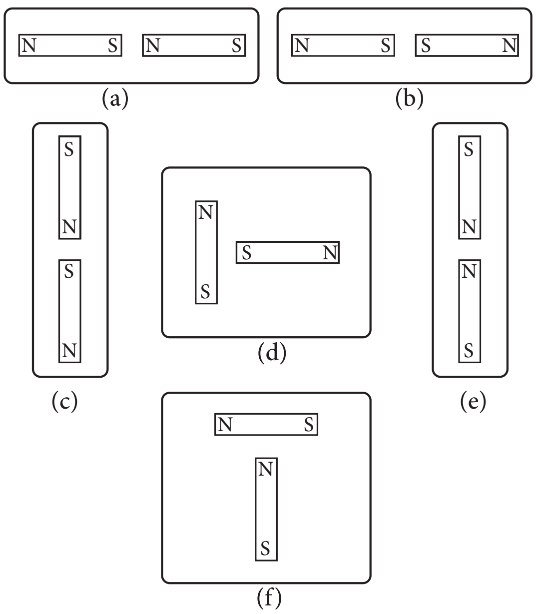
V. Circle the odd ones and give reasons

1. Iron nail, pins, rubber tube , needle.

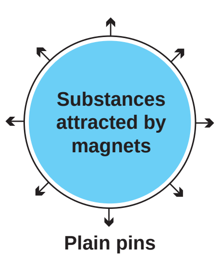
2. Lift, escalator, electromagnetic train, electric bulb.

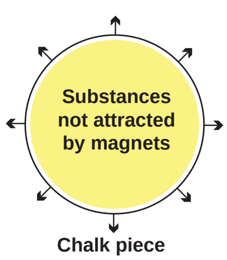
3. Attraction, repulsion, pointing direction, illumination.

VI. The following diagrams show two magnets near one another. Use the words, 'Attract, Repel, Turn around' to describe what happens in each case.



VII. Write down the names of substances.





VIII. Give short answer

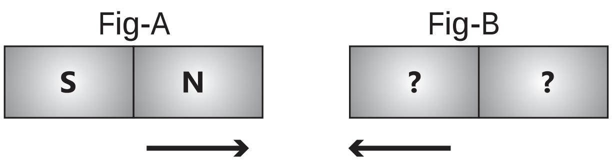
1. Explain the attraction and repulsion between magnetic poles.
2. A student who checked some magnets in the school laboratory found out that their magnetic force is worn out. Give three reasons for that?

IX. Answer in detail

1. You are provided with an iron needle. How will you magnetize it ?
2. How does the electromagnetic train work?

X. Questions based on Higher Order Thinking Skills

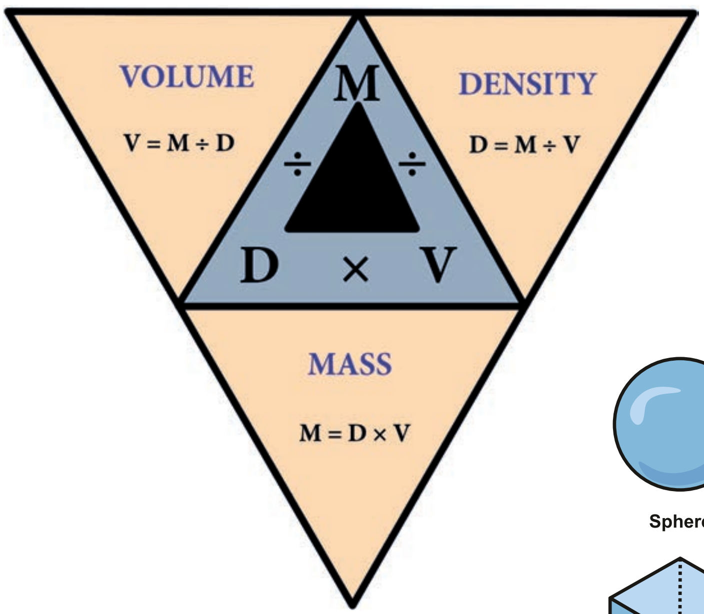
1. You are provided with iron filings and a bar magnet without labelling the poles of the magnet. Using this...
   a. How will you identify the poles of the magnet?
   b. Which part of the bar magnet attracts more iron filings? Why?
2. Two bar magnets are given in the figure A and B. By the property of attraction,identify the North pole and the South pole in the bar magnet (B)

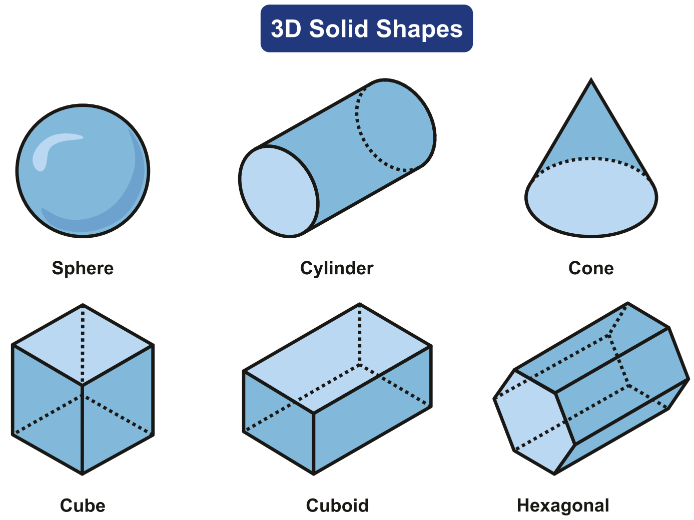


3. Take a glass of water with a few pins inside. How will you take out the pins without dipping your hands into water?

Unit 1

Measurement





Learning Objectives

After studying this unit, students will be able

- To identify fundamental and derived physical quantities.
- To identify fundamental and derived units.
- To obtain units for certain derived quantities.
- To measure the area and volume of some regular shaped and irregular shaped objects.
- To convert the volume of objects from cubic metre to litre and vice versa.
- To calculate the density of solids and liquids.
- To define Astronomical unit and light year.

4LNYXX

Introduction:

How are the various articles and materials shown in the picture measured?

Vegetables	Cloth	Milk	Time
______	______	______	______
Litre	Metre	Second	Kilogram

In day to day life, we measure many things such as the weight of fruits, vegetables, food grains, volume of liquids, temperature of the body, speed of the vehicles etc., Quantites such as mass, weight, distance, temperature, volume are called physical quantities.

A value and a unit are used to express the magnitude of a physical quantity. For example Suresh walks 2 kilometre everyday. In this example '2' is the value and 'kilometre' is the unit used to express the magnitude of distance which is a physical quantity.

1.1 Fundamental and derived quantities:

Generally, physical quantities are classified into two types, namely, (i) Fundamental quantities and (ii) Derived quantities.

Fundamental quantities:

A set of physical quantities which cannot be expressed in terms of any other quantities are known as "Fundamental quantities". Their corresponding units are called "Fundamental units".

There are seven fundamental physical quantities in SI Units (System of International Units).

S.No.	Fundamental quantity	Fundamental unit
1	Length	Metre (m)
2	Mass	Kilogram (kg)
3	Time	Second (s)
4	Temperature	Kelvin (K)
5	Electric current	Ampere (A)
6	Amount of substance	Mole (Mol)
7	Luminous (light) intensity	Candela (cd)

Derived quantities:

All other physical quantities which can be obtained by multiplying, dividing or by mathematically combining the fundamental quantities are known as "derived quantities".

Their corresponding units are called "Derived units". Some of the derived quantities and their units are given in table 1.1.

1.2 Area:

The area is a measure of how much space there is on a flat surface.

The area of the plot of land is derived by multiplying the length and breadth

Area = length × breadth

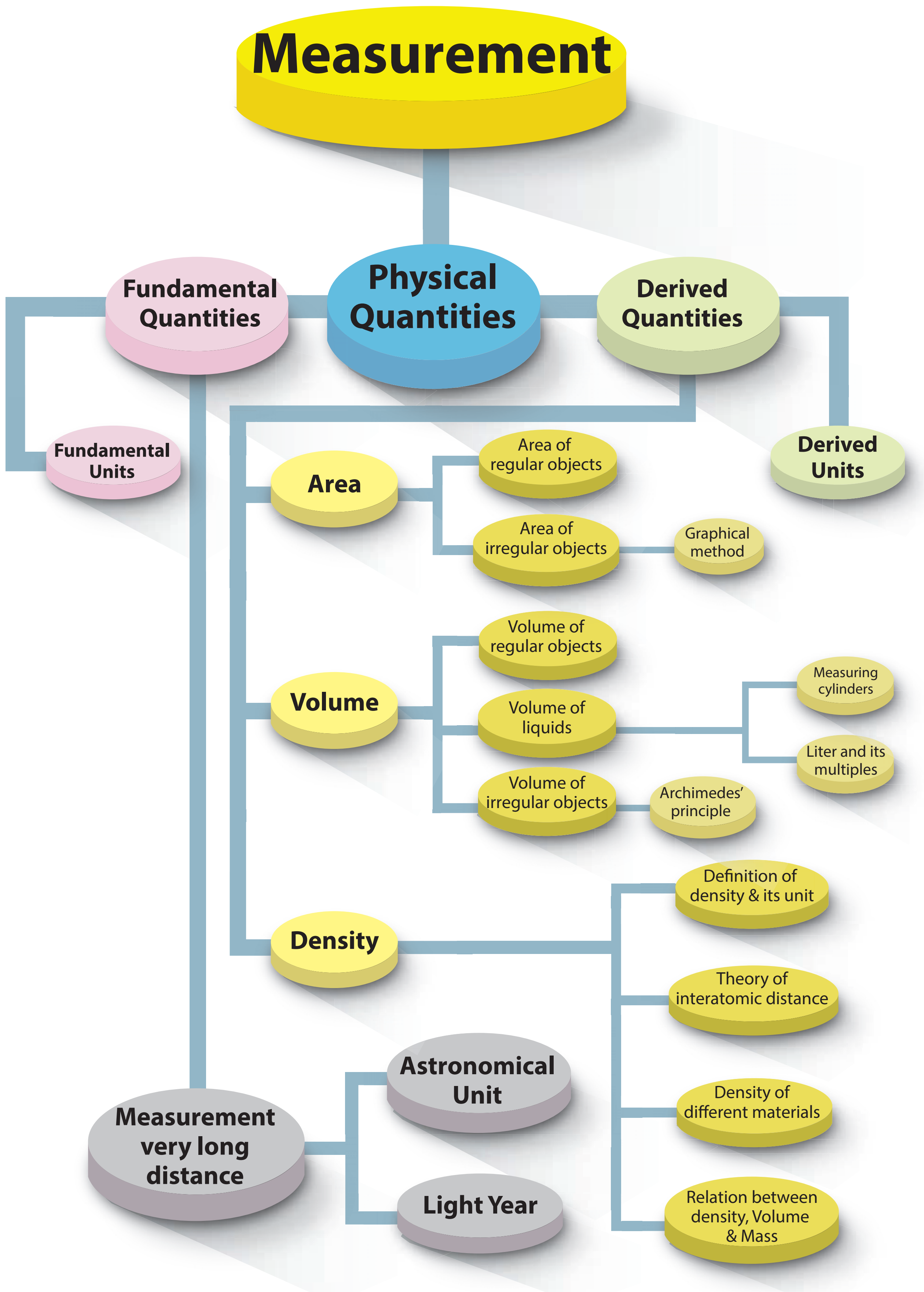
The unit of the area is = metre × metre

= metre^2

= m^2 (Read as square metre)

Table 1.1 **Some of the derived quantities and their units in SI System of units**

S.No.	Derived quantity	Unit
1	Area = length × breadth	m × m = square metre (or) m^2
2	Volume = length × breadth × height	m × m × m = cubic metre (or) m^3
3	Speed = distance / time	m / s (or) $m\ s^{-1}$
4	Electric charge = electric current × time	A × s = As (or) Coulumb (C)
5	Density = mass / volume	Kg / m^3 (or) $kg\ m^{-3}$


Measurement
Physical Quantities
Fundamental Quantities
Derived Quantities
Fundamental Units
Derived Units
Area
Area of regular objects
Area of irregular objects
Graphical method
Volume
Volume of regular objects
Volume of liquids
Measuring cylinders
Liter and its multiples
Volume of irregular objects
Archimedes' principle
Density
Definition of density & its unit
Theory of interatomic distance
Density of different materials
Relation between density, Volume & Mass
Measurement very long distance
Astronomical Unit
Light Year

Area is a derived quantity as we obtain are by multiplying twice of the fundamental physical quantity length.

> **DO YOU KNOW?** One square metre is the area enclosed inside a square of side 1 metre.

Problem 1.1

What is the area of a 10 squares each of side of 1 m.

Area of a square = side × side

= 1 m × 1 m

= 1 m^2 or 1 square metre

Area of 10 squares = 1 square metre × 10

= 10 square metre

(Even though the area is given in square metre , the surface need not to be square in shape)

Area of regularly shaped figures

The area of regularly shaped figures can be calculated using the relevant formulae. In the table 1.2, the formulae used to calculate the area of certain regularly shaped figures are given.

Problem 1.2

Find the area of the following regular shaped figures: (Take π = 22/7)

(a) A rectangle whose length is 12 m and breadth is 4 m.

(b) A circle whose radius is 7 m.

(c) A triangle whose base is 6 m and height is 8 m.

