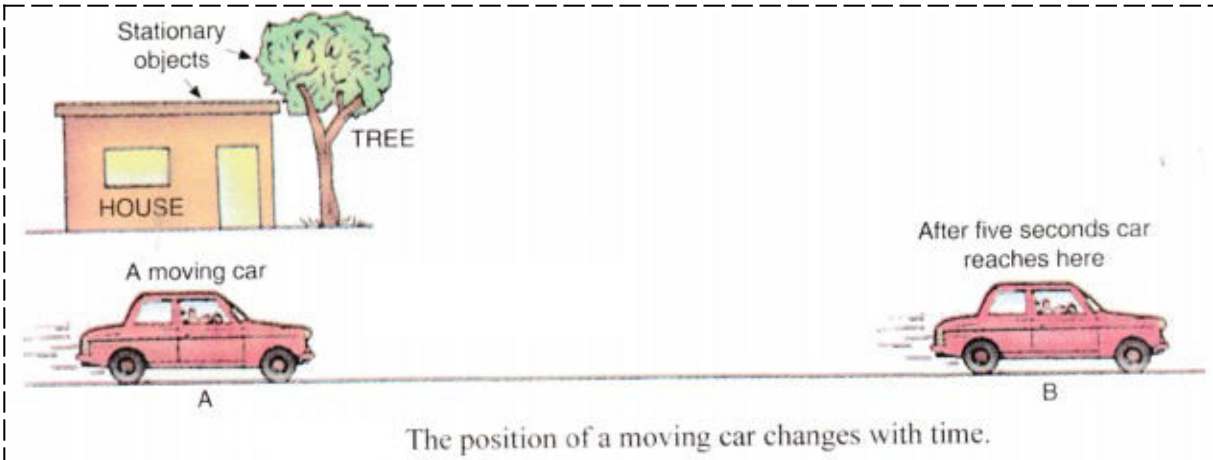
MOTION AND TIME

- When an object changes its position with time, it is said to be in **motion**.
- Example – When the position of a car changes with time, we say that the car is moving or the car is in motion.



The position of a moving car changes with time.

SLOW OR FAST MOTION

- ✗ The motion of an object with respect to another object can be slow or fast.
- ✗ The distance covered by objects in a given set of time decided which object is faster or slower.
- ✗ **SLOW** – An object which takes longer time with respect to another object to cover a certain distance is said to be slow.
- ✗ **FAST** – An object which takes shorter time to cover the same distance is said to be fast.

✗ **Example –** Manish covers the distance between school and home in 10 minutes and Rahul travels the same distance in 20 minutes. Suppose, Manish and Rahul, leave school at 1 PM. Manish reaches home at 1:10 PM and Rahul reaches home at 1:20 PM. So, Manish reaches home before Rahul.

So, we can conclude that **Manish moves faster than Rahul**.

SPEED

✗ Speed is defines as **the distance covered by an object in unit time**. i. e.

$$\textbf{Speed} = \frac{\textbf{Distance Travelled}}{\textbf{Time Taken}}$$

✗ SI Unit of speed is **meter/sec** (m/s)

✗ Example – Suppose a car travels a distance of 100 Km in 2h, then the speed of car is given by -

$$\text{Speed} = \frac{100\,Km}{2\,h} = 50 \text{ km/h}$$

The fastest possible speed in the universe is the speed of light i.e. ***3 X 10^8 m/s*** *or* ***3 X 10^5 Km/s****. It means, light can travel 3 lakh km per sec.*

Question:

Roger covers 400 meters in 1 minute in a marathon race. What is the speed of Roger in m/s and km/h respectively.

Answer:

- **Speed of Roger in m/s**
  Roger covers 400 m distance in 1 min

$$\textbf{Speed} = \frac{\textbf{Distance Travelled}}{\textbf{Time Taken}}$$

we know, 1 min = 60 sec [Converting minutes to sec]

$$\text{Speed} = \frac{400}{1\,X\,60} = 6.66 \text{ m/s}$$

So, speed of Roger in **6.66 m/s.**

- **Speed of Roger in km/h**

  To do so, first we convert meter to kilometre and then time in seconds to time in an hour.

