Measuring liquids

Fig. 6.3

Your mother asks you to get milk from the milkman. When you buy milk from the milkman, he will give it to you in litres (i.e) volume of liquid is measured in litres.

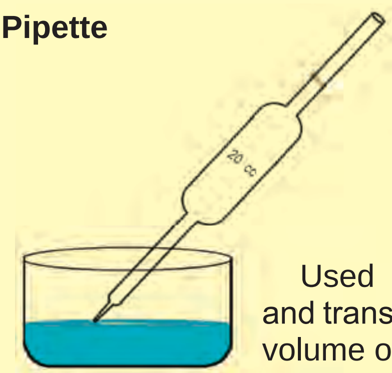
What is the meaning of 1 litre?

1 litre = 1000 cm^3.

One cubic centimetre is otherwise known as 1 millilitre written as ml.

What are the different vessels used to measure the volume of liquids?

Pipette



Used to measure and transfer a definite volume of liquid.

Fig 6.4

Measuring cylinder

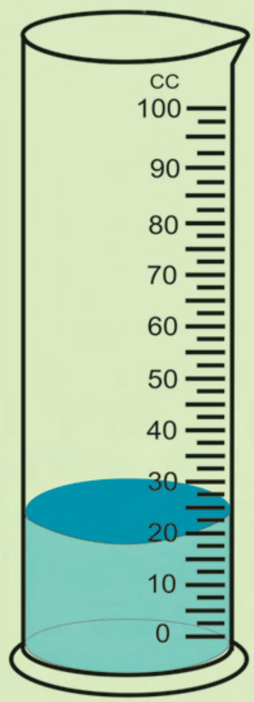


Fig 6.5

Used to measure the volume of liquid.

Burette

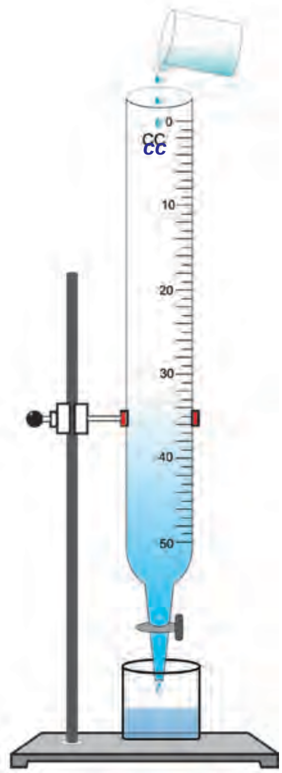


Fig 6.6

Used to make a small fixed volume of liquid to flow.

Measuring flask

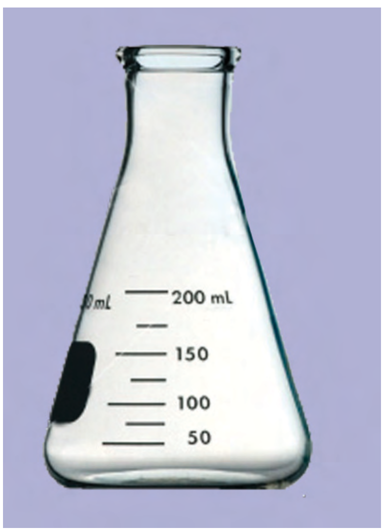
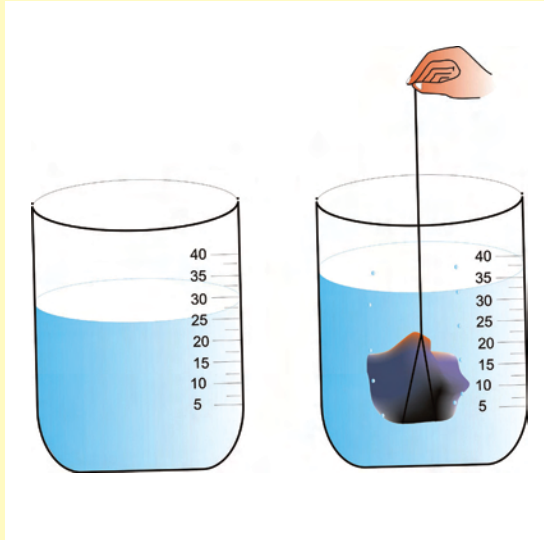


Fig 6.7

Designed to hold a fixed volume.

ACTIVITY 6.9



Let us find the volume of a stone using a measuring cylinder.

Follow the steps given below.

1) Pour water in the measuring cylinder up to a certain level.
2) Note the initial level of water.
3) Tie the stone by means of a thread.
4) Lower the stone into the water so that it is completely immersed without touching the sides.
5) Note the final level of water.
6) The difference between the final and initial levels gives the volume of the stone.

MORE TO KNOW

How will you express volume of water stored in a dam or reservoir?

In thousand million cubic feet (tMc).