Solution:

(a) Area of rectangle = length × breadth

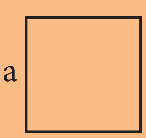
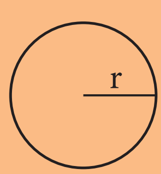
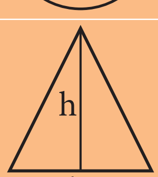
= 12 × 4

= 48 m^2

(b) Area of circle = $\pi \times r^2 = (22/7) \times 7 \times 7$

= 154 m^2

Table 1.2 **Area of some regularly shaped figures**

S.No.	Plane figure	Diagram of figure	Area
1	Square		side × side $a \times a = a^2$
2	Rectangle		length x breadth $l$xb=lb
3	Circle		$\pi \times (\text{radius})^2$ $\pi \times r^2$ πr^2
4	Triangle		(1/2) × base × height 1/2 × b × h

(c) Area of triangle $= (1/2) \times \text{base} \times \text{height}$

$= (1/2) \times 6 \times 8$

$= 24\ m^2$

Area of irregularly shaped figures

In our daily life, we encounter many irregularly shaped figures like leaves, maps, stickers of stars or flowers, peacock feather etc. The area of such irregularly shaped figures cannot be calculated using any formula.

How can we find the area of these irregularly shaped objects?

We can find the area of these figures with the help of a graph sheet.

The following activity shows how to find the area of irregularly shaped plane figures.

The graphical method explained above can be used to find the area of regularly shaped figures also. In the case of square and rectangle, this method gives the area accurately.

1.3 Volume

The amount of space occupied by a three dimensional object is known as its volume.

volume = surface area × height

The SI unit of volume is cubic metre or m^3.

Volume of regularly shaped objects

As in the case of area, the volume of the regularly shaped objects can also be determined using an appropriate formula.

Table 1.3 gives the formulae used to calculate the volume of these regularly shaped objects.

Problem 1.3

Find the volume of (Take $\pi = 22/7$)

i. a cube whose side is 3 cm.

ACTIVITY 1

Take a leaf from any one of trees in your neighbourhood. Place the leaf on a graph sheet and draw the outline of the leaf with a pencil (Figure 1.2). Remove the leaf. You can see the outline of the leaf on the graph sheet.

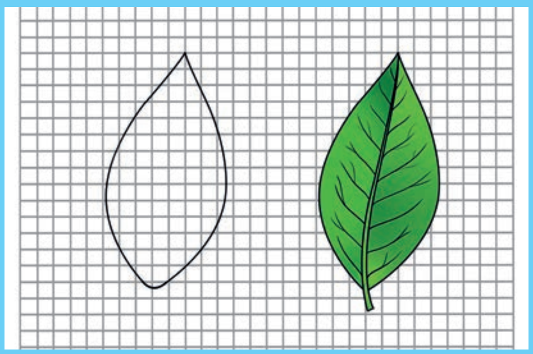


Figure 1.1 Area of an irregularly shaped plane figure

i. Now, count the number of whole squares enclosed within the outline of the leaf. Take it to be M.
ii. Then, count the number of squares that are more than half. Take it as N.
iii. Next, count the number of squares which are half of a whole square. Note it to be P.
iv. Finally, count the number of squares that are less than half. Let it be Q.
v. M = __________; N = __________;
P = __________; Q = __________

Now, the approximate area of the leaf can be calculated using the following formula:

Approximate area of the leaf = M + (3/4) N + (1/2) P + (1/4) Q square cm.

Area of the leaf = _______________.

This formula can be used to calculate the area of any irregularly shaped plane figures.

ACTIVITY 2

Draw the following regularly shaped figures on a graph sheet and find their area by the graphical method. Also, find their area using appropriate formula. Compare the results obtained in two methods by tabulating them.

(a) A rectangle whose length is 12 cm and breadth is 4 cm.

(b) A square whose side is 6 cm.

(c) A circle whose radius is 7 cm.

(d) A triangle whose base is 6 cm and height is 8 cm.

S. No.	Shape	Area using formula	Area using graphical method

ii. a cylinder whose radius is 3 m and height is 7 m.

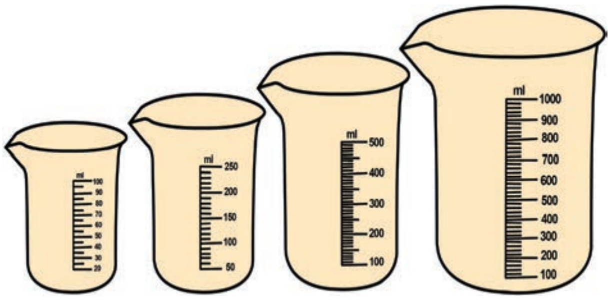
Solution:

(a) Volume of a cube = side × side × side = 3 cm × 3 cm × 3 cm = 27 cubic cm or cm^3.

(b) Volume of a cylinder = $\pi \times r^2 \times$ height = $(22/7) \times 3 \times 3 \times 7 = 198\ m^3$.

Volume of liquids

Liquids also occupy some space and hence they also have volume. But, liquids do not possess any definite shape. So, the volume of a liquid cannot be determined as in the case of solids. When a liquid is poured into a container, it takes the shape and volume of the container. The volume of any liquid is equal to the space that it fills and it can be measured using a measuring cylinder or measuring beaker. The maximum volume of liquid that a container can hold is known as the "capacity of the container". A measuring container is graduated as shown in figure.



Measuring containers

The volume of a liquid is equal to the volume of space it fills in the container. This can be directly observed from the readings marked in the measuring containers. If we notice the measuring cups given in figure carefully, we can observe that the readings are marked in the unit of "ml". This actually represents millilitre. To understand this unit of volume, let us first understand how much a litre means. Litre is the commonly used unit to measure the volume of liquids. we can understand that the unit of volume is cubic cm if the dimensions of the object are given in cm. This cubic cm is commonly known as cc. A volume of 1000 cc is termed as one litre (*l*).

1 litre = 1000 cc or cm^3

1000 ml = 1 litre

DO YOU KNOW?

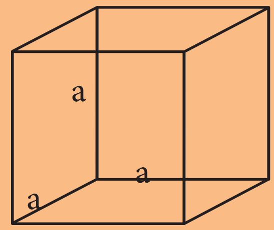
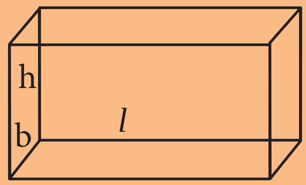
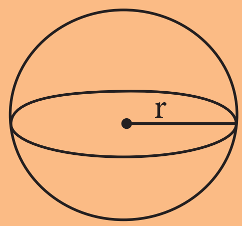
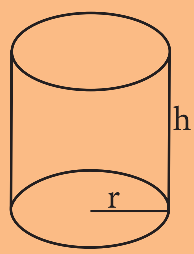
To measure the volume of liquids, some other units are also used. Some of them are gallon, ounce, and quart.

1 gallon = 3785 ml

1 ounce = 30 ml

1 quart = 1 litre

Table 1.3 Volume of regularly shaped objects

S.No.	Objects	Figure	Volume
1	Cube		side × side × side a×a×a a^3
2	Cuboid		length × breadth × height l×b×h $l$bh
3	Sphere		4/3 × π × $(\text{radius})^3$ 4/3 × π ×r^3 4/3 π r^3
4	Cylinder		π × $(\text{radius})^2$ × height π ×r^2×h π r^2h

Volume of irregularly shaped objects

As we discussed earlier for the case of area, there are no formulae to determine the volume of irregularly shaped objects. For such cases, their volume can be determined using a measuring cylinder and water.

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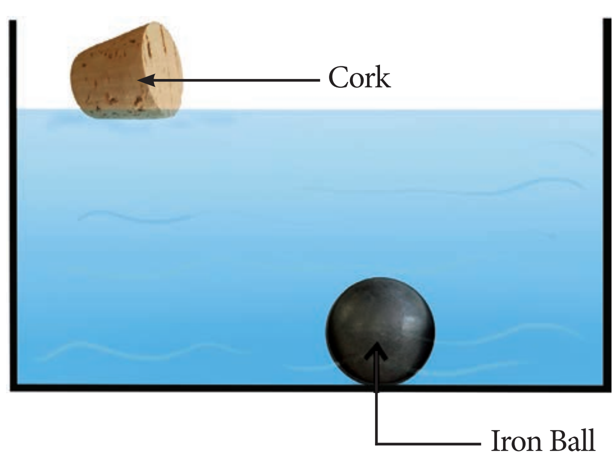
1.4 Density

Take water in a beaker and drop an iron ball and a cork bowl into the water. What do you observe? The iron ball sinks and the cork floats as shown in figure. Can you explain why? If your answer is "heavy objects sink in water and lighter objects float is water", then, why does a metal coin sink in water whereas a much heavier wooden log floats? These questions can be answered when we understand the concept of density.



Iron ball sinks while cork floats in water

Lighter coin sinks while heavier wooden log floats

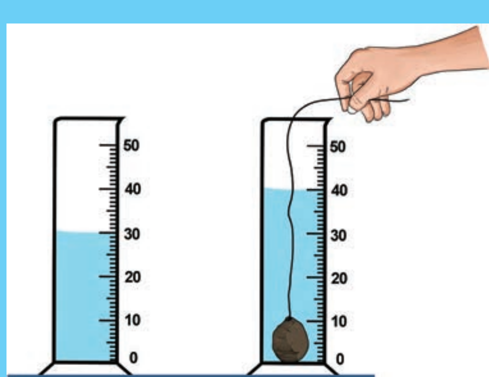
ACTIVITY 3

Take a measuring cylinder and pour some water into it (Do not fill the cylinder completely). Note down the volume of water from the readings of the measuring cylinder. Take it as V_1. Now take a small stone and tie it with a thread. Immerse the stone inside the water by holding the thread. This has to be done such that the stone does not touch the walls of the measuring cylinder (Figure). Now, the level of water has raised. Note down the volume of water and take it to be V_2. The volume of the stone is equal to the raise in the volume of water.

V_1 = ______; V_2 = ____________;

Volume of stone = $V_2 - V_1$

= ______________.



Volume of an irregularly shaped object

From the activity 4, we observe that wooden block occupies more volume than the iron ball of same mass. Also, we observe that wooden block is lighter than the iron block of same size.

The lightness or heaviness of a body is due to density. If more mass is packed into the same volume, it has greater density. so , the iron block will have more mass than the wooden block of the same size. Therefore iron has more density.

Definition of density:

Density of a substance is defined as the mass of the substance contained in unit volume (1 m^3).

If the mass of a substance is "M" whose volume is "V", then, the equation for density is given as

$$Density\ (D) = \frac{mass\ (M)}{volume\ (V)}$$

$$D = \frac{M}{V}$$

ACTIVITY 4

(a) Take an iron block and a wooden block of same mass (say 1kg each). Measure their volume. Which one of them has more volume and occupies more volume?

Ans: _________________

(b) Take an iron block and a wooden block of same size. Weigh them and measure their mass. Which one of them has more mass?

Ans: _________________

VII Std Science Term-1 EM Unit 1.indd 8 13-03-2019 3.23.45 PM

Unit of density

SI unit of density is kg/m^3. The CGS unit of density is g/cm^3.

Density of different materials

Different materials have different densities. The materials with higher density are called “denser” and the materials with lower density are called “rarer”.

The density of some widely used materials are listed in the following table 1.4.

Table 1.4 Density of some common substances, at room temperature

S.No.	Nature	Materials	Density (kg/m^3)
1	Gas	Air	1.2
2	Liquid	Kerosene	800
3		Water	1,000
4		Mercury	13,600
5	Solid	Wood	770
6		Aluminium	2,700
7		Iron	7,800
8		Copper	8,900
9		Silver	10,500
10		Gold	19,300

Suppose you have one Kg of iron and gold, which of them would have more volume than the other? Give your reason.

Problem 1.4

A solid cylinder of mass 280 kg has a volume of 4 m^3. Find the density of cylinder.

Solution:

$$\textit{Density of cylinder} = \frac{\textit{mass of cylinder}}{\textit{volume of cylinder}}$$

$$= \frac{280}{4} = 70\ kg/m^3$$

Problem 1.5

A box is made up of iron and it has a volume of 125 cm^3. Find its mass. (Density of iron is 7.8 g / cm^3).

Solultion:

Density = Mass / Volume

Hence, Mass = Volume × Density

= 125 × 7.8 = 975 g.

Problem 1.6

A sphere is made from copper whose mass is 3000 kg. If the density of copper is 8900 kg/m^3, find the volume of the sphere.

Solution:

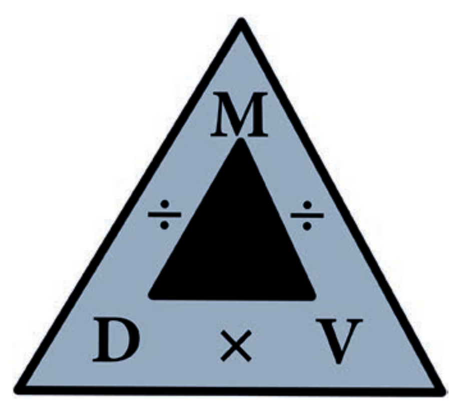
Density = Mass / Volume

Hence, Volume = Mass / Density

= 3000 / 8900 = 30 / 89

= 0.34 m^3

The relationship between Mass, density and volume are represented in the following density triangle:



- Density = Mass/ Volume
- Mass = Density × Volume
- Volume = Mass / Density

Relationship between density, mass and volume

1.5 Measuring distance of celestial bodies

Normally, we use centimeter, metre and kilo metre to express the distances that we measure in our day to day life. But, for space research, astronomers need to measure very long distances such as the distance between the earth and a star or the distance between two stars. To express these distances, we shall learn about two such units, namely,

i. Astronomical unit
ii. Light year

DO YOU KNOW? Water has more density than oils like cooking oil and castor oil, although these oils appear to be denser than water. Density of castor oil is 961 kg/m^3. If we put one drop of water in oil, water drop sinks. But, if we put one drop of oil in water, oil floats and forms a layer on water surface. However, some oils are denser than water.