  We know, 1 Km = 1000 m

  $$1 \text{ m} = \frac{1}{1000} \text{ Km}$$

  $$400 \text{ m} = \frac{400}{1000} \text{ Km} = 0.4 \text{ Km [Distance covered by Roger in 1 min]}$$

  Now, 1 hour = 60 min

  $$1 \text{ min} = \frac{1}{60} \text{ h}$$

  Speed of roger in Km/h is

  $$\text{Speed} = \frac{0.4}{1/60} = 0.4 \text{ X } 60 \text{ Km/h} = \textbf{24 km/h}$$

TIP: To convert speed from Km/h to m/s multiply by $\frac{5}{18}$ and to convert it from m/s to Km/h multiply it by $\frac{18}{5}$.

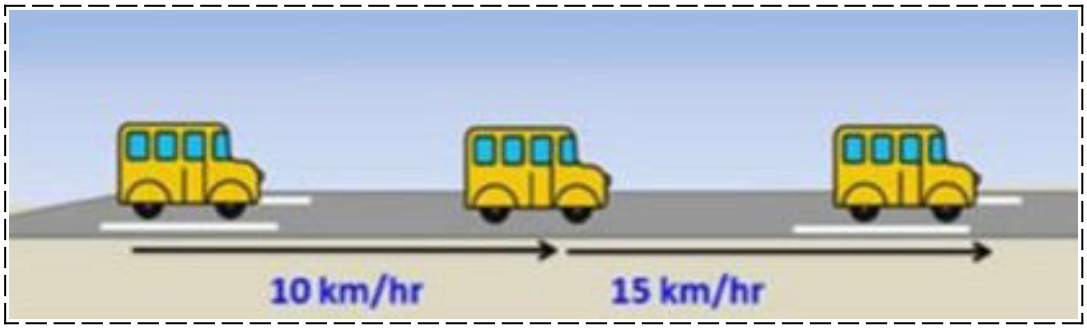
UNIFORM AND NON-UNIFORM MOTION

- **Uniform Motion** – An object moving along a straight line with a constant or uniform speed is said to be in uniform motion.

  Example – The school bus is travelling at a constant speed of 15 km/hr in a straight line, as shown below. Its speed is not changing at different points.

- **Non-Uniform Motion –** If the speed of an object moving along a straight line keeps changing, then the object is in non-uniform motion.

  Example – The speed of the school bus is changing while it is moving in a straight line.



MEASURING SPEED

Speedometer – A speedometer is a device which is used to measure the speed of a vehicle. It records the speed directly in km/h.

Odometer – Odometer is usually combined with a device which is used to measure the distance covered by vehicle, known as odometer.

MEASUREMENT OF TIME

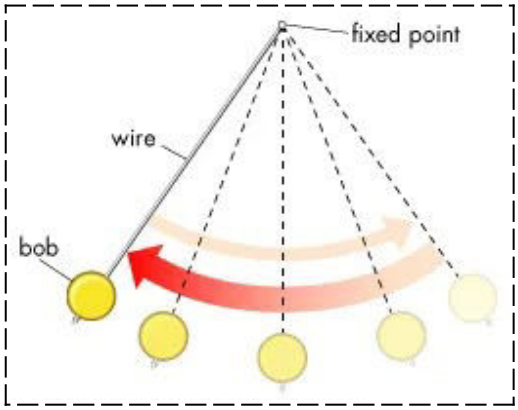
- ✗ The duration or moment in which things occur is known as time.
- ✗ We generally measure time with the help of clocks and watches.
- ✗ To measure time, we need a motion that repeats itself at equal intervals. Such a motion is called periodic motion.

UNITS OF TIME -

1 minute = 60 seconds
1 hour = 60 minutes
1 day = 24 hours
1 week = 7 days
1 year = 365 days
1 decade = 10 years
1 century = 100 years

Simple Pendulum -

- ✗ A Simple pendulum is a device which is used to measure time.
- ✗ It was discovered by **Galileo Galilei**.
- ✗ It consists of a metallic ball call **bob** which is suspended on a long thread from a rigid support such that bob is free to swing back and forth.



- ✗ The time taken by the pendulum to complete one oscillation is called its time period.

$$\textbf{Time Period} = \frac{\textbf{Time taken for oscillation}}{\textbf{Number of oscillations}}$$

Question:

Calculate the time period of a simple pendulum that takes 55 seconds to complete 50 oscillation.