SCIENCE

Density

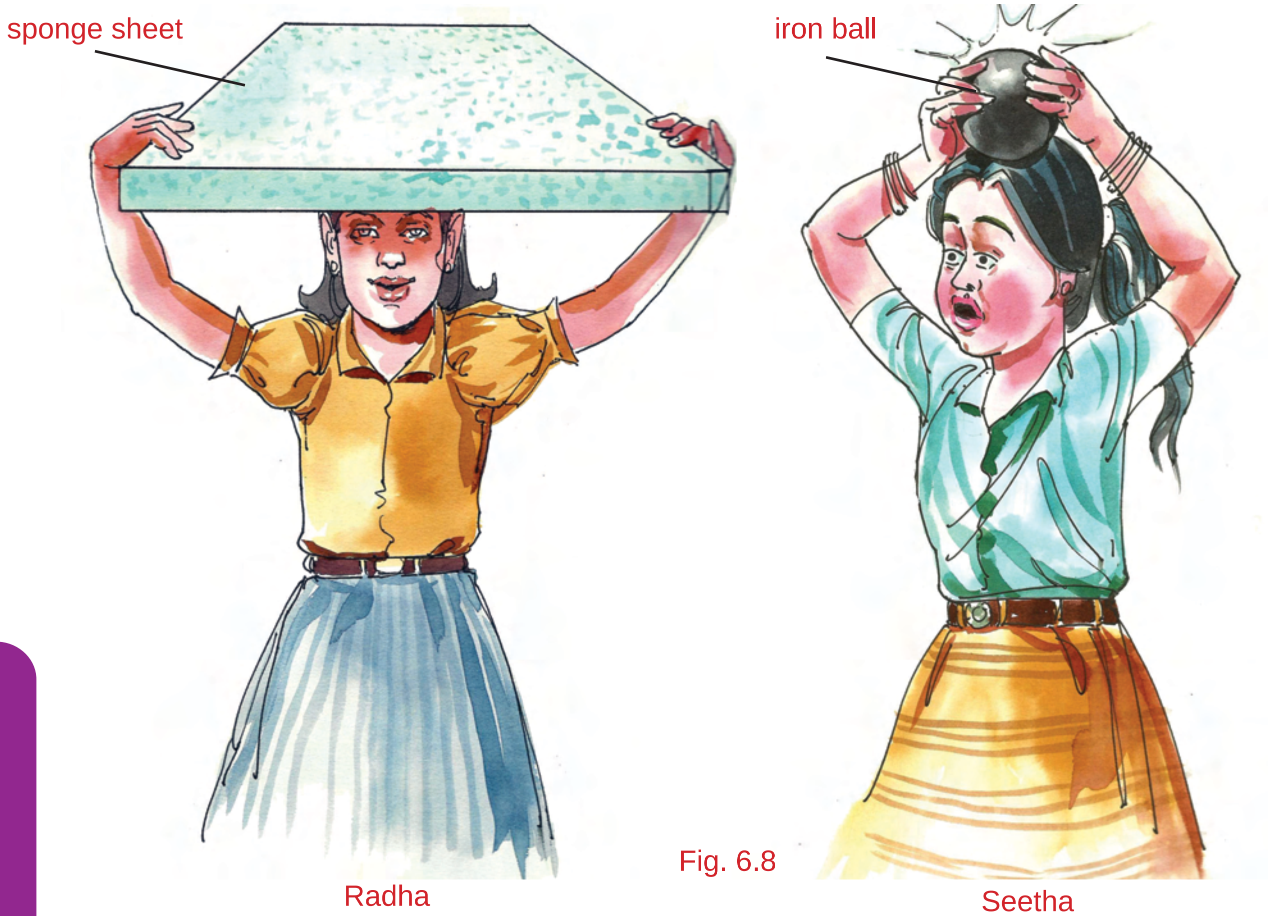


Fig. 6.8

Have a look at the pictures. Who is happier ? Radha or Seetha ?

Definitely Seetha will not be happy as her load (iron ball) is heavier, while Radha will be happy as her load (sponge sheet) is lighter.

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 ball will have more mass than the sponge of same size. Therefore iron has more density.

Density is the mass of unit volume of the substance.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

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

ACTIVITY 6.10

Let us take three balls (spheres) of the same size but made of different materials like cork (cricket ball), iron (shot put) and rubber (bouncing ball) Hold them separately in your hand. Arrange them according to the descending order of their mass.

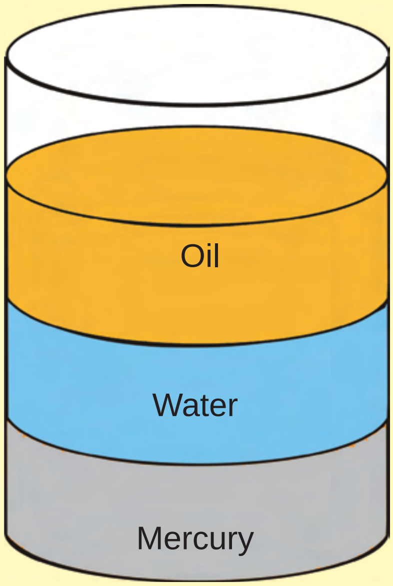
1.

2.

3.

We see that the iron ball has more mass when compared to cork and rubber. It shows that iron has greater density.

ACTIVITY 6.11



Observe the diagram

Let us identify the following :

(i) The liquid denser than water is ________

(ii) The liquid lighter than water is ________

If a substance is lighter than water, it will float; but if it is heavier than water, it will sink.

MORE TO KNOW

Density of water is 1000 kg/m^3. This means that water taken in a tank of length 1m, breadth 1m and height 1m, has a mass of 1000kg.

If the same tank is filled with mercury it will have a mass of 13,600 kg. So mercury is 13.6 times denser than water.

SELF CHECK

1) Density of steel is 7800 kg/m^3. Will it float or sink in mercury?

2) Give the mass of water contained in a tank of length 5m, breadth 3m and height 2m.

TO THINK

A balloon filled with air does not fly whereas a balloon filled with helium can fly. Why?

Hot air ballon

Why does this hot air balloon fly?

6.2. MEASUREMENT OF TIME

Why do we need to measure time?

We need to measure time for many reasons –to know when to go to school, when to take food, when to watch TV and when to sleep . The earlier clocks like the sundial , water clock and hour glass were not very accurate. There was the need to have more accurate and precise instruments . The earliest pendulum clocks which had weights and a swinging pendulum satisfied this need.

SCIENCE

Simple pendulum

Fig 6.9. swing

Have you been on a swing? The back and forth motion of the swing is an example of oscillatory motion. You can observe the same in pendulum clocks, which work on the principle of the simple pendulum.

A simple pendulum is a small metallic ball (bob) suspended from a rigid stand by an inelastic thread. When the bob is pulled gently to one side and released, it moves to and fro. One complete to and fro motion is called one **oscillation.** i.e. from one end (extreme) to the other end and back. The time taken to complete one oscillation is called **time period**.

The distance between the point of suspension and the centre of the bob is called **length of the pendulum**.

Amplitude is the distance upto which the bob is pulled from the position of rest.