Astronomical unit

We all know that the earth revolves around the sun in an elliptical orbit. Hence, the distance between the sun and the earth varies every day. When the earth is in its perihelion position (Perihelion is position of the shortest distance between the earth and the sun), the distance between the earth and the sun is about 147.1 million kilometre. When the earth is in its farthest position, that is when the distance between Earth and Sun is the largest (called aphelion position) the distance is 152.1 million kilometer. The average distance between the earth and the sun is about 149.6 million kilometer. This average distance is taken as one astronomical unit.

Neptune is 30 AU away from the Sun. It means it is thirty times farther than the Earth.

One astronomical unit is defined as the average distance between the earth and the sun.

1 AU = 149.6 million km = 149.6×10^6 km = 1.496×10^{11} m.

Light year

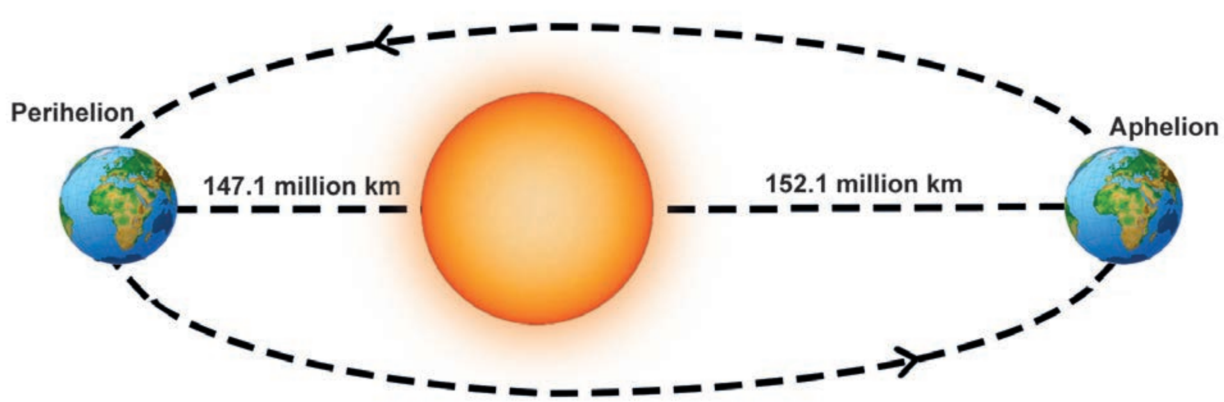
The nearest star to our solar system is Proxima Centauri. It is at a distance of 2,68,770 AU. We can clearly see that using the AU for measuring distances of stars would be unwieldy. Therefore, astronomers use a special unit, called 'light year', for measuring the distance in deep space.We have learnt that the speed of light in vacuum is 3×10^8 m/s. This means that light travels a distance of 3×10^8 m in one second. In a year (non-leap), there are 365 days. Each day has 24 hours; Each hour has 60 minutes; Each minute has 60 seconds.

Thus, the total number of seconds

in one year = $365 \times 24 \times 60 \times 60$

= 3.153×10^7 second

7KU74W



Perihelion and Aphelion position of earth

If light travels a distance of 3×10^8 m in one second, then the distance travelled by light in one year = $3 \times 10^8 \times 3.153 \times 10^7 = 9.46 \times 10^{15}$ m. This distance is known as one light year.

One light year is defined as the distance travelled by light in vacuum during the period of one year.

1 Light year = 9.46×10^{15} m.

In terms of light year, Proxima Centauri is at 4.22 light-years from Earth and the Solar System (and Earth). The Earth is located about 25,000 light-years away from the galactic center.

Points to remember:

❖ A set of physical quantities which cannot be expressed in terms of any other quantities are known as "Fundamental quantities". Their corresponding units are called "Fundamental units".

❖ The physical quantities which can be obtained by mathematically combining (i.e., multiplying and dividing) the fundamental quantities are known as "Derived quantities". Their corresponding units are called "Derived units".

❖ The area of a figure is the region covered by the boundary of the figure. Its SI unit is square metre or m^2.

❖ The area of irregularly shaped figures can be calculated with the help of a graph sheet.

❖ The amount of space occupied by a three dimensional object is known as its volume. The SI unit of volume is cubic metre or m^3.

❖ The volume of liquids are expressed in terms of litre. One litre = 1000 cc.

❖ The maximum volume of a liquid that a container can bold is known as the capacity of the container.

❖ Density of a substance is defined as the mass of the substance contained in unit volume (1 m^3).

❖ SI unit of density is kg/m^3. The CGS unit of density is g/cm^3. $1 g/cm^3 = 10^3 kg/m^3$.

❖ The materials with higher density are called "denser" and the materials with lower density are called "rarer".

❖ If the density of a solid is higher than that of a liquid, it sinks in that liquid. If the density of a solid is lower than that of a liquid, it floats in that liquid.

❖ Density = Mass / Volume

❖ Mass = Density × Volume

❖ Volume = Mass / Density

❖ One astronomical unit is defined as the average distance between the earth and the sun. 1 AU = 149.6×10^6 km = 1.496×10^{11} m.

❖ One light year is defined as the distance travelled by light in vacuum during the period of one year. 1 Light year = 9.46×10^{15} m.

ICT CORNER

Measurement

Let's know about the effects of mass and volume on density.

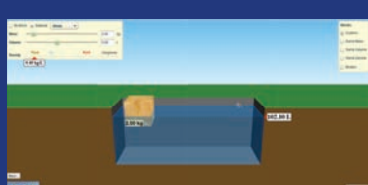
PROCEDURE :

Step 1: Use the URL or scan the QR code to open the activity page.

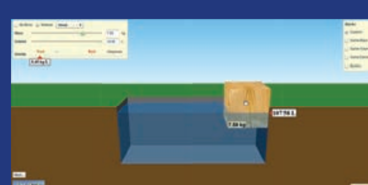
Step 2: Select the options at top right side window to customize

Step 3: Move the sliders on the top left-side window to change the Material and Mass, Volume. Now see the effects of mass and volume on density.

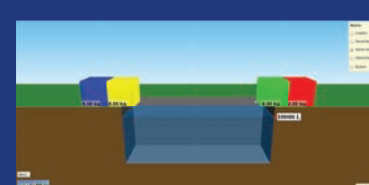
Step 4: Click 'Reset all' button to refresh



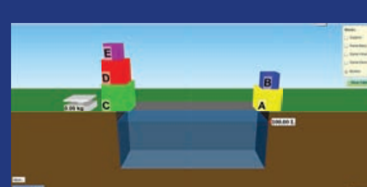
Step 1



Step 2



Step 3



Step 4

Measurement URL:

https://phet.colorado.edu/en/simulation/density (or) scan the QR Code

*Pictures are indicative only

*If browser requires, allow Flash Player or Java Script to load the page.

B351_7_SCI_EM

Evaluation

I. Choose the appropriate answer:

1. Which of the following is a derived unit?
   a) mass
   b) time
   c) area
   d) length

8V5V78

2. Which of the following is correct?
   a) 1L = 1cc b) 1L = 10 cc
   c) 1L = 100 cc d) 1L = 1000 cc

3. SI unit of density is
   a) kg/m^2 b) kg/m^3
   c) kg/m d) g/m^3

4. Two spheres have equal mass and volume in the ratio 2:1. The ratio of their density is
   a) 1:2 b) 2:1
   c) 4:1 d) 1:4

5. Light year is the unit of
   a) Distance
   b) time
   c) density
   d) both length and time

II. Fill in the blanks:

1. Volume of irregularly shaped objects are measured using the law of ______________.
2. One cubic metre is equal to ______________ cubic centimetre.
3. Density of mercury is ______________.
4. One astronomical unit is equal to ________________________.
5. The area of a leaf can be measured using a ________________________.

III. State whether the following statements are true or false:

1. The region covered by the boundary of the plane figure is called its volume.
2. Volume of liquids can be found using measuring containers.
3. Water is denser than kerosene.
4. A ball of iron floats in mercury.
5. A substance which contains less number of molecules per unit volume is said to be denser.

IV. Match the items in column-I to the items in column-II:

(1)

Column-I	Column-II
i. Area	(a) light year
ii. Distance	(b) m^3
iii. Density	(c) m^2
iv. Volume	(d) kg
v. Mass	(e) kg / m^3

(2)

Column-I	Column-II
i. Area	(a) g / cm^3
ii. Length	(b) measuring jar
iii. Density	(c) amount of a substance
iv. Volume	(d) rope
v. Mass	(e) plane figures

V. Arrange the following in correct sequence:

1. 1L, 100 cc, 10 L, 10 cc
2. Copper, Aluminium, Gold, Iron

VI. Use the analogy to fill in the blank:

1. Area: m^2 :: Volume: __________
2. Liquid: Litre :: Solid: __________
3. Water: kerosene :: ________ : Aluminium

VII. Assertion and reason type questions:

Mark the correct choice as

a. If both assertion and reason are true and reason is the correct explanation of assertion.
b. If both assertion and reason are true, but reason is not the correct explanation of assertion.
c. Assertion is true but reason is false.
d. Assertion is false but reason is true.

1. **Assertion:** Volume of a stone is found using a measuring cylinder.
   Reason: Stone is an irregularly shaped object.
2. **Assertion:** Wood floats in water.
   Reason: Water is a transparent liquid.
3. **Assertion:** Iron ball sinks in water.
   Reason: water is denser than iron.

VIII. Give very short answer:

1. Name some of the derived quantities.
2. Give the value of one light year.
3. Write down the formula used to find the volume of a cylinder.
4. Give the formula to find the density of objects.
5. Name the liquid in which an iron ball sinks.
6. Name the units used to measure the distance between celestial objects.
7. What is the density of gold?

IX. Give short answer:

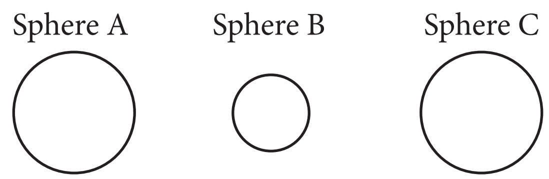
1. What are derived quantities?
2. Distinguish between the volume of liquid and capacity of a container.
3. Define the density of objects.
4. What is one light year?
5. Define -one astronomical unit?

X. Answer in detail.

1. Describe the graphical method to find the area of an irregularly shaped plane figure.
2. How will you determine the density of a stone using a measuring jar?

XI. Questions based on Higher Order Thinking skills:

1. There are three spheres A, B, C as shown below:



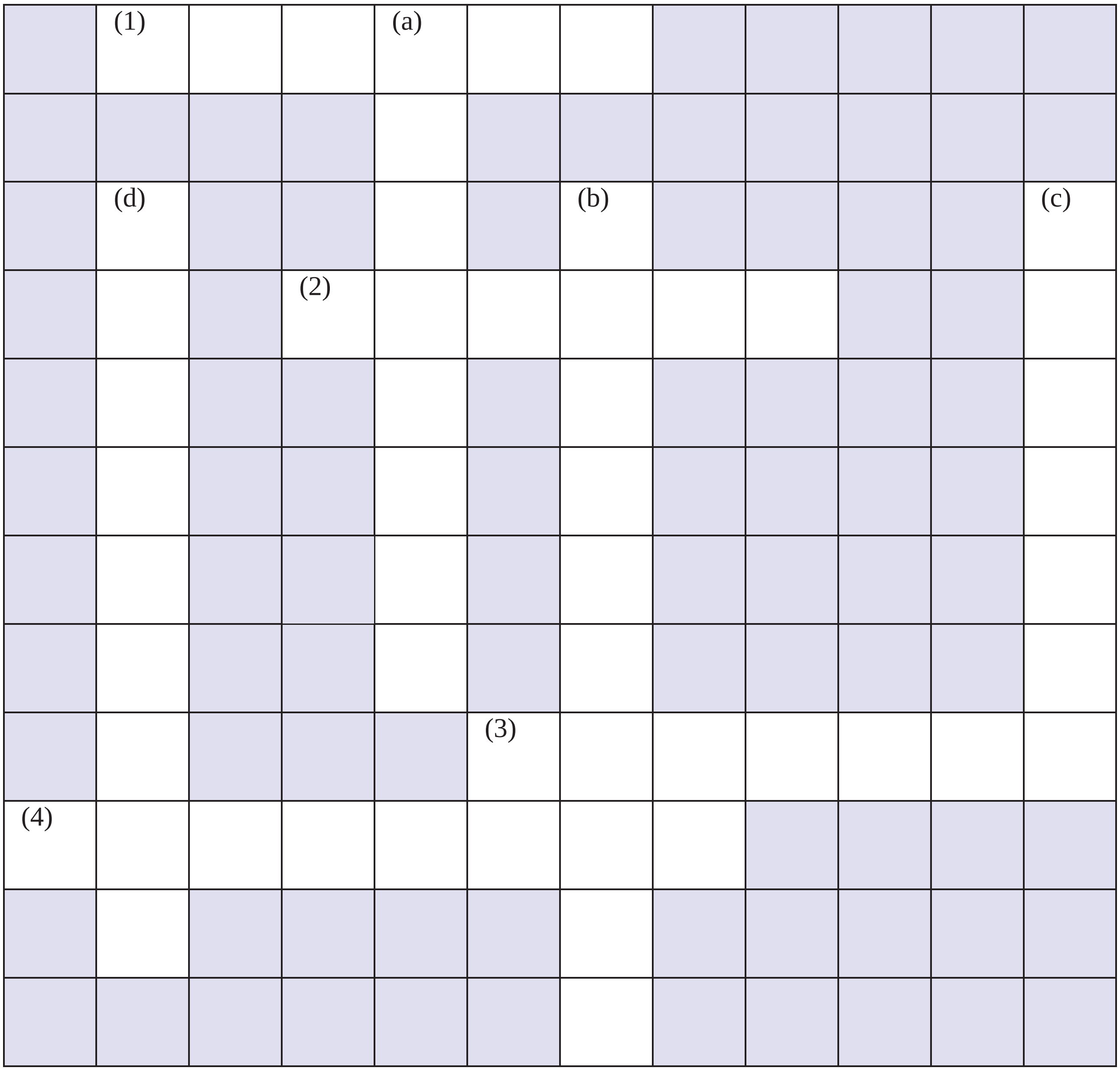
Sphere A and B are made of the same material. Sphere C is made of a different material. Spheres A and C have equal radii. The radius of sphere B is half that of A. Density of A is double that of C. Now answer the following questions:

i. Find the ratio of masses of spheres A and B.
ii. Find the ratio of volumes of spheres A and B.
iii. Find the ratio of masses of spheres A and C.