Answer:

$$\text{Time Period} = \frac{\text{Time taken for oscillations}}{\text{Number of oscillations}}$$

$$= \frac{55}{50} = \textbf{1.1 sec}$$

Before the pendulum clock, many other time measuring devices are used like sundials, water clocks, and sand clock, etc.

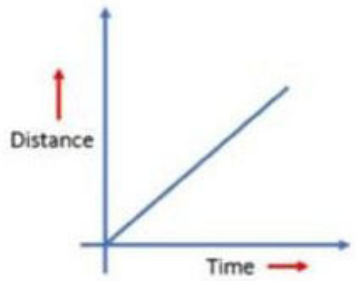
1. **Sundial**
   This is a device that tells the time of day. It consists of a flat plate, which casts a shadow onto the dial when there is sunlight and that shadow helps to know the time of day.

2. **Sand Clock**
   It uses the flow of sand to measure time. It consists of two rounded glass bulbs connected by a narrow neck of the glass. The upper bulb contains some sand that streams down into the bottom bulb giving the fixed interval of time.

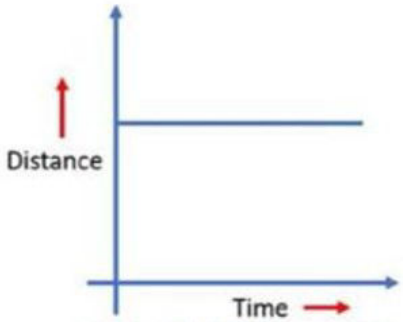
3. **Water clock**
   Consists of two containers kept at different levels. This device uses the rate at which water drips from one vessel to another to measure the time interval.

DISTANCE - TIME GRAPH

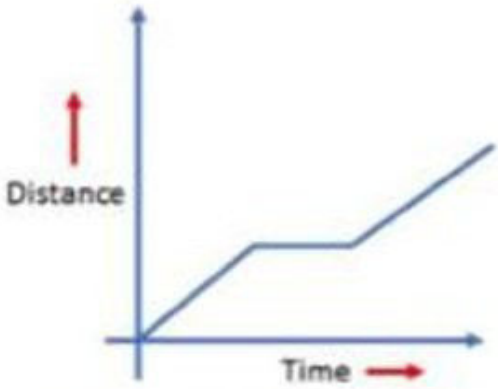
- ✗ In the distance-time graph, distance is marked on the y-axis and time is marked in the x-axis.
- ✗ Distance-Time graph is useful to study the motion of a body.