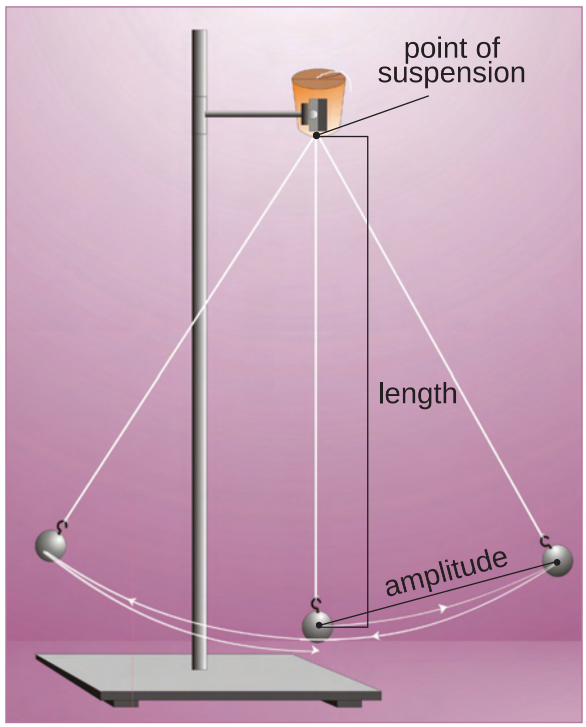
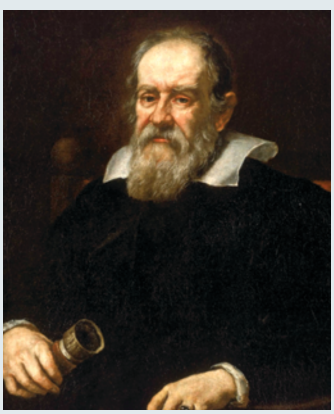


Fig 6.10. Simple pendulum

SCIENCE

A story is told of Galileo. He went to a church in Pisa (in Italy). He noticed that a lamp suspended from the roof by a long chain was swinging periodically. Using his pulse beats he found that the time of swing of the lamp remained constant even as the swinging decreased. His keen observation made him understand the importance of the constant time of the swing.



Galileo

Before he died in 1642, he made plans for the construction of a pendulum clock; but the first successful pendulum clock was constructed by the Dutch scientist Christian Huygens only in 1657.

ACTIVITY 6.12

1. Set up a simple pendulum in your class room with a thread of length 60cm.
2. Set the bob into oscillations
3. Note the time taken for 20 oscillations in seconds, using a stop clock.
4. Time period = Time for one oscillation = $\frac{\text{time taken for 20 oscillations}}{20}$

EXPERIMENT

Repeat the above experiment using

(i) bobs of different sizes without changing length of the pendulum.

(ii) threads of length of 80 cm and 100cm.

(iii) various amplitudes.

Do you notice any change in the time period?

In the first and third cases you will find no change in the time period

But in the second case the time period increases with increase in length. So we infer that **time period of a simple pendulum depends on the length of the pendulum and is independent of mass of the bob and the amplitude.**

6.3. ASTRONOMICAL DISTANCES

Meera and Sundar were very excited as their uncle had joined ISRO (Indian Space Research Organisation). They were eagerly anticipating a visit to his new work place to see rockets and satellites. Let us listen to a conversation between Meera, Sundar and their uncle.

Meera : Uncle, will you become an astronaut?

Uncle : No, Meera, I will be joining a team responsible for the launch of rockets.

Sundar : Rockets rise many thousands of kilometre in the sky, don't they?

Uncle : Yes, indeed they do. These rockets send satellites into orbits and spacecraft on their journey into outer space. A spacecraft travels lakhs and lakhs of kilometres in space. Do you realise that in order to express huge distances other units of measurement are required?

Meera &
Sundar : What are these units? Do tell us!

Uncle : Now you see, to measure very long distances like the distance of the sun, other stars and different planets from the earth we use convenient units like **astronomical unit** and **light year**.

Astronomical Unit is the average distance between the earth and the sun.

1 Astronomical Unit = 149.6 million kilometre (14.96 crore km).

$$1 \text{ AU} = 1.496 \times 10^{11} \text{ m}$$

Light year is the distance travelled by light in vacuum in one year.

1 Light year = 9.46×10^{12} km (9,46,000 crore kilometres). (or)

1 Light year = 9.46×10^{15} m

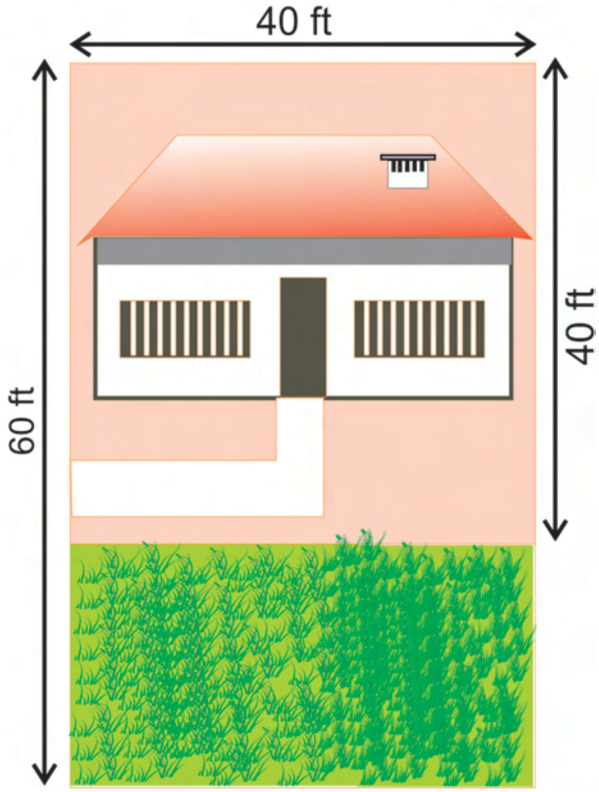
MORE TO KNOW

Light travels distance of 3 lakh km in one second.

Imagine this boy is travelling at the speed of light . He can travel around the world seven and a half times in one second. He would take eight minute, and twenty seconds to reach the earth from the sun . A racing car travelling at 1,000 kilometres per hour would take 17 years to complete the same journey.