XII. Numerical problems:

1. A circular disc has a radius 10 cm. Find the area of the disc in m^2. (Use $\pi = 3.14$).
2. The dimension of a school playground is 800 m × 500 m. Find the area of the ground.
3. Two spheres of same size are made from copper and iron respectively. Find the ratio between their masses. Density of copper 8,900 kg/m^3 and iron 7,800 kg/m^3.
4. A liquid having a mass of 250 g fills a space of 1000 cc. Find the density of the liquid.
5. A sphere of radius 1cm is made from silver. If the mass of the sphere is 33g, find the density of silver. (Take $\pi = 3.14$).

XIII. Cross word puzzle:



CLUES – ACROSS

1. SI unit of temperature
2. A derived quantity
3. Mass per unit volume
4. Maximum volume o liquid a container can hold

CLUES – DOWN

a. A derived quantity

b. SI unit of volume

c. A liquid denser than iron

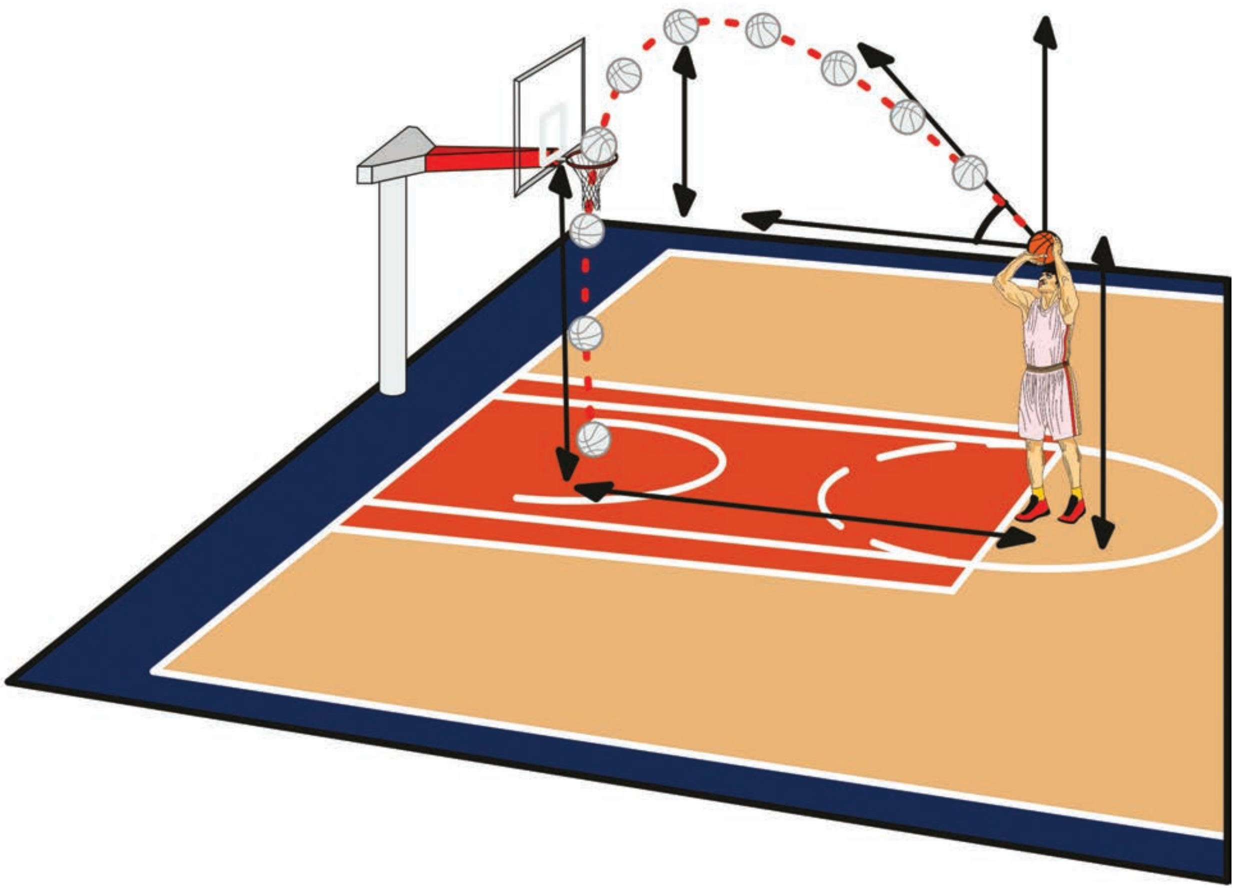
d. A unit of length used to measure very long distances

Ans: [1. Kelvin; 2. Volume; 3. Density; 4. Capacity]

[a. Velocity; b. Cubic metre; c. Mercury; d. Lightyear]

Unit 2

Force and Motion



Learning Objectives

After studying this unit, students will be able

- ❖ To define distance and displacement.
- ❖ To differentiate distance and displacement
- ❖ To define speed, velocity and acceleration.
- ❖ To differentiate speed and velocity
- ❖ To draw and explain distance- time and velocity time graphs.
- ❖ To measure and calculate the speed of the moving objects.
- ❖ To know the day to day uses of centre of gravity and stability.

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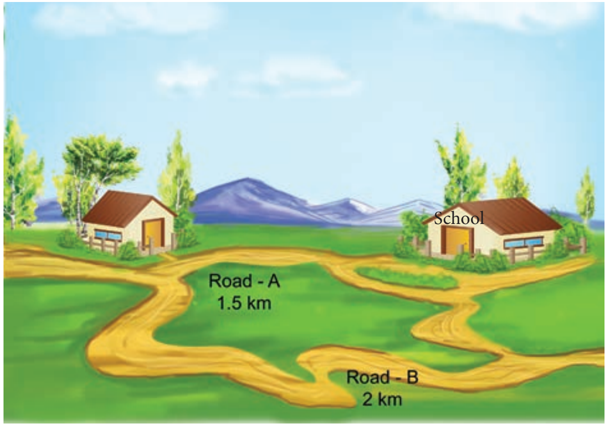
Introduction



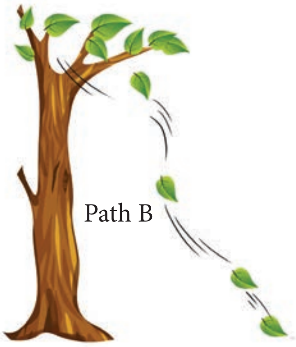
As shown in the above picture, Kavitha can reach her school in two ways. Can you tell, by choosing which path she could reach the school early.

Road A

Road B

Look at the nearby picture

Path of the leaf, when there is no wind.

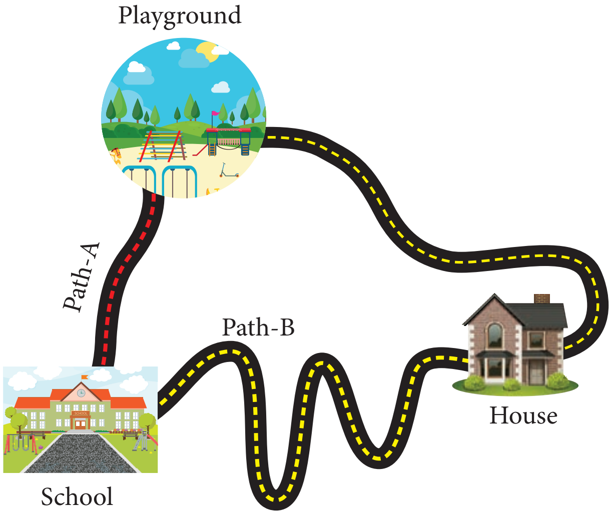


Path of the leaf when there is wind.

In which path the leaf will reach the ground first?

____

Uma and Priya are friends studying in the same school. After school hours, they go to the nearby playground, play games and return back home. Oneday Uma told that she would reach the playground after visiting her grandmother's house . The path in which they took reached the playground is shown here.



Take a twine and measure the length of the two paths (A & B). Which is the longest path among the two? __________________________.

From the above examples, we could conclude that when an object travel from one place to another, it will reach faster if it travels along the straight line path. The straight line path is the shortest distance between two points.

Distance and Displacement

Distance - The total length of a path taken by an object to reach one place from the other is called distance.

Displacement – The shortest distance from the initial to the final position of an object.

Both the distance and displacement posses the same unit. The SI unit is meter (m).

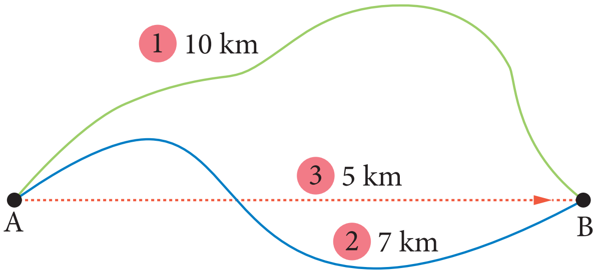
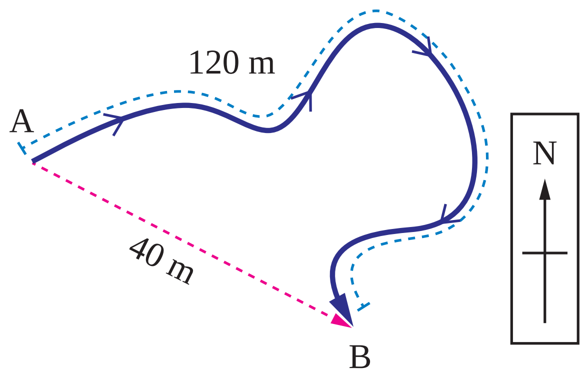


Figure shows the motion of a person between two places A and B.

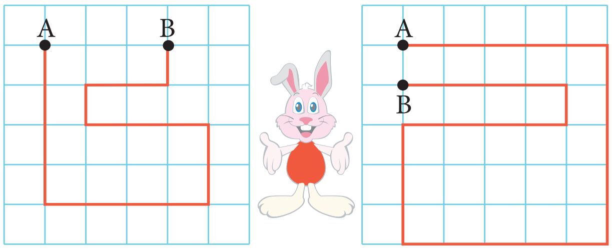
He travels 10 km in first path. In the second path, he travels 7 km.

The distance between A and B via first path is 10 km. In the second path the distance is 7 km. The shortest distance between the two places is 5 km represented as 2. So the displacement is 5 km. (In east direction)



The path of an object travelling from A to B is shown in figure. Total distance travelled by the object is 120 m. The displacement of the object is 40 m (south-east direction)

The path in which a rabbit ran is shown in figure. Find the distance and displacement of it in the two figures. Let us consider that each square is in an unit of one square meter. The rabbit starts from point A and reaches the point B.



Distance ________________ Distance ________________

Displacement ____________ Displacement ____________

When will the distance and displacement be equal. Explain. But the starting and finishing points should be different.

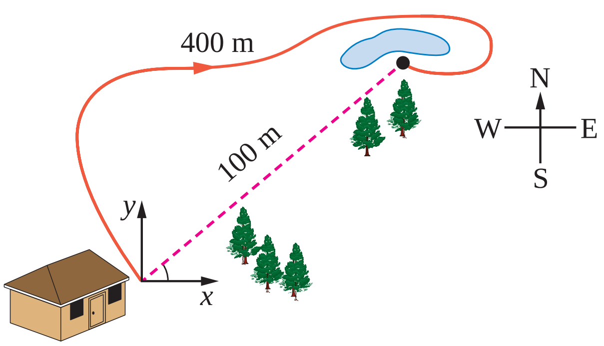
____

____

____

When we represent the displacement, we use a positive or negative sign depending on the direction with which it travels.

Here we can consider the starting point as A and while the object moves from A to B the displacement is considered to be positive and from B to A it is negative.



Answer the following questions:

- ❖ Subha goes to the nearby playground from her home.
  1. What is the distance she travelled?
  2. What is her displacement?
- ❖ The distance travelled by an object is 15 km and its displacement is 15 km. What do you infer from this?
- ❖ The distance of a person is 30 km and his displacement is 0 km. What do you infer from this?

DO YOU KNOW?

Nautical mile

Nautical mile is the unit for measuring the distance in the field of aviation and sea transportation. One nautical mile is 1.852 km.

The unit for measuring the speed of aeroplanes and ships is knot. One knot is the speed taken to travel one nautical mile in hour.

VII Std Science Term-1 EM Unit 2.indd 18 13-03-2019 3.24.14 PM

2.2 Speed - Velocity

Speed

Recapitulation

In sixth standard we already studied about the speed in detail.

