Ch-13-Motion and Time

Motion

Time

Graph

Motion

Motion is often described as 'relative.' This implies that in a given situation the same activity may appear as stationary to one observer while another observer might see it differently. For example: let's take the case of an aeroplane speeding along the runway about to take off!! For two co-passengers sitting next to each other each one appears stationary with respect to the him/ herself and to the plane. This is because both are moving together within the same plane at the same speed. However, both find themselves moving with respect to the airstrip/ground outside the plane with considerable speed. Likewise, an outside observer finds the people within the plane moving very fast.

Distance: The distance covered by a moving object is the actual length of the path followed by the object.   Distance is a scalar quantity. SI unit of distance is meter.

Displacement: It is the shortest distance covered by a moving object from the point of reference (initial position of the body), in a specified direction.

Speed : The distance covered by an object in a unit time is defined as speed.

$$\text{Speed} = \frac{Total\ distance\ covered}{Total\ Time\ taken}$$

Objects are said to be in fast or slow motion depending upon the speed of their motion. Speed varies from object to object.

The basic unit for time is second, and it can be calculated in minutes and hours, too, depending on the need. The basic unit for distance is metre. So, the unit for speed is metres per second (m/s).

Large speeds are measured in kilometre per hour (km/h). The symbols for units are written in singular form only.

For example, the speed of the cheetah is 112 km/h, and Speed of giant tortoise = 0.27 km/h.

Types of Speed

Slow speed: An object said to be moving slowly if it covers less distance in a given time.

Moving Fast speed: An object is said to be moving fast if it covers more distance in a given time.

Uniform Speed: An object is said to be moving with uniform speed if it covers equal distances in equal intervals of time.

Non-uniform : An object is said to be moving with variable speed or non-uniform speed if it covers equal distances in unequal intervals of time or vice-versa.

Average speed: When we travel in a vehicle the speed of the vehicle changes from time to time depending upon the conditions existing on the road. In such a situation, the speed is calculated by taking the ratio of the total distance travelled by the vehicle to the total time taken for the journey. This is called the average speed.

The average speed of a moving object is defined as the total distance covered by it divided by the total time taken.

Instantaneous speed: The speed of a moving body at any particular instant of time is called instantaneous speed.

For example:

When we say that the car travels at an average speed of 60 km/h it does not mean that the car would be moving with the speed of 60 km/h throughout the journey. The actual speed of the car may be less than or greater than the average speed at a particular instant of time.

Uniform Motion

Objects that move in a straight line and maintain the same speed throughout the distance covered are said to be in uniform motion.

Non-Uniform Motion

Objects that move in straight line and whose speed varies are said to be in non-uniform motion.

Measurement of Speed

<u>Speedometer :</u> An instrument used in vehicles to show speed. Not all moving vehicles have a speedometer. The speedometer has a needle that indicates the speed.

For example, a bicycle does not have a speedometer, whereas a car has one.

<u>Odometer:</u> An odometer is a device in vehicles to track the distance covered.
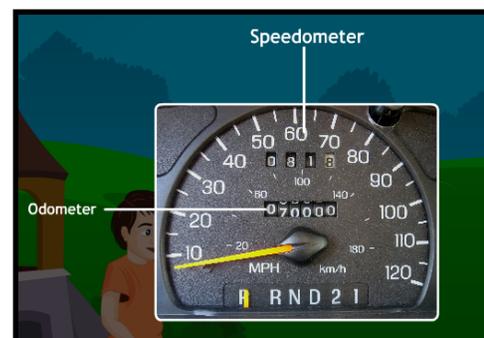
Time

There are certain events in nature that can help us track time. For example, the phases of the moon indicate the time of the month. There are man-made structures that were constructed to measure time. For example, the Jantar Mantar in Jaipur, which is basically a sun clock, is used to measure time. Water clocks and sand clocks were also used hundreds of years ago to measure time. All mechanical clocks used oscillatory motion to measure time.
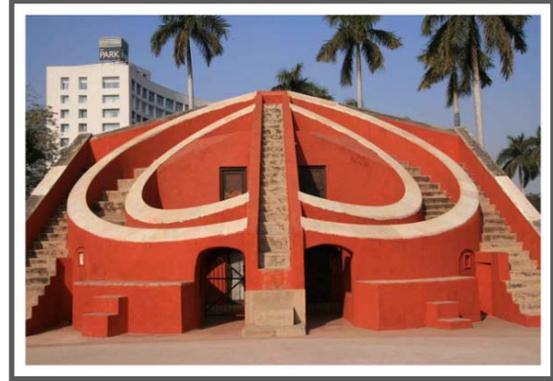
Jantar Mantar (Sun clock)

Measurement of Time

The basic unit of time is a second. Its symbol is 's'. Larger units of time are minutes (min) and hours (h). You already know how these units are related to one another.

Time Period

The time period of a pendulum is the time taken for one full oscillation. The working of a pendulum clock is based on the time period of its pendulum. Winding clocks and wrist watches developed from modifications to the pendulum clock. A quartz clock is more accurate than other clocks because its oscillations are regulated by a quartz crystal.

Oscillation

A metal ball is considered to have completed one oscillation, if the pendulum moves from its mean position 'Y' and goes to 'X' to 'Z' and back to its mean position 'Y'.

Graph

Graph is a pictorial representation of two sets of numerical data.

Distance-time graphs

Motion of an object can be represented by its distance-time graphs. It gives information about the nature of the motion of an object like uniform or uniform motion.

Uses of Graph

Graphs are used for better understanding. For example, using these graphs, the performance of two batsmen can be compared, performance of two bowlers can also be observed in a cricket match. Also, in population studies, these graphs are used to compare the birth and the death rate, and other kinds of data.

Plotting of Graph

Draw a graph as given data

Distance (In Km)	0	10	20	30	40
Time (in hr)	10.00 am	10.15 am	10.30 am	10.45 am	11.00am

- Take a graph paper. At the centre of the paper, draw two lines perpendicular to each other. Mark the point of intersection of the lines as 'O'.
- The horizontal line is called the X-axis, while the vertical line is called the Y-axis. The point of intersection of the two axes is called the origin, 'O'.
- Take one quantity along