EVALUATION

1. Ananth's father had a rectangular plot of length 60 feet and breadth 40 feet. He built a house in the plot and in the remaining area he planted a garden as shown.

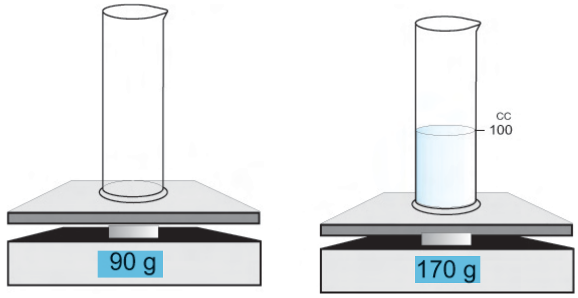


Can you help Ananth to find out the area of his garden.

2. 'Density is the lightness or heaviness of a substance.

Kamala wanted to know whether water or coconut oil had lesser density. Her sister Mala asked her to bring a cup of water and some coconut oil. How did Mala clear Kamala's doubt?

3. Observe the given picture and note

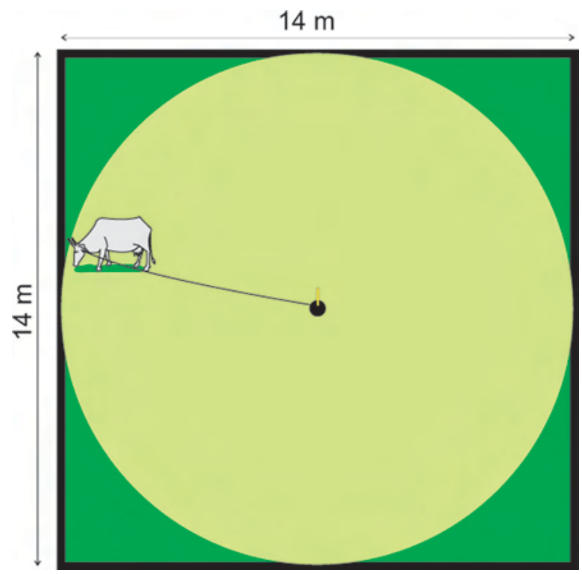


(i) Mass of the liquid ---------- gm

(ii) Volume of the liquid ---------- cc

(iii) Density of the liquid ---------- g/cc

4. Farmer Kandasamy had a square fenced field in which he allowed his cow to graze. He tied his cow to a stake at the centre of the plot by a rope of length 7 m.



Farmer Kandasamy's son Raju was amused to see that the cow grazed over a large circle of grass but left grass at the corners untouched. How did Raju find out how much land was not grazed?

SCIENCE

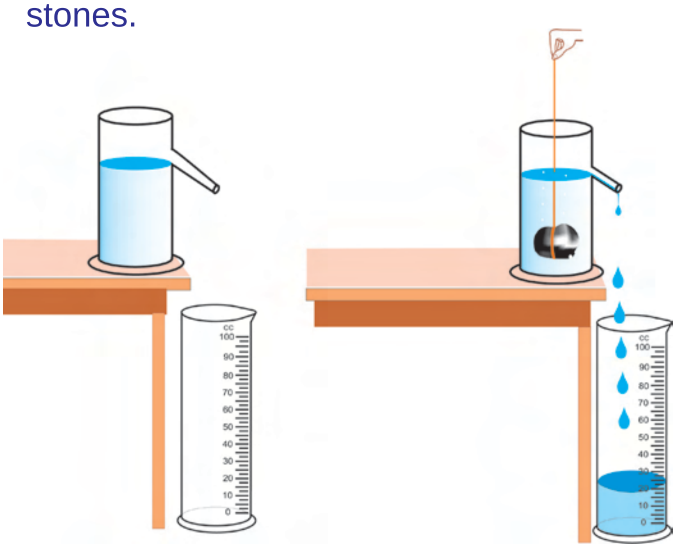
PROJECTS

1. Take a vessel with water and a 25ml graduated beaker. Distribute the water by giving 100ml, 125ml, 175 ml and 200 ml respectively to each of your four friends with the help of the beaker. How many times did you use the beaker for each friend?

2. Use a stop clock and determine how many times the following activities can be repeated in a span of one minute.

S.No.	Activity	Number of repetitions in one minute.
1.	Your friend inhales and exhales	
2.	The heart beat of your friend	
3.	Your friend blinking his eyes	

3. Using an overflow jar and a measuring cylinder find the volume of different stones.



Record Your observations:

Stone	Volume
1.	
2.	
3.	

FURTHER REFERENCE

Books

1. Frame work of Science - Paddy Gannon, Oxford University Press, New Delhi

Websites

http://www.kidastronomy.com

http://www.bbc.co.uk/schools/ks3bitesize/phys/html

7.1. SPEED


Fig 7.1

Two of the most exciting events in any sports meet is the 100m dash and 4x100m relay. Though all athletes run the same distance, the athlete who runs the distance in the shortest time will be the winner. In other words, the athlete who has the highest speed or is the fastest will win.

The most obvious feature of an object in motion is speed. It is a measure of how fast or slow an object is moving.

MORE TO KNOW

Usain Bolt won the 100m in 9.6 seconds and 200m in 19.19 second at the Beijing Olympics in 2008. He also won the 4 x 100m relay along with his team mates. His high speed made the media call him **'Lightning Bolt'**.

ACTIVITY 7.1

Let us observe a car, a cycle and a bullock-cart as they move on the road. Which of these takes the shortest time to cover a certain distance?

The car travels the fastest as it takes least time. The bullock-cart is the slowest as it takes longest time. The cycle has a speed between that of the car and the bullock-cart.

A fast moving object has high speed and a slow moving object has slow speed.

Now, what about an aeroplane?


Car


Bullock cart


Cycle

7.2. WHAT IS SPEED?

Speed of a body is the distance travelled by the body in one second.

$$\text{SPEED} = \frac{\text{DISTANCE TRAVELLED}}{\text{TIME TAKEN}}$$

Distance travelled is measured in metre and time in second

Therefore, the unit of speed is metre / second . [m / s].