> **DO YOU KNOW?**
>
> **1 km/h = 5/18 m/s**
>
> How we got this ?
>
> 1 km = 1000 m
>
> 1 h = 3600 s
>
> 1 km / h = 1000 m / 3600 s = 5/ 18 m /s

Speed is the rate of change of distance .

Speed = distance /time

Unit is metre/second (m/s)

We can classify speed into two types.

Uniform speed

If a body in motion covers equal distances in equal intervals of time, then the body is said to be in uniform speed.

Non- uniform speed

If a body covers unequal distances in equal intervals of time, the body is said to be in non-uniform speed.

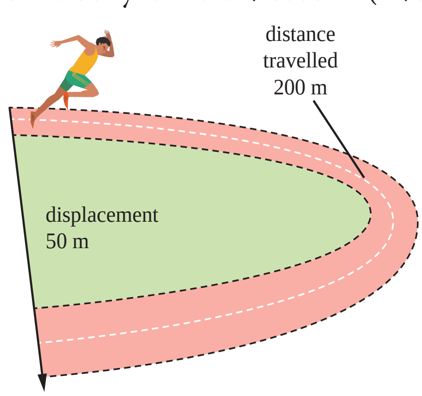
Average speed = total distance travelled / time taken to travel the distance.

Velocity

Velocity is the rate of change in displacement.

Velocity (v) = displacement / time

SI unit of velocity is meter / second (m/s).



If an athlete in the diagram takes 25 s to complete a 200 m sprint event. Find her speed and velocity.

Speed = distance / time
= 200 / 25
= 8 m/s

velocity = displacement /time
= 50 / 25
= 2 m/s

Uniform velocity

A body has uniform velocity, if it covers equal displacement in the same direction in equal intervals of time. **E.g.** light travels through vacuum.

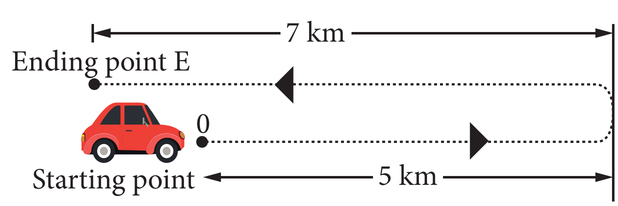
Non uniform velocity

If either speed or direction changes, the velocity is non uniform. **E.g.** a train starting and moving out of the station.

Average velocity

Average velocity = total displacement / total time taken

E.g. Figure shows a car that travels 5 km due east and makes a U – turn to travel another 7 km. If the time taken for the whole journey is 0.2 h. Calculate the average velocity of the car.



Average velocity = total displacement/time taken.

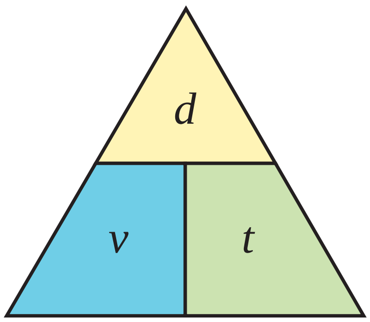
(taking the direction due east of point O as positive)

= (5 – 7) / 0.2

= –2 / 0.2

= –10 km/h (or) –10 × 5/18 = 25/9

= –0.28 m / s



The triangle method can help you to recall the relationship between velocity (v), displacement (d), and time(t).

v = d / t , t = d / v, d = v × t

Answer the following questions:

❖ Calculate the velocity of a car travelling with a uniform velocity covering 100 m distance in 4 seconds.

❖ Usain Bolt covers 100 m distance in 9.58 seconds. Calculate his speed. Who will be the winner if Usain Bolt comepetes with a Cheetah running at a speed of 30 m/s?

❖ You are walking along east covering a distance of 4 m, then 2 m towards south, then 4 m towards west and at last 2 m towards north. You cover the total distance in 21 seconds, what is your average speed and average velocity?

2.3 Acceleration

Acceleration (a)

Acceleration is the rate of change in velocity. In other words if a body changes its speed or dirction then it is said to be accelerated.

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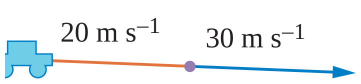
Acceleration = change in velocity/ time

= [final velocity (v) – intial velocity (u)] / time (t)

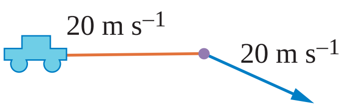
a = (v–u) / t

SI unit of acceleration is m/s^2

In other words, the object undergoes acceleration when its speed and/or direction change(s).



(a) Change in speed

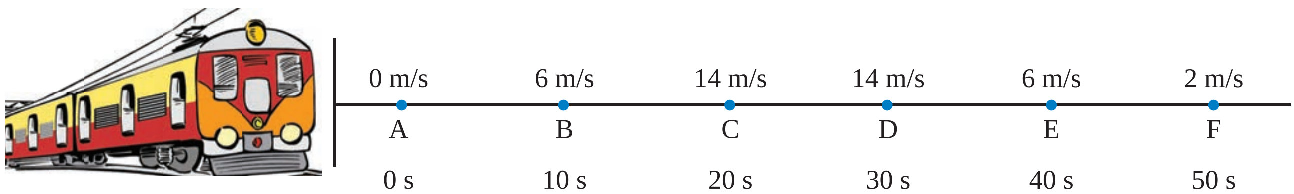


(b) Change in directoin

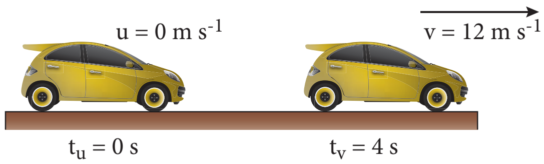
(c) Change in both speed and directoi

The distance travelled by train	Initial velocity (u) m/s	Final velocity (v) m/s	Change in velocity (v – u) m/s	Time taken (t) s	Acceleration = change in velocity / time a = (v – u) / t m / s^2
A-B	0	6	6	10	0.6
B-C					
C-D					
D-E					
E-F					

The velocity at different times of a train departing direction is given in the figure. Analyse this and complete the table .



Tell me



A car at rest starts to travel in a straight path. It reaches a velocity of 12 m/s in 4 s . What is its acceleration. Assuming that it accelerates uniformly?

Initial velocity u = 0 m/s (since the car starts from rest)

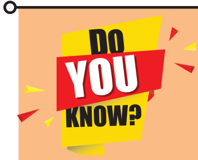
Final velocity (v) = 12 m /s

Time taken (t) = 4 s

acceleration (a) = (v – u) / t

= (12 – 0) / 4

= 3 m / s^2



See how brisk I am !

My name is cheetah. I can run at a great speed. Do you know what my speed is? 25 m/s to 30 m/s. My speed changes from 0 to 20 m/s in 2 second. See how good my acceleration is !

Tell me

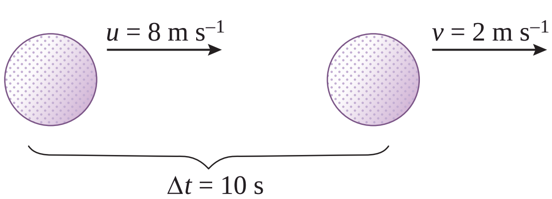
From the above information, can you calculate the acceleration of the cheetah?

Positive acceleration

If the velocity of an object increases with respect to time, then the object is said to be in positive acceleration or just acceleration.

Negative acceleration or deceleration or retardation

If the velocity of an object decreases with respect to time, then the object is said to be in negative acceleration or deceleration or retardation.



The velocity of a golf ball rolling in a straight line changes from 8 m/s to 2 m/s in 10 s. What is its deceleration, assuming that it is decelerating uniformly ?

Initial velocity (u) = 8 m/s

Final velocity (v) = 2 m/s

Time taken(t) = 10 s

Acceleration (a) = (v – u)/t

= (2 – 8)/10

= –0.6 m/s^2

The deceleration is –0.6 m/s^2

Uniform acceleration

An object undergoes uniform acceleration when the change (increase or decrease) in its velocity for every unit of time is the same.

Table shows a moving bus with uniform acceleration.

Time (s)	1	2	3	4	5
Velocity (m/s)	20+20	40+20	60+20	80+20	100 + 20
	(acceleration)				
	100 – 20	80-20	60-20	40-20	20-20
	(deceleration)				

When the velocity of the object is increasing by 20 m/s the acceleration is 20 m/s^2. When the velocity of the object is decreasing by 20 m/s the deceleration is 20 m/s^2.

Non – uniform acceleration

An object undergoes non uniform acceleration if the change in its velocity for every unit of time is not the same.

Time (s)	0	1	2	3	4	5
Velocity (m/s)	0	10	40	60	70	50
Change in Velocity (m/s)	0	10	30	20	10	20

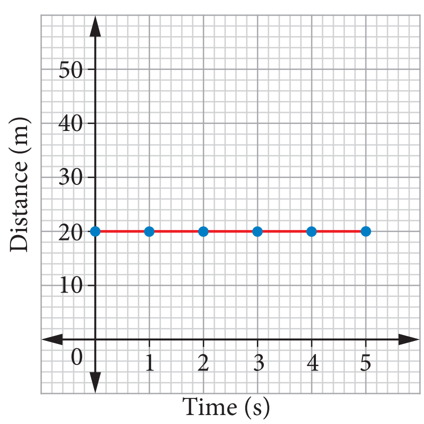
Note that the change in velocity is not the same for every second. The moving object is undergoing non uniform acceleration.

2.4 Distance – Time Graphs

Figure shows a car travelling along a straight line away from the starting point O. The distance of the car is measured for every second. The distance and time are recorded and a graph is plotted using the data. The results for four possible journeys are shown below.

(a) Car at rest

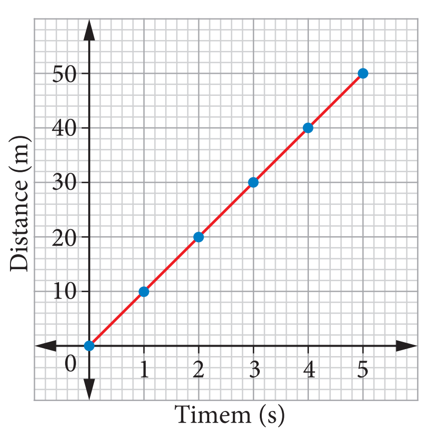
Time (s)	0	1	2	3	4	5
Distance (m)	0	20	20	20	20	20



The graph has zero gradient. The distance is a constant for every second.

(b) Car travelling at uniform speed of 10 m s^{-1}

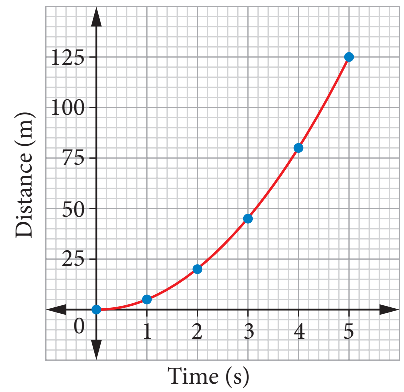
Time (s)	0	1	2	3	4	5
Distance (m)	0	10	20	30	40	50



The graph has a zero constant gradient. The distance increases 10 m every second.

(C) Car travelling at increasing speed

Time (s)	0	1	2	3	4	5
Distance (m)	0	5	20	45	80	125

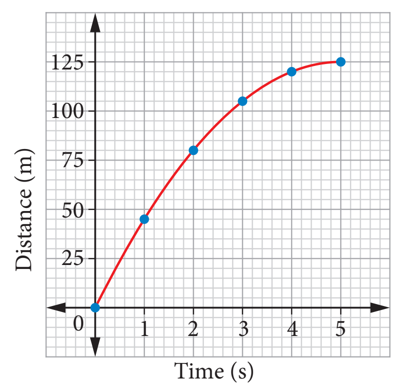


The graph has an increasing gradient. The speed increases

The instantaneous speed of the car at t = 3 s is given by the gradient of the tangent at the point.

(D) Car travelling at decreasing speed

Time (s)	0	1	2	3	4	5
Distance (m)	0	45	80	105	120	125



The graph has a decreasing gradient. The speed decreases

2.5 Speed – time graphs

Let us consider a bus travelling from Thanjavur to Trichy. The speed of the bus is measured for every second. The speed and time are recorded and a graph is plotted using the data. The results for four possible journeys are shown.

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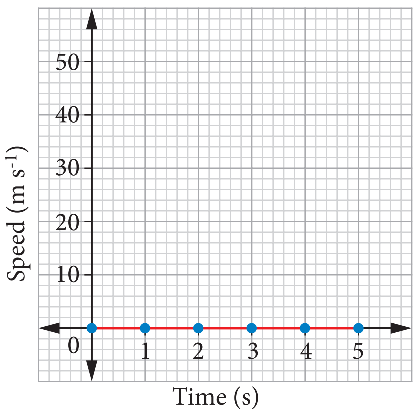
1. Bus at rest

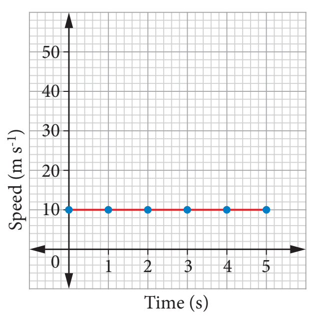
Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	0	0	0	0	0	0



The speed remains at 0 m s^{-1}, so the car has zero acceleration.