Uniform motion: Object moving with a constant speed



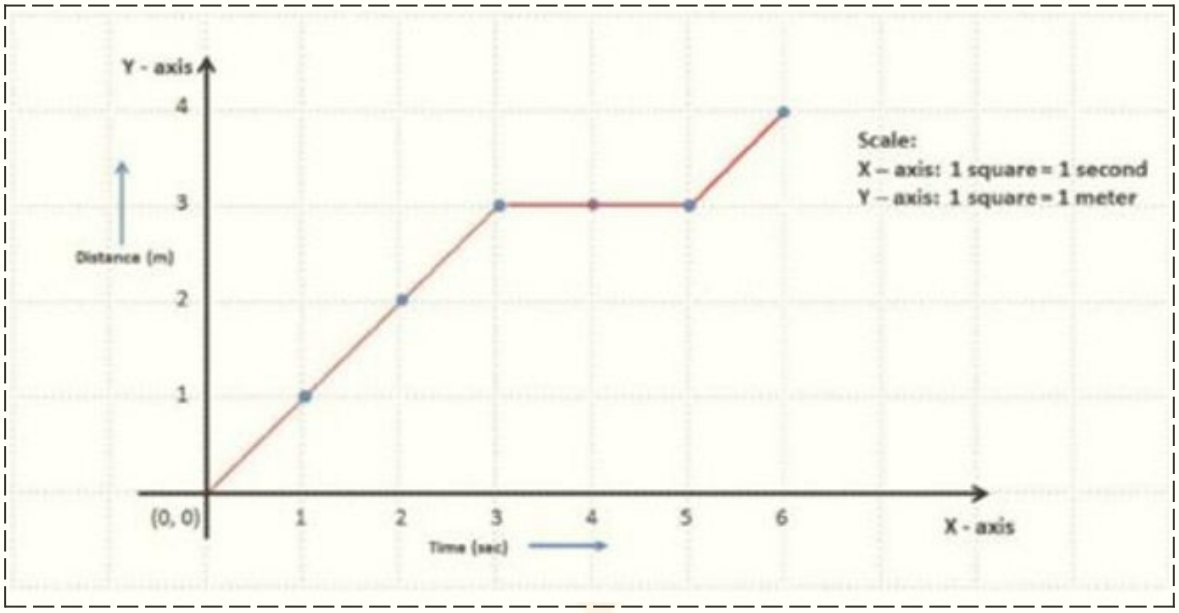
When Object is at rest



Non-uniform motion: When object moving with a different speed.

Question:

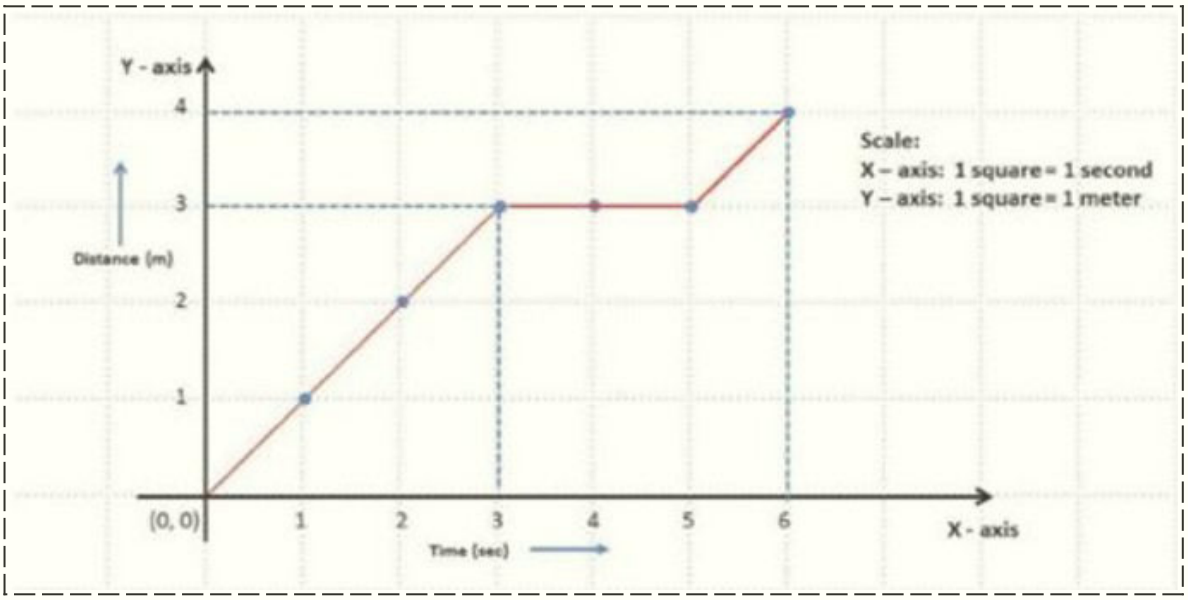
From the distance-time graph of the motion of an object answer the following questions?



1. What will be the position of the object at t = 3 sec?
2. What is the average speed of the object?

Answer:

1. From the graph distance travelled by an object at t = 3 sec is 3 meters.



2. We know,

$$\text{Average speed} = \frac{\text{Total time}}{\text{Total Distance}}$$

The total distance travelled by an object is 4 meters and the total time taken by the object is 6 sec.

Therefore,

$$\text{Average speed} = \frac{4}{6} = \textbf{0.66 m/s}$$

GLOSSARY

- **Speed** – Total distance covered by an object divided by total time taken is called speed.
- **Uniform motion –** When an object moves with a constant speed along a straight line, then its motion is called uniform motion.
- **Non-Uniform motion** – When an object changes its speed during its motion, then its motion is called non-uniform motion.
- **Simple pendulum** – It contains a mass hung with a thread to a rigid support. The mass can move freely to and fro.
- **Oscillation** – To and fro motion of pendulum is known as oscillation.
- **Time period** – The time taken by pendulum to complete one oscillation is called time period.
- **Speedometer** – An instrument which is used to measure the speed is called speedometer.
- **Odometer** – An instrument which is used to measure the total distance covered by a vehicle is called odometer.