It can also be expressed in kilometre / hour [km / h]

What do you mean by saying the speed of a car is 50 km/h?

It means that the car travels a distance of 50 km in one hour.

1 km = 1000m and 1 hour = 60x60 s

So, $1 \text{ km/h} = \dfrac{1000\text{ m}}{60\text{x}60\text{ s}}$

$= \dfrac{5}{18}$ m/s

Example :

a) 2 km/h = $2 \times \dfrac{5}{18}$ m/s

b) 3 km/h = $3 \times \dfrac{5}{18}$ m/s

If you know the speed of an object, you can find out the distance covered by it in a given time. All you have to do is multiply the speed and time.

Distance covered = Speed x Time

SCIENCE

ACTIVITY 7.2

Let us give a cricket ball to a group of four friends and ask them each to throw the cricket ball from a given point. Mark the point up to which each of them throws the ball. Measure the distance thrown and discuss the speed of the ball.

SELF CHECK

a) 36 km/h = ——— m/s

b) 72 km/h = ——— m/s

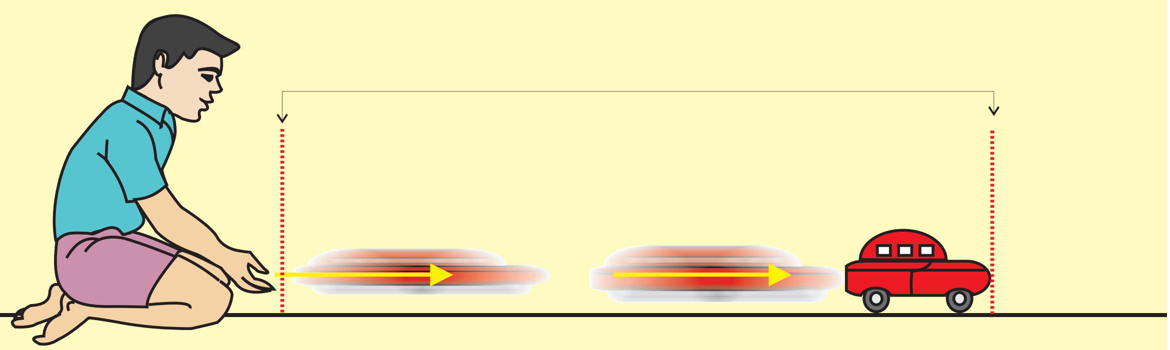
c) 180 km/h = ——— m/s

d) 15m/s = ——— km / h

e) 25m/s = ——— km / h

f) 35m/s = ——— Km/ h

ACTIVITY 7.3



Let us organise a toy car race to understand the concept of speed. Divide the class into 5 groups. Draw a line at the starting point .

One from each group should roll the toy car along the ground. Another should note the time from the instant the car crosses the line to the instant it stops. Measure the distance. Calculate the speed of each car and record it.

S.No	Group	Distance travelled by the car	Time taken	Speed
1	I			
2	II			
3	III			
4	IV			
5	V			

Find

1) Which group was the fastest?

2) Which group was the slowest?

Variable Speed

The speed of a bus during a journey may vary. When the bus is nearing a bus stop, its speed decreases.

On the highways the bus travels with greater speed. But in a city or town it travels with less speed due to heavy traffic.

The bus has different speeds at different times. So we say that it has **variable speed.**

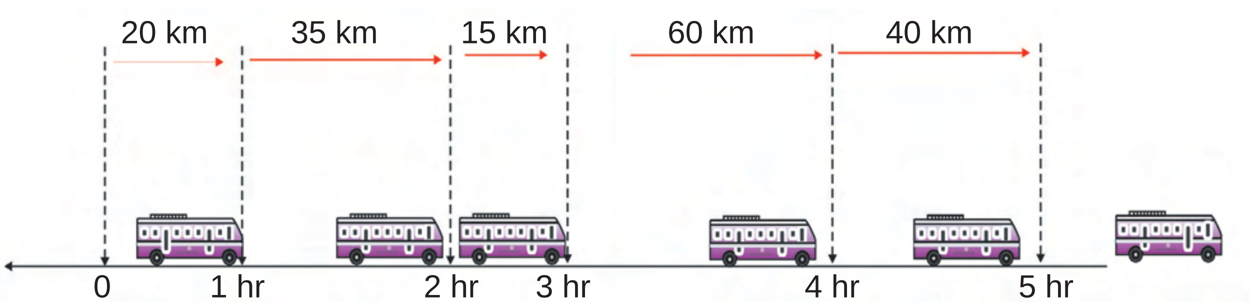


Fig 7.2. Variable speed

For such bodies, we can calculate the average speed:

$$\textbf{Average speed} = \frac{\textbf{Total distance travelled}}{\textbf{Total time taken}}$$

If a body moves with the same speed at all times we say that it has **uniform speed.**

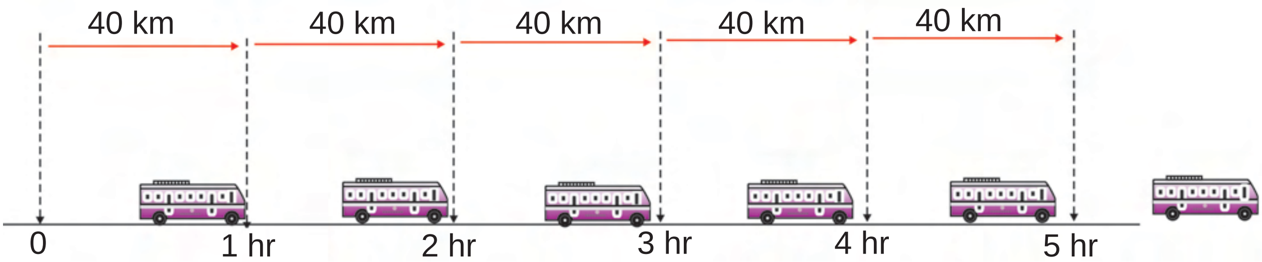


Fig 7.3. Uniform speed

Graphical representation

Have you seen a graph shown on your television screen while watching a cricket match?