2. Bus travelling at uniform speed of m/s

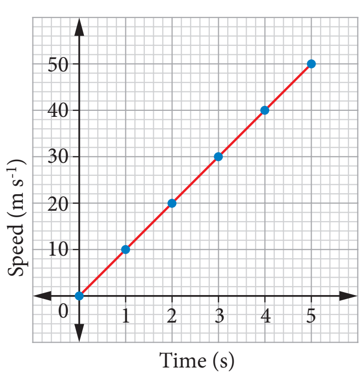
Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	10	10	10	10	10	10



The speed remains at 10 m s^{-1}, so the car has zero acceleration.

3. Bus travelling with uniform acceleration

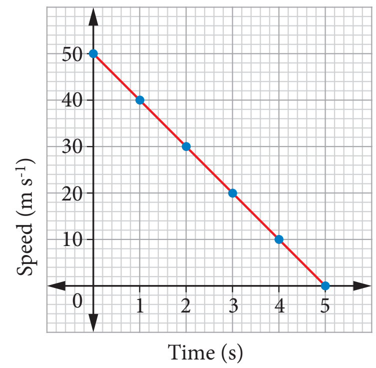
Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	10	10	20	30	40	50



The speed of the car increases by 10 m s^{-1}, every second. Hence, the graph has a positive and constant gradient, and the acceleration is constant.

4. Bus travelling with uniform deceleration

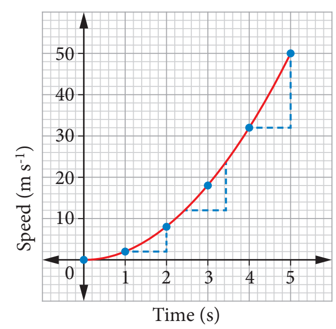
Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	50	40	30	20	10	0



The speed of the car decreases by 10 m s^{-1}, every second. Hence, the graph has a negative and constant gradient, and the acceleration is constant.

5. Bus travelling with increasing acceleration (non – uniform acceleration)

Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	0	2	8	18	32	50

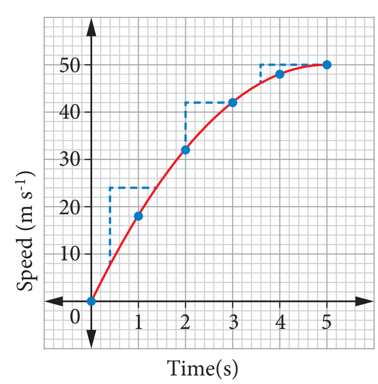


The increase in speed is increasing with time. Hence, the graph has a positive and increasing gradient, and the acceleration increases.

The instantaneous acceleration of the car at t = 3 s is given by the gradient of the tangent at the point.

6. Bus travelling with decreasing acceleration (non – uniform acceleration)

Time (s)	0	1	2	3	4	5
Speed (m s^{-1})	0	18	32	42	48	50

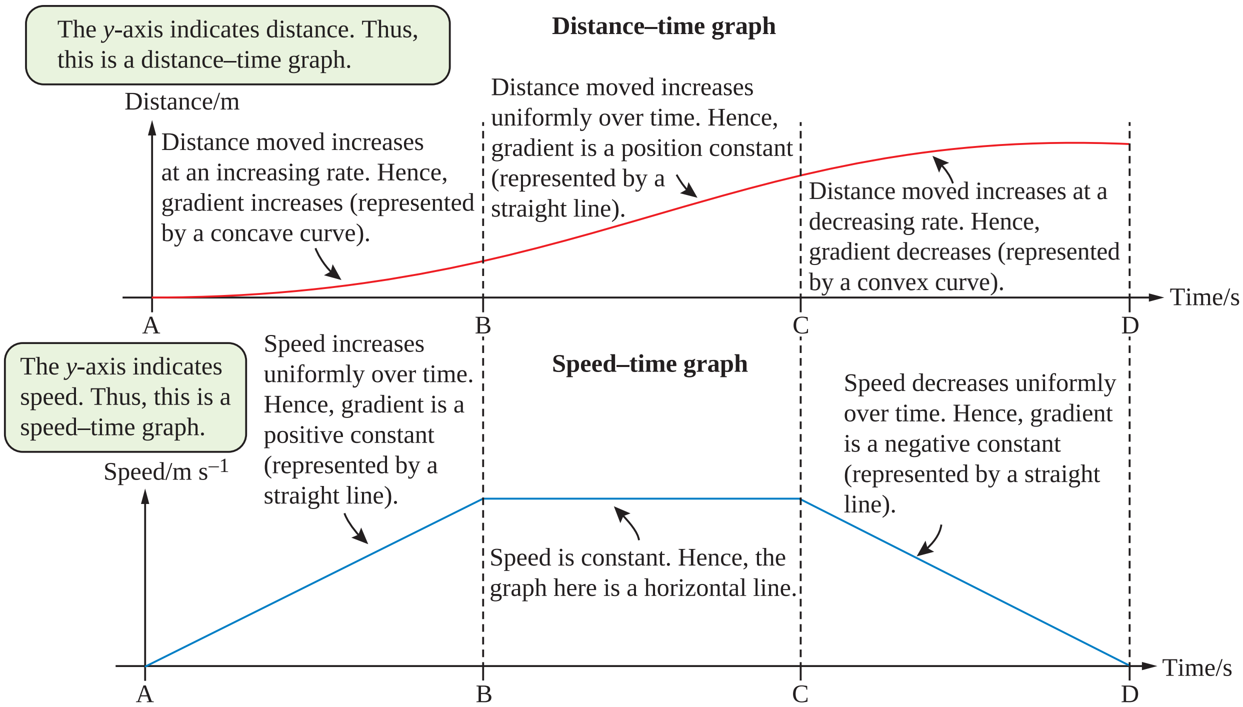


The increase in speed is decreasing with time. Hence, the graph has a positive and decreasing gradient and the acceleration decreases.

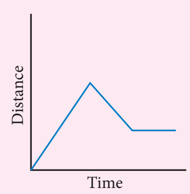
Comparisons between distance – time and speed – time graphs

Speed – time graphs and Distance – time graphs look very similar, but they give different information. We can differentiate them by looking at the labels.

From A to B	From B to C	From C to D
Car accelerates uniformly from rest.	Car moves at constant speed.	Car decelerates uniformly to a stop.

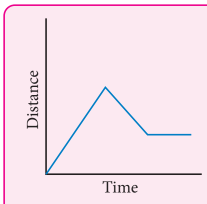


Graph and Story



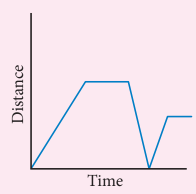
Raju began walking to his school. he remembered that he forgot his pen and walked back home, but he stopped suddenly when he heard a noise.

Draw a graph for the given story.



Rani was waiting for her mother for some time. When she saw her mother, she ran out of her home hugged her and stood there for a while.

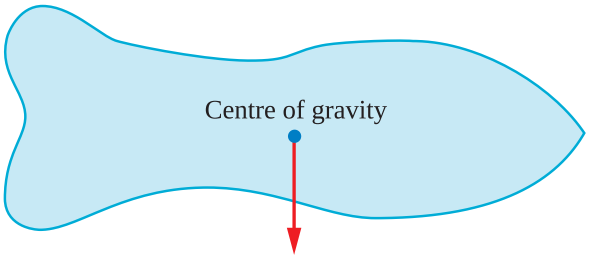
Imagine and write a story on your own for the given graph?



2.6 Centre of Gravity and Stabilty

Centre of gravity

Try to balance a cardboard on your figure tip. What do we observe. We observe there is only one point which the cardboard is balanced. The point which the cardboard is balanced is called the cenre of gravity of the cardboard.

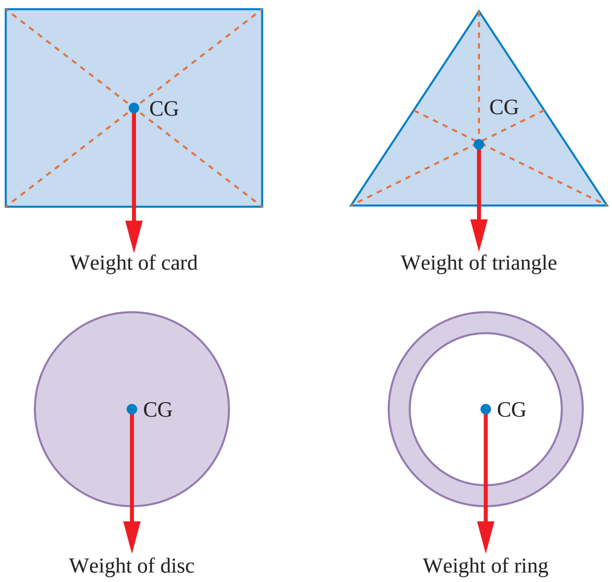


Total pull of the earth (weight) appears to act through the centre of gravity

Centre of gravity: The centre of gravity of an object is the point through which the entire weight of the object appears to act.

How to we find the centre of gravity of a object ?

Centre of gravity for Regular – shaped objects



Generally the centre of gravity of the geometrical shaped object lie on the geometric centre of the object.

Examples of centre of gravity for Regular-shaped objects. 1. Weight of Card, 2. Weight of Triangle, 3. Weight of Disc, 4. Weight of Ring.

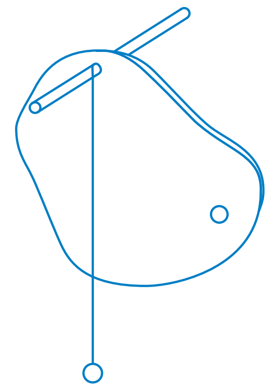
What about irregular shaped objects ?

Apparatus : Irregularly shaped card, string, pendulum bob, stand

1. Make three holes in the lamina.
2. Suspend the lamina from the optical pin through one of the holes as shown.
3. Suspend the plumbline from the pin and mark the position of the plumbline on the lamina.
4. Draw lines on the lamina representing the positions of the plumbline.
5. Repeat the above steps for the holes.
6. Label the intersection of the three lines as X, the position of the centre of gravity of the lamina.

Meter Rule

The ruler is in equilibrium when supported at its centre of gravity.



For a regular object such as a uniform meter rule , the centre of gravity is at the centre of the object. When the object is supported at that point, it will be balanced. If it is supported at any other point, it will topple.

2.7 Stability

Stability is a measure of the body's ability to maintain its original position.

The three types of stability are

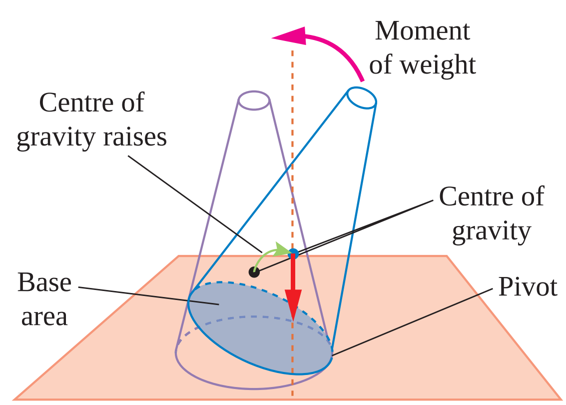
(a) Stable equilibrium

(b) Unstable equilibrium

(c) Neutral equilibrium

Stable Equilibrium

The frustum can be tilted through quite a big angle without toppling.



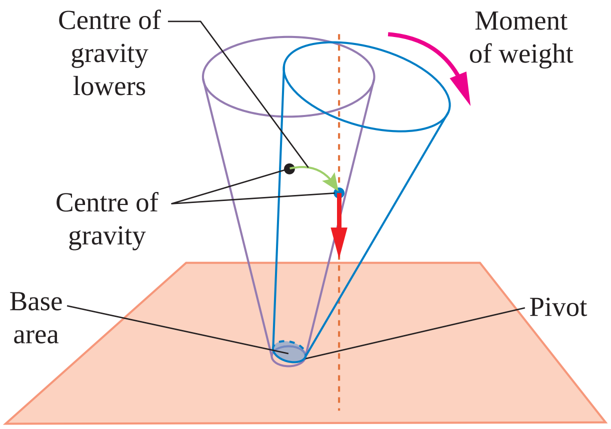
Its centre of gravity is raised when it is displaced.

The vertical line through its centre of gravity still falls within its base.

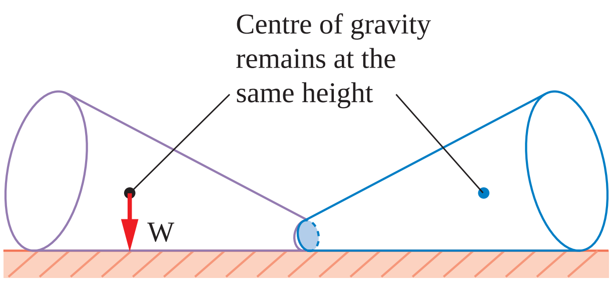
So it can return to its orginal positionl.

Unstable Equilibrium

The frustum will topple with the slightest tilting. Its centre of gravity is lowered when it is displaced.



The vertical line through its centre of gravity falls outside its base.



Neutral Equilibrium

(d) It causes frustum to topple.

(e) The frustum will rolls about but does not topple.

(f) Its centre of gravity remains at the same height when it is displaced.

(g) The body will stay in any position to which it has been displaced.

Condition for Stability

To make a body more stable

- Lower its centre of gravity
- Increase the area of its base
- This box is at the point of tipping over
- A heavy base lowers at the centre of gravity So the box does not tip over
- A brode base makes the box more difficult to tip over

The Thanjavur Doll

It is s type of traditional Indian toy made of terracotta material. The centre of gravity and the total weight of the doll is concentrated at its bottom most point, generating a dance-like continuous movement with slow oscillations.

