Chapter – 13

Motion and Time

SLOW OR FAST

Slow or Fast: An **object A** that covers a certain distance in less time is said to be faster than the **object B** which takes a longer time to cover the same distance and is said to be slower than object A.

Example: Manish and Rahul are siblings and they study in the same school.

Manish covers the distance from his school to home in 10 minutes by running, whereas Rahul covers the same distance in 20 minutes by walking. If they start at the same time from school, who shall reach home first?

Solution: We know that the distance covered by objects in a given interval of time can help us to find out which object moves faster than the other.

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.

We can also conclude that Manish moves faster than Rahul.

Tip: Remember the object which moves faster covers a given distance in lesser time.

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SPEED

Speed: The distance covered by an object in unit time is called the speed of the object.

$$Speed = \frac{Total\ Distance}{Total\ Time}$$

The SI unit of speed is meter/sec (m/s).

Example: In a 4000 m marathon race, Roger covers 400 meters in 1 minute. What is the speed of Roger in m/s and in km/h respectively?

Solution: The speed of Roger in m/s

Roger covers 400 m distance in 1 min

$$Speed = \frac{Total\ Distance}{Total\ Time}$$

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

$$Speed = \frac{400}{1 \times 60}$$

The speed of Roger is 6.66 m/s

Now, we have to find the speed of Roger in km/h.

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

We know, 1 km = 1000 m

$$\Rightarrow 1\text{m} = \frac{1}{1000}\ \text{km}$$

$$\Rightarrow 400\ \text{m} = \frac{400}{1000}\ km = 0.4\ \text{km}$$ [Distance covered by Roger in 1 minute]

1 hour = 60 minutes

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

Now, the speed of Roger in km/h is

$$\text{Speed} = \frac{0.4}{\frac{1}{60}}$$

Speed = 0.4 x 60

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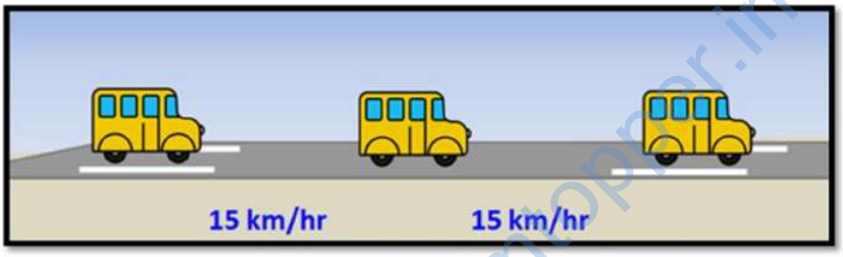
Speed = 24 km/h

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

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

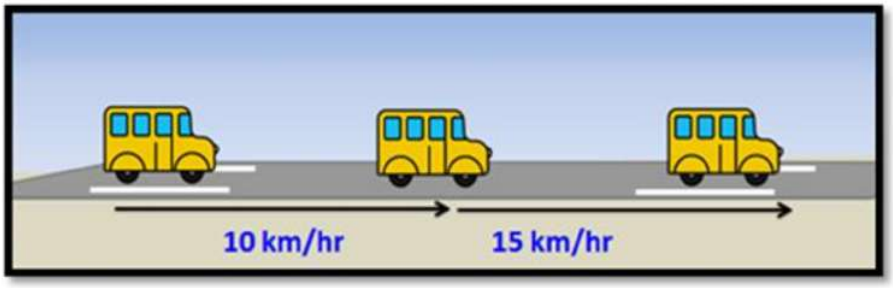
Example: The school bus is travelling at a constant speed of 15 km/hr in a straight line, as shown below. Its speed is not changing at different points.



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 moving in a straight line.

Generally, vehicles moving on the road are in non-uniform motion, as they travel with different speeds at different time intervals.



Speedometer: A speedometer is the device on the dashboard of a vehicle which measures and displays the speed of a vehicle.

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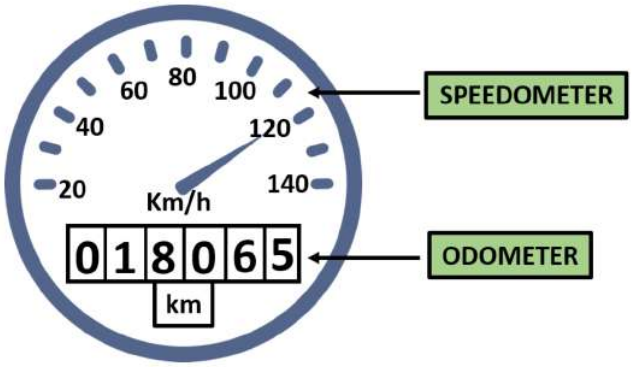
Odometer: The distance moved by a vehicle is measured by the device called an odometer. The odometer records the distance travelled by the vehicle in kilometers (km).



MEASUREMENT OF TIME

Measurement of time: A clock is a device used to measure time. To measure time, we need a motion that repeats itself at equal intervals. Such a motion is called periodic motion.

The SI unit to measure the time is second.

Unit of Time:

1 minute = 60 seconds

1 h = 60 minutes

1 day = 24 hours

1 week = 7 days

1 year = 365 days

1 decade = 10 years

1 century = 100 years

Types of clocks:

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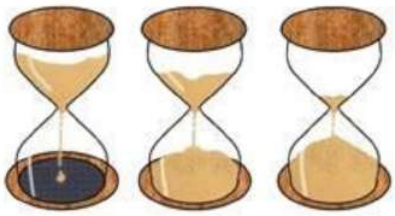
(A) **Sand Clock** uses the flow of sand to measure time. It consists of two rounded glass bulbs connected by a narrow neck of the glass. The upper bulb contains some sand that streams down into the bottom bulb giving the fixed interval of time.