It gives you an idea of the runs scored and also compares the performances of two teams.

Why is graphical representation used?

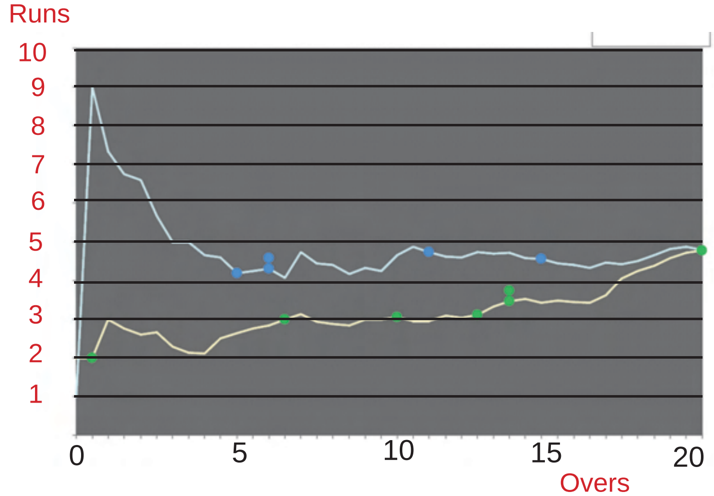


Fig 7.4. Graphical representation

When you are given a set of numbers which are relative to one another, it may not give you a clear idea of the relationship between them.

If the same numbers are represented on a graph, it gives a beautiful visual representation and therefore a clearer idea of the relation.

Hence, change of distance with time may be represented by a distance - time graph.

Science today

Have you noticed a meter fitted in the front of a scooter or a motorcycle?

Such meters can be found on the dashboard of cars, buses etc,. This meter has provision to measure both speed and distance. One of the meters has km/h written. This is a **speedometer**. It gives the speed of the vehicle every instant in km/h. There is another meter also which measures the total distance covered by the vehicle in metre. This is called an **Odometer**.

Speedometer with odometer

SCIENCE

7.3. DISTANCE – TIME GRAPH

Rajesh was travelling with his father in their car from Erode to Coimbatore. He kept himself busy by noting the distance travelled by the car every 5 minutes.

This is what he noted in the first 30 minutes.

S.No	Time in minutes	Distance in km
1	0	0
2	5	5
3	10	10
4	15	15
5	20	20
6	25	25
7	30	30

You can make a graphical representation of his observations:

Follow these simple steps.

Taking axes and scale:

Take a graph sheet and draw two lines perpendicular to each other.

Mark the horizontal line as OX(x-axis) and the vertical line as OY (y-axis).

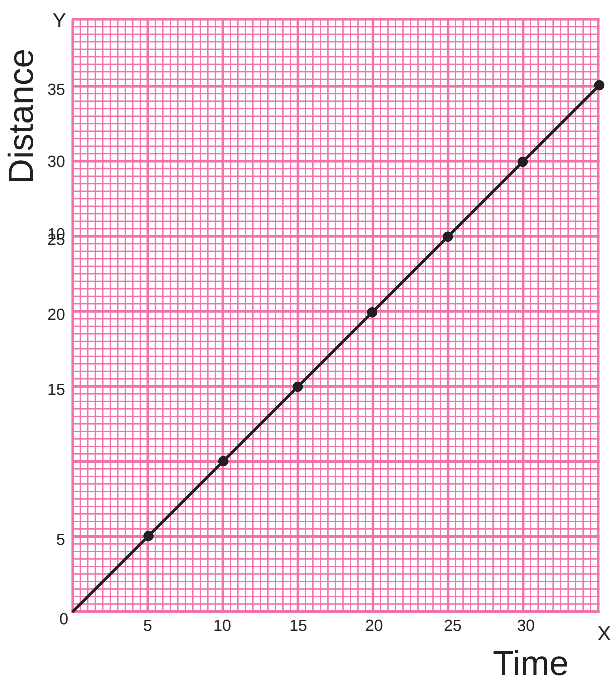


Fig 7.5. Distance Time Graph

Time is taken on the X-axis and distance on the Y-axis.

Choose scales to represent distance and time.

For example, the scales could be

X-axis : 1 cm = 5 minutes

Y-axis : 1 cm = 5 km

Plotting the graph :

Mark the values on the axes for time and distance according to the scales you have chosen.

According to the values noted, mark the points on the graph sheet. Join the points. You will get a straight line.

For uniform speed, the distance time graph is always a straight line.

For variable speed, it could be of any shape.