Real Life Applications of Centre of Gravity

It is for the reasons of stability that the luggage compartment of a tour bus is located at the bottom and not on the roof. Extra passengers are not allowed on the upper deck of a crowded double decker bus. Racing cars are built low and broad for stability. Table lamps and fans are designed with large heavy bases to make them stable.

2.8 Science Today

Typical Speeds

Tortoise	0.1 m/s
Person walking	1.4 m / s
Falling raindrop	9-10 m / s
Cat running	14 m/s
Cycling	20-25 km/h
Cheetah running	31 m/s
Bowling speed of fast bowlers	90-100 miles /h
Badminton smash	80-90 m/s
Passenger jet	180 m/s

Points to Remember

- ❖ **Distance** - The path taken by an object to reach one place from the other is called distance.
- ❖ **Displacement** – The straight line path between two points is called displacement
- ❖ **Velocity** is the rate of change in displacement. SI unit of velocity is meter / second (m/s).
- ❖ **Acceleration** is the rate of change in velocity. SI unit of acceleration is m/s^2
- ❖ **Centre of gravity** : The centre of gravity of an object is the point through which the entire weight of the object appears to act.
- ❖ Generally the centre of gravity of the geometrical shaped object lie on the geometric centre of the object.
- ❖ **Stability** is a measure of the body's ability to maintain its original position.
- ❖ The three types of stability are : 1. Stable equilibrium 2. Unstable equilibrium 3. Neutral equilibrium.

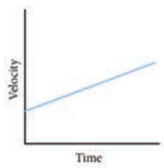
Evaluation

I. Choose the best answer.

1. A particle is moving in a circular path of radius *r*. The displacement after half a circle would be
   a. Zero b. R
   c. 2 *r* d. *r* / 2

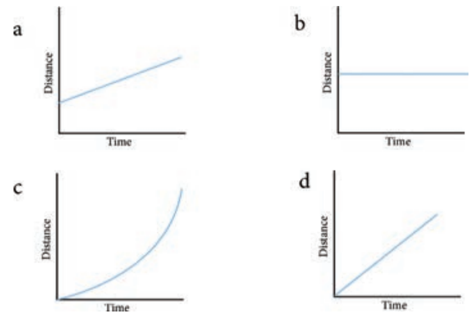
AJZEAV

2. From the given v-t graph it can be inferred that the object is



   a. in uniform motion
   b. at rest
   c. in non uniform motion
   d. moving with uniform acceleration

3. Which of the following figures represent uniform motion of a moving object correctly?



4. Suppose a boy is enjoying a ride on a marry go round which is moving with a constant speed of 10 m/s. It implies that the boy is
   a. at rest
   b. moving with no acceleration
   c. in accelerated motion
   d. moving with uniform velocity

5. What is one way you might increase the stability of an object?
   a. lower the centre of gravity
   b. raise the centre of gravity
   c. increase the height of the object
   d. shorten the base of the object

II. Fill in the blanks.

1. The shortest distance between the two places is ____________.
2. The rate of change of velocity is__________.
3. If the velocity of an object increases with respect to time, then the object is said to be in___________ acceleration.
4. The slope of the speed–time graph gives ____________.

5. In __________ equilibrium its centre of gravity remains at the same height when it is displaced.

III. Match the following:

Displacement	Knot
Light travels through vacuum	Geometric centre
Speed of ship	Metre
Centre of gravity of the geometrical shaped object	Larger base area
Stability	Uniform velocity

IV. Analogy

1. velocity : metre/ second : : acceleration : __________ .
2. length of scale : metre : : speed of aeroplane : __________ .
3. displacement / time : velocity : : speed / time : __________ .

V. Give very short answer.

1. All objects having uniform speed need not have uniform velocity. Describe with the help of examples.
2. "She moves at a constant speed in a constant direction". Rephrase the same sentence in fewer words using concepts related to motion.
3. Correct your friend who says "The acceleration gives the idea of how fast the position changes".

VI. Give short answer.

1. Show the shape of the distance – time graph for the motion in the following cases.
   a. A bus moving with a constant speed.
   b. A car parked on a road side.
2. Distinguish between speed and velocity.
3. What do you mean by constant acceleration?
4. What is centre of gravity ?

VII. Answer in detail.

1. Explain the types of stability with suitable examples.
2. Write about the experiment to find the centre of gravity of the irregularly shaped plate.

VIII. Numerical problems.

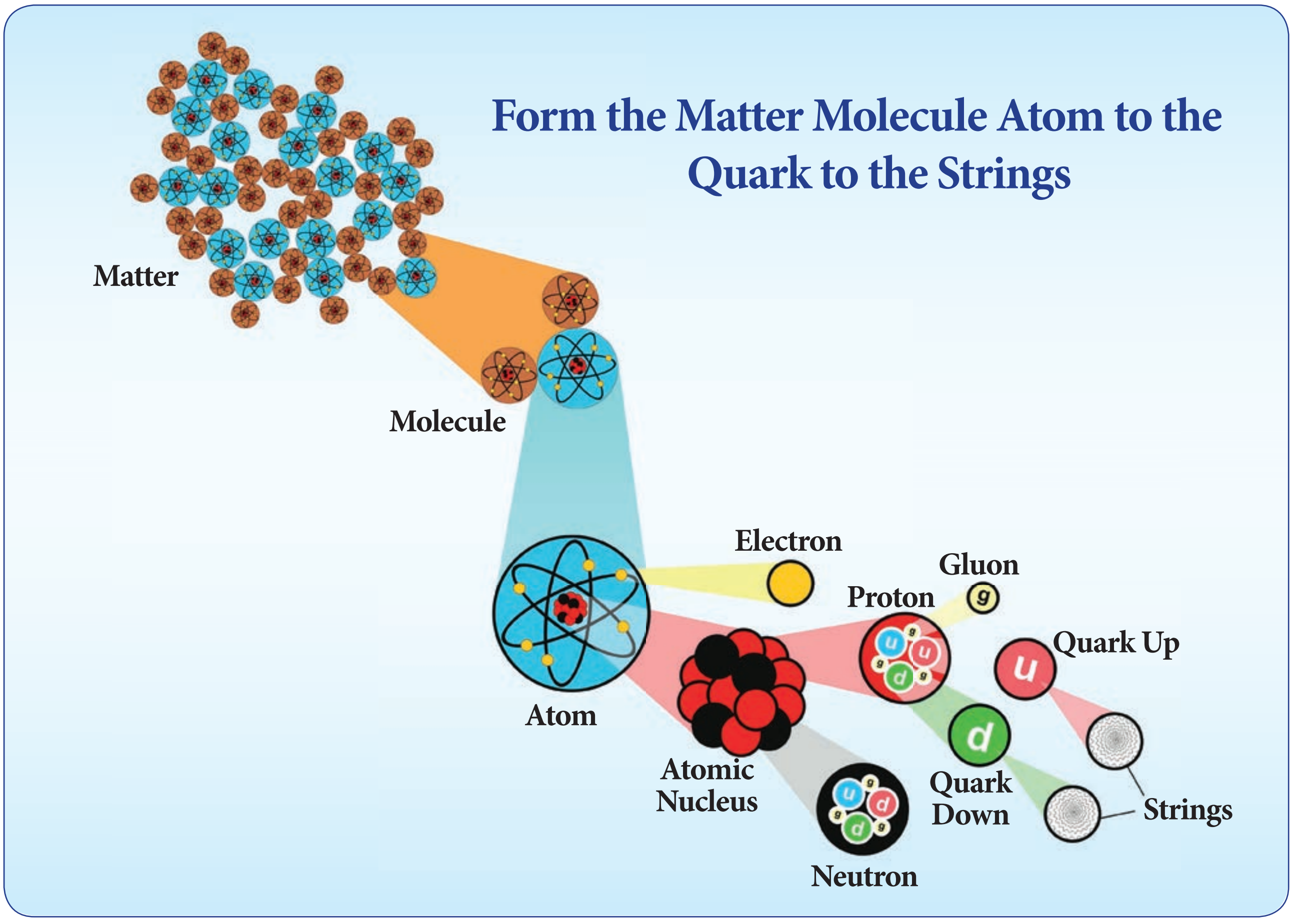
1. Geetha takes 15 minutes from her house to reach her school on a bicycle. If the bicycle has a speed of 2 m/s, calculate the distance between her house and the school.
2. A car started from rest and travelling with velocity of 20 m /s in 10 s. What is its acceleration?
3. A bus can accelerate with an acceleration 1 m / s^2. Find the minimum time for the bus to reach the speed of 100 km / s from 50 km / s.

IX. Fill in the boxes.

S.No.	First Move	Seconde Move	Distance (m)	Displacement
1.	Move 4 meters east	Move 2 meters west	6	2 m east
2.	Move 4 meters north	Move 2 meters south		
3.	Move 2 meters east	Move 4 meters west		
4.	Move 5 meters east	Move 5 meters west		
5.	Move 5 meters south	Move 2 meters north		
6.	Move 10 meters west	Move 3 meters east		

Unit 4

Atomic Structure



Learning Objectives

- ❖ To know the structure of an atom.
- ❖ To know the position of the subatomic particle, understand and compare the properties of subatomic particles.
- ❖ To understand the term atomic number and mass number.
- ❖ To calculate the number of protons, electrons and neutrons in an atom from the symbols in the periodic table.
- ❖ To understand the term valency

GIATMT

Introduction

In the last chapter we have studied anything around us is matter and is made up of molecules. The molecules are combination of atoms of different elements or the same element.

ACTIVITY 1

Some known objects are shown, also the broken particles of the objects are shown.

1. Name the articles or objects you see here? Also try to write What each of it made of?

1. --------------------

2. --------------------

3. --------------------

4. --------------------

Hey friends! I am atom. I am the smallest particle.

Table, chair, bag, book, chalk and blackboard, in short everything you see around are made up of atoms. I cannot be seen through a microscope. Molecule can be cut or divided into atoms that makes it up.

Hey friends! I am molecule.
I am made up of two or more atoms.

Do you guys know how small I am? When compared with the things you see daily you all will get a better idea.

4.1 How small is an atom?

An atom is one and thousand times smaller than the thickest human hair. It has an average diameter of 0.0000000001m or 1×10^{-9} m. To understand atom's size with the familiar things we know, now let us find what is the size of pencil, red blood cell, virus and dust particle.

1×10^{-2} m 1×10^{-4} m 1×10^{-6} m
1×10^{-7} m 1×10^{-10} m

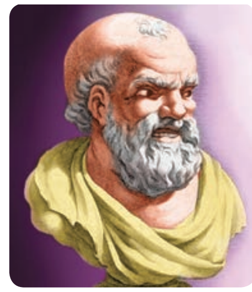
Now you could imagine how small an atom would be.

4.2 Evolution of idea of an atom

Many scientists have studied the structure of the atom and advanced their theories about it. The theories proposed by Dalton, Thomson and Rutherford are given below.

Dalton's atomic theory

John Dalton proposed the atomic theory in the year 1808. He proposed that matter consists of very small particles which he named atoms. An atom is smallest indivisible particle, it is speherical in shape. His theory does not propose anything about the positive and negative charges of an atom.



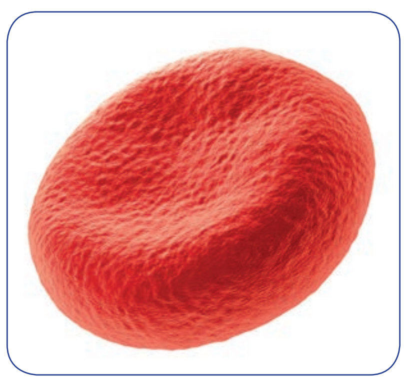
John Dalton

Hence , it was not able to explain many of the properties of substances.

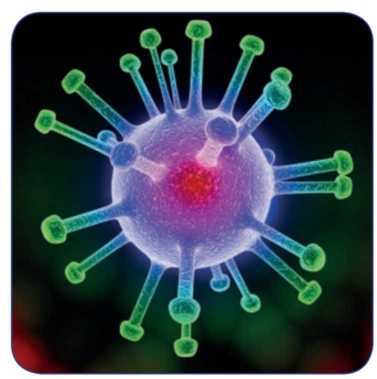
DO YOU KNOW?

Nanometer is the smallest unit used to measure small lengths. One metre is equal to 1×10^{-9} nm or one nanometer is equal to 1×10^{-9} m

Pencil 1×10^{-2} m

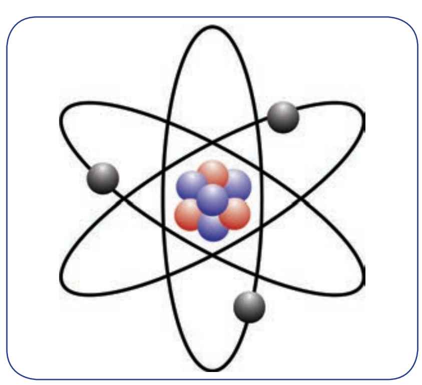


Red Blood Cell 1×10^{-4} m



Virus 1×10^{-6} m

Dust Particle 1×10^{-7} m



Atom 1×10^{-10} m

Thomson's theory

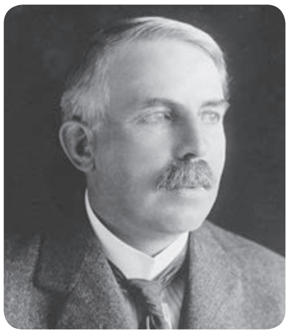
J.J. Thomson

In 1897 J.J Thomoson proposed a different theory. He compared an atom to a watermelon.

His theory proposed that the atom has positively charged part like the red part of the watermelon and in it are embedded , like the seeds, negatively charged particles which he called electrons. According to this theory as the positive and negative charges are equal, the atom as a whole does not have any resultant charge.