(B) **Sundial** 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.

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(C) **Water Clock** uses the flow of water to measure time. The flow of water is into or out of the vessel

(D) **Clock or watch** having an electric circuit with one or more cells is called quartz clock e.g. Wrist watch.

Simple Pendulum: A simple pendulum consists of a small metallic ball called a bob. A simple pendulum performs an oscillatory motion.

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

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

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

Solution:

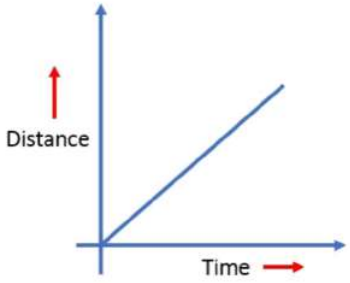
$$Time\ Period = \frac{Time\ taken\ for\ oscillations}{Number\ of\ oscillations}$$

$$Time\ Period = \frac{55}{50}$$

$$Time\ Period = 1.1\ sec$$

DISTANCE-TIME GRAPH

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



Uniform motion: Object moving with a constant speed

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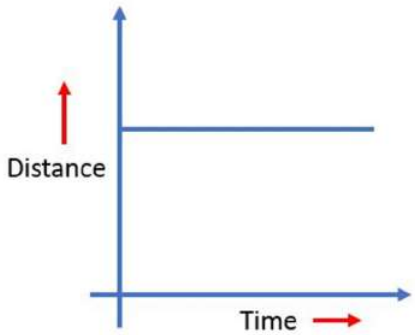
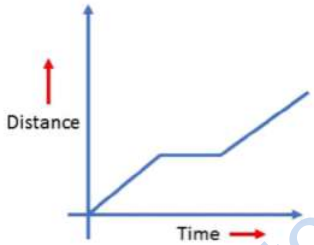


When Object is at rest



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

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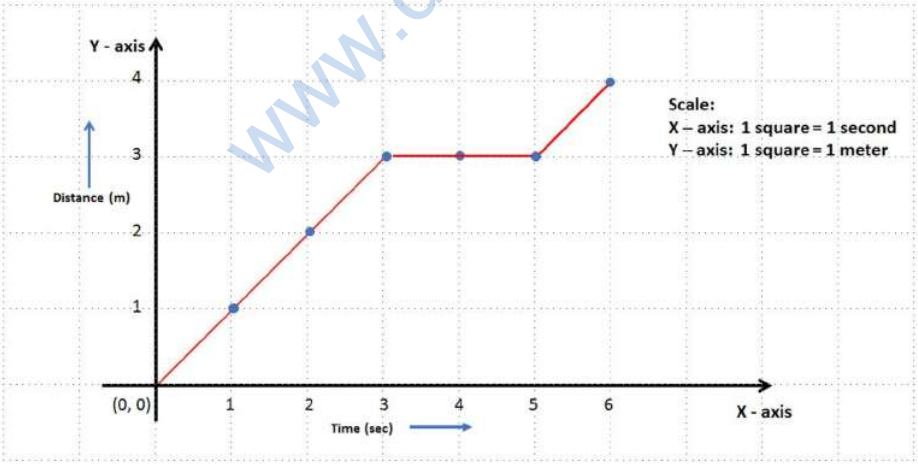
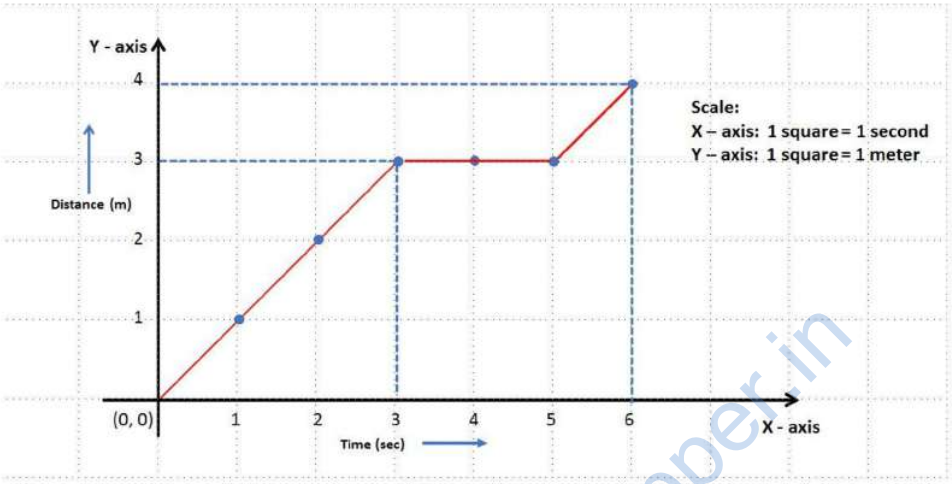
Example: From the distance-time graph of the motion of an object, answer the following questions?



1. What will be the position of the object at t = 3 sec?

2. What is the average speed of the object?

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



2) We know,

$$Average\ speed = \frac{Total\ Time}{Total\ Distance}$$

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

Therefore,

$$Average\ speed = \frac{4}{6}$$

$$Average\ speed = 0.66\ m/s$$

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