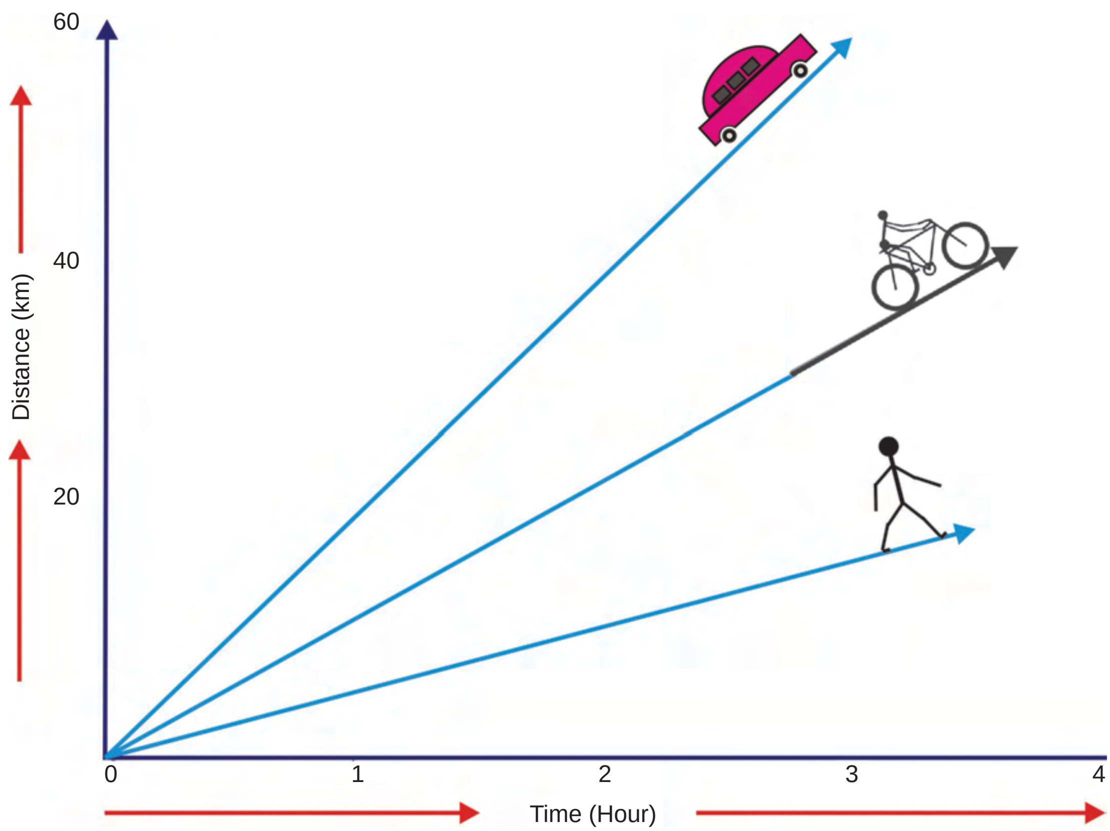


Fig 7.6

Greater the speed, steeper will be the graph.

ACTIVITY 7.4

Three cars, A, B and C travel from Madurai to Salem. The time taken and the distance covered are given in the table below.

S.No	Time taken in hours	Distance travelled in km		
		Car A	Car B	Car C
1	1	20	50	40
2	2	40	100	80
3	3	60	150	120
4	4	80	200	160
5	5	100	250	200

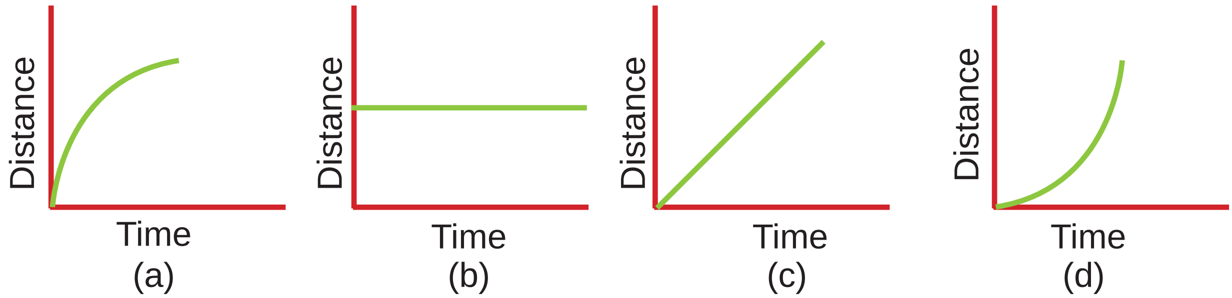
Plot the distance- time graph for the three cars in the same graph sheet.

a) What do you infer?

b) Which car had the maximum speed?

SELF CHECK

What do the following graphs represent?



(a) and (d) represent variable speed. (b) represents an object at rest.

(c) represents uniform speed.

7.4. VELOCITY

Every day when you go to school from your house,you could take path 1 or path 2 or path 3. Do these paths have the same distance? No, the distance is not the same; it varies with the path taken.

Imagine that you travel from your house to school in a straight line.

Fig 7.7.

This will be the shortest distance between them, called **displacement**. In the picture, it is represented by a dotted line.

Displacement is the shortest distance between two points in a particular direction.

MORE TO KNOW

Anemometer is a device used for measuring wind speed. It has aluminium cups which turn on a spindle. As the wind speed increases the cups rotate faster.

Velocity is the displacement of a body in one second.

$$\text{VELOCITY} = \frac{\text{DISPLACEMENT}}{\text{TIME TAKEN}}$$

Its unit is m / s.

Velocity is nothing but speed in a definite direction.

7.5. ACCELERATION

Do you ride a bicycle to school? If you are late, what would you do?

Obviously, you would pedal faster to reach school on time. In other words, you would increase your velocity or accelerate.

So, acceleration is the measure of change in velocity.

Acceleration is the change of velocity in one second.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken}}$$

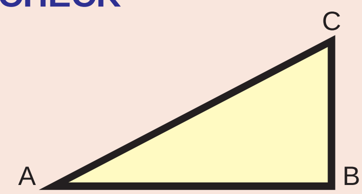
Its unit is m / s^2.

If a car has an acceleration of 5 m/s^2 every second its velocity increases by 5 m/s.

If the velocity of a moving body decreases, we say that it has negative acceleration or retardation or deceleration.

Example : A train slowing down to stop at a station.

SELF CHECK



Suresh walks from point A to B and then again from B to C.

a) What is the distance he has travelled?

b) What is the displacement?

Acceleration due to gravity

Let us see what happens when a ball is thrown up vertically?

As it rises, its velocity gradually decreases till it becomes zero ie., the ball is retarded. As the ball falls down its velocity gradually increases ie., it is accelerated.

The retardation or acceleration is due to the earth's gravitational force. It is known as acceleration due to gravity. It has an average value of 9.8 m/s^2 and is represented as g.

$g=9.8 m/s^2$

This means that the velocity of a body decreases by 9.8 m/s every second when it is thrown up and the velocity increases by 9.8 m/s every second when it falls down.

To Think

A marble and a big stone are dropped simultaneously from a particular height. Which will reach the ground first?

7.6. SCIENCE TODAY - ADVENTURE SPORTS

Have you ever dreamed of flying like a bird or gazed up at flying birds and longed to join them.

1. Hang gliding

Hang gliding is a sport in which a pilot flies a light un-motorized aircraft called a hang glider launched by foot.