Thomson's greatest contribution was to prove by experimentation the existence of the negatively charged particles or electrons in an atom. For this discovery, he was awarded the Nobel Prize in 1906. Although this theory explained why an atom is neutral , it was an incomplete theory in other ways.

Rutherford's theory



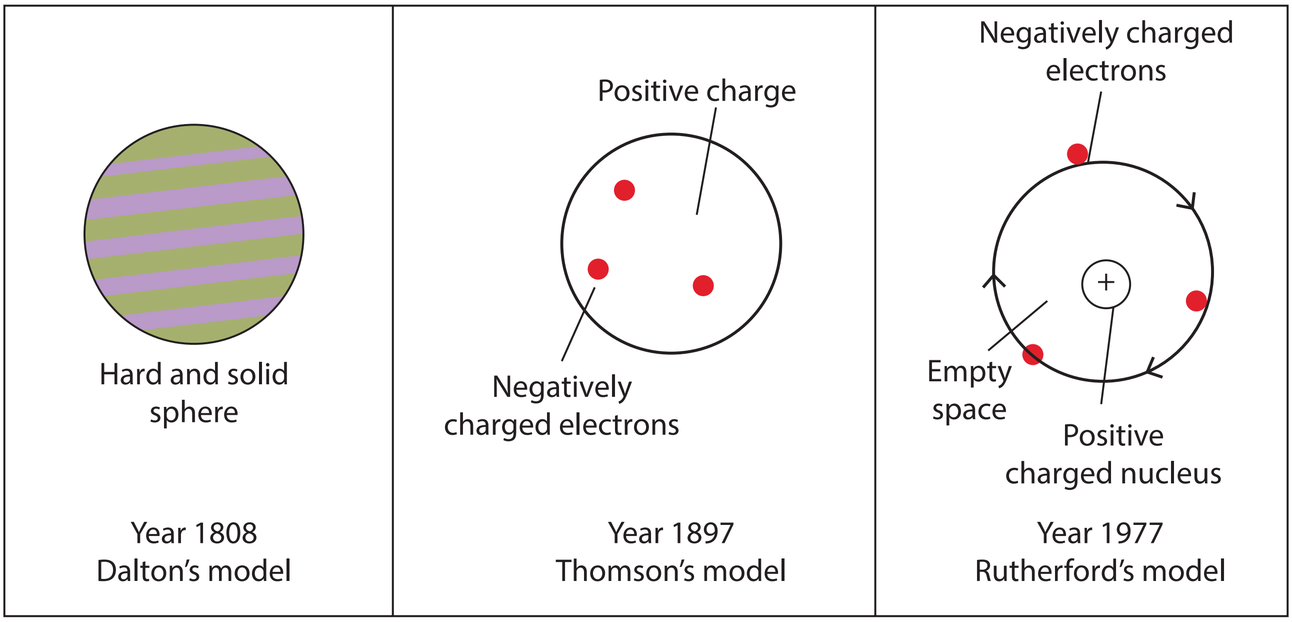
Rutherford

There were short comming in Thomson's theory, Earnest Rutherford gave a better understanding. Earnest Rutherford conducted an experiment. He bombarded a very thin layer of gold with positively charged alpha rays. He found that most of these rays which travel at a great velocity passed through th gold sheet without encountering any obstacles. A few are, however, turned back from the sheet.

Rutherford considered this remarkable and miraculous as if a bullet had turned back after colliding with tissue paper.

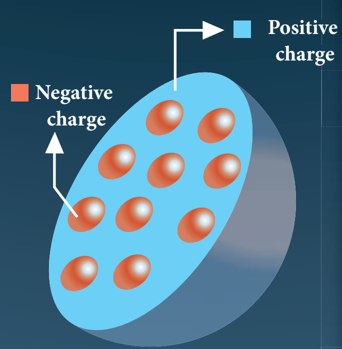
Based on this experiment, Rutherford proposed his famous theory. In his opinion, – 1. The fact that most alpha particles pass through the gold sheet means that the atom consists mainly of empty space. 2. The part from which the positively charged particles are turned back is positively charged but very small in size as compared to the empty space.

Stages of discovery of the constituents of an atom

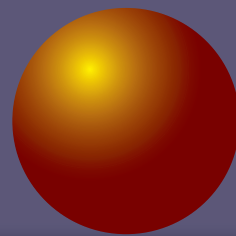


Evolution of the atomic structure from the 5 elements

Hindu philophers discuss atoms as ultimate pieces of the elements earth, air, fire and water. Atoms are round and differ in properties such as color, flavor and odor.

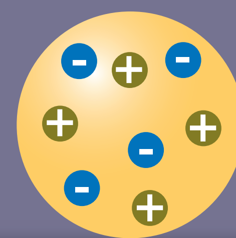


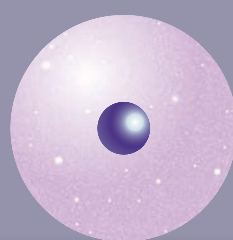
J.J. Thomson proposes the "plum pudding" model of the atom, picturing negatively charged electrons rotating in concentric rings within a sphere of positive electricity



1803
DALTON THEORY

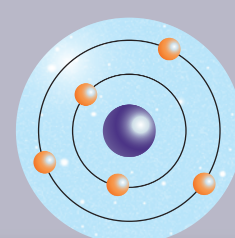
1904
J.J. THOMSON THEORY

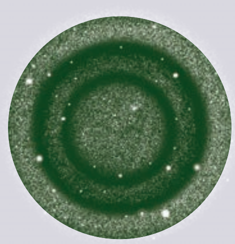




1911
RUTHERFORD THEORY
(the nucleus)

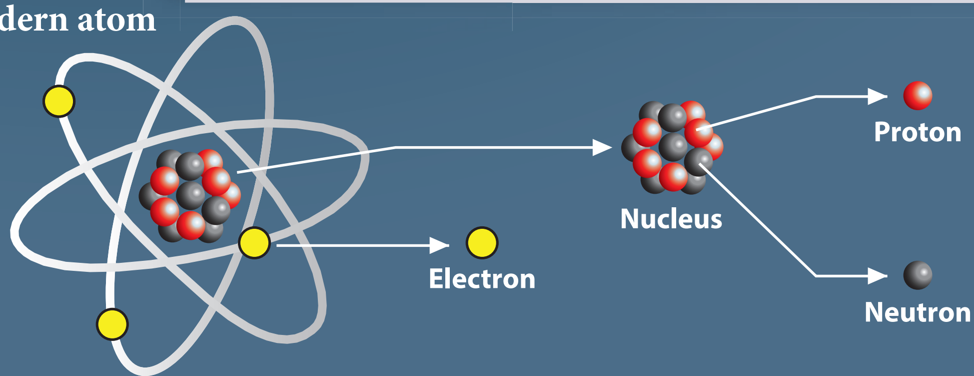
1913
BOHR THEORY
(the energy levels)



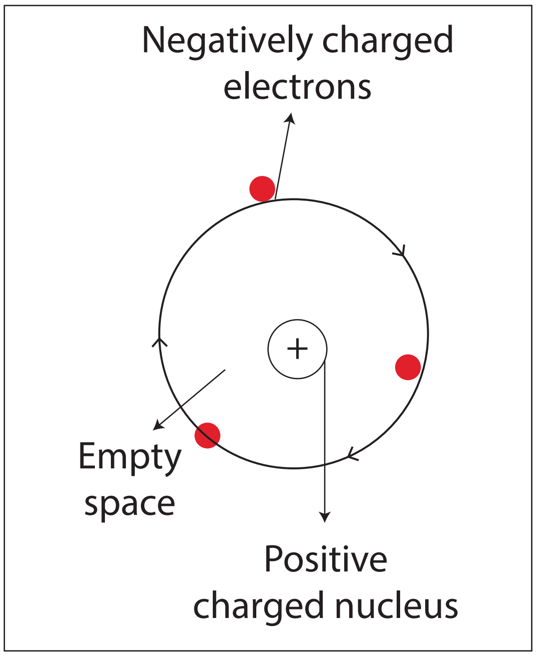


1926
SCHRODINGER THEORY
(electron cloud model)

Modern atom



From these inferences, Rutherford presented his theory of the structure of atoms. For this theory, he was awarded the Nobel prize for chemistry.



Rutherford's theory proposes that

1. The nucleus at the centre of the atom has the positive charge. Most of the mass of the atom is concentrated in the nucleus.
2. The negatively charged electrons revolve around the nucleus in specific orbits.
3. In comparison with the size of the atom, the nucleus is very very small

DO YOU KNOW? You have around 7 billion atoms in your body, yet you replace about 98% of them every year!

4.3 The subatomic particles

The discoveries made during the twentieth century proved that atoms of all elements are made up of smaller components - electron, proton and neutron. An electron from hydrogen atom is no different from electron of a carbon atom. In the same manner, protons and neutrons of all elements also have same characteristics.These particles that make up the atom are called Subatomic Particles.

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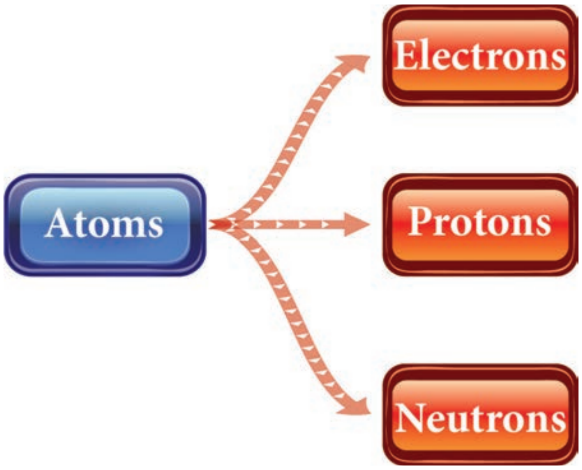


Proton (p)

The proton is the positively charged particle and its located in the nucleus. Its positive charge is of the same magnitude as that of the electron's negative charge.

Neutron (n)

Neutron is inside the nucleus. The neutron does not have any charge. Excepting hydrogen (protium), the nuclei of all atoms contain neutrons.

Electron (e)

This is a negatively charged particle. Electrons revolve around the nucleus of the atom in specific orbits. The mass of an electron is negligible as compared to that of a proton or neutron. Hence, the mass of an atom depends on the number of protons and neutrons in the nucleus.

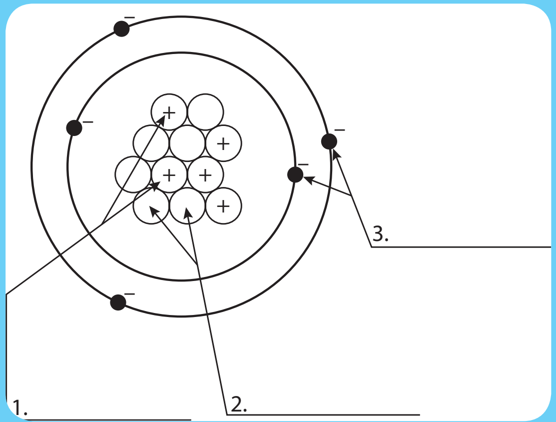
Protons and Neutrons are the two types of particles in the nucleus of an atom. They are called nucleons.The total negative charge of all an electrons outside the nucleus is equal to the total positive charge in the nucleus. That makes the atom electrically neutral.

Charge and mass of the sub atomic particles:

Particle	Discoverer	Symbol	Charge	Mass (kg)
Proton	Ernest Rutherford	p	+1	1.6726×10^{-27}
Electron	Sir John Joseph Thomson	e	-1	9.1093×10^{-31}
Neutron	James Chadwick	n	0	1.6749×10^{-27}

ACTIVITY 2

Let us learn the characteristics of the subatomic particles through the following activity. Label the parts in the given diagram and answer the following.



1. The positively charged particle is ______________ .
2. The negatively charged particle is ______________ .
3. ______________ is neutral.

4.4 Atomic number and Mass number

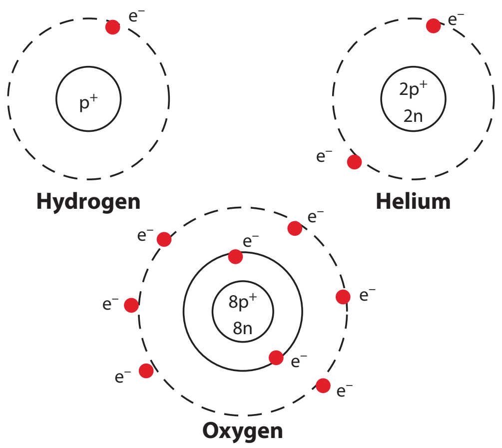
If all elements are made up of same type of electrons, protons and neutrons how does a carbon atom differ from a iron atom? Further investigations led to the discovery that the number of the protons inside the nucleus of an atom determines what element it is. For Example if the nucleus has only one proton, then all such atoms are hydrogen atom. If there are eight protons then that atom is oxygen.

J2X6SG

Is the structure of the atom the same as the structure of the solar system? Yes ! It is similar to the solar system. It has a core center called nucleus and it has paths called orbits around the nucleus.

Atomic number (z)

The number of electrons or protons in an atom is called the atomic number of that atom. It is represented by the letter Z. if we know the atomic number of an atom, we know the number of electrons or protons in it.



Look at the figures. The hydrogen nucleus has one proton around which revolves one electron. It means that its atomic number z=1.

In the helium atom there are two protons and two electrons in orbit around the nucleus, so the atomic number of helium is z=2.

Look at the atomic structure of oxygen shown in the figure. What is its atomic number?