Most modern hang gliders are made of aluminium alloy. The pilot is safe inside a harness suspended from the frame of the glider.

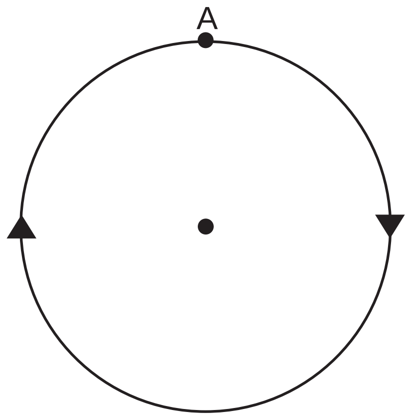
2. Para-gliding

Para-gliding is the latest aero sport. A para-glider is a non-motorised, foot launched inflatable wing, easy to transport, launch and land. It is basically a parachute made of special nylon or polyester fabric. The pilot is clipped to a harness in a comfortable sitting position. A para-glider is much lighter than a hang glider and easier to operate.

Yelagiri in Vellore district of Tamil Nadu is a hill station with gentle slopes ideal for para-gliding. Tamil Nadu Tourism holds a para-gliding festival at Yelagiri in August- September every year.

EVALUATION

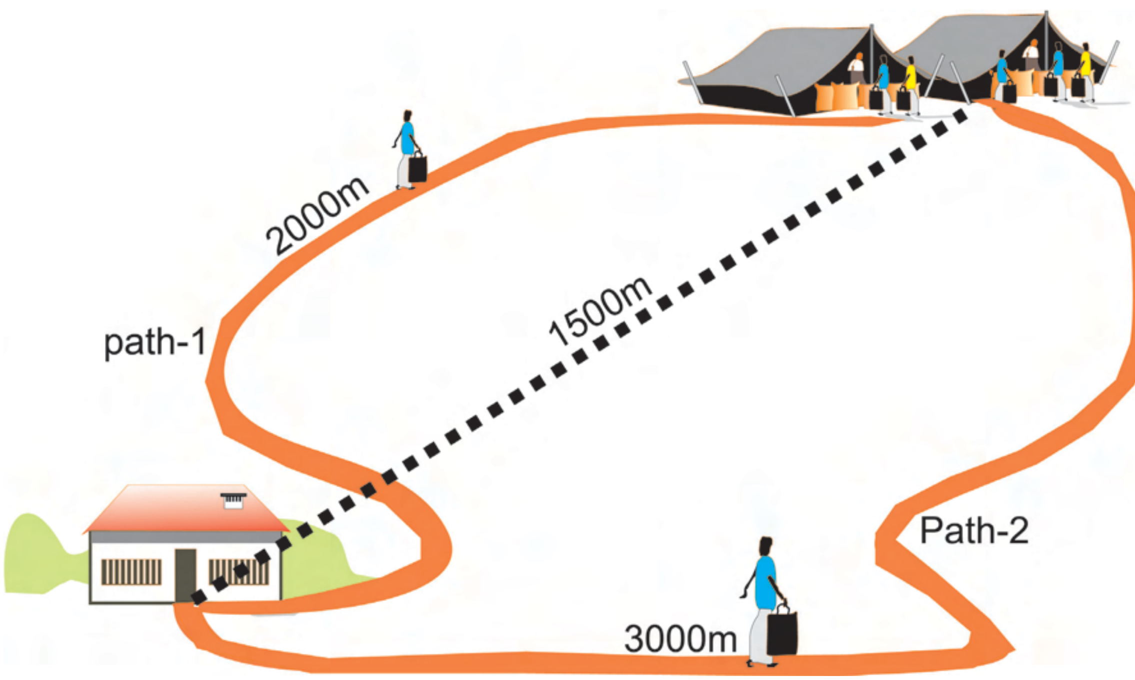
1. Selvi goes for a morning walk in the park near her house. She starts from point 'A', walks a circular path of radius 7m and returns to the same point 'A'.



(i) What is her displacement?

(ii) Find the distance she has walked.

2. Mani and Shankar walk from their home to the market in 20 minutes, Mani takes path 1 while Shankar takes path 2.



(i) What do you infer about their speeds?

(ii) Who has the greater velocity? Why?

3. Raju is travelling in a train moving at a speed of 72 km/h. In order to stop the train, the driver decreases the speed. The rate of decrease in speed of the moving body is known as deceleration.

If the dece leration of the train is $10 m/s^2$, how much time will it take to come to a stop?

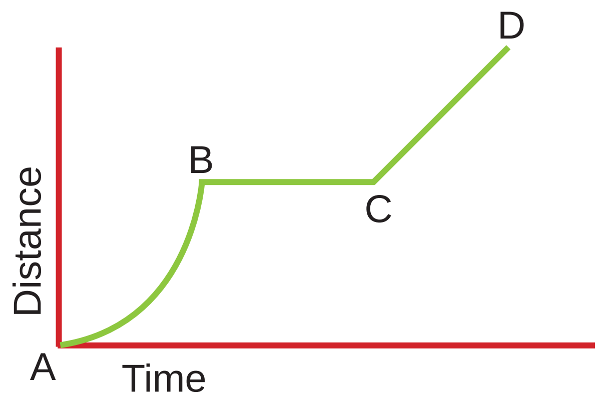
SCIENCE

4. The given graph depicts the motion of a bus. Interpret the motion the bus.

a) AB represents __________

b) BC represents __________

c) CD represents __________



PROJECTS

1. Take a graph sheet. Draw a distance – time graph with the data given below.

Time (minute)	10	15	20	25	30
Distance (km)	10	20	30	40	50

2. Conduct a race and find who is the fastest among your friends. Make 4 friends run a distance of 50 m one by one and note the time taken by each. Complete the given table.

S.No.	Name of the friend	Time taken (second)	Speed (m/s)
1. 2. 3. 4.			

FURTHER REFERENCE

Books

1. Physics for higher Tier - Stephen people, Oxford University Press, New Delhi.

2. Fundamentals of Physics - Halliday, Resnick and Walker, Wiley India Pvt.Ltd.

Websites

http://www.sciencemadeeasy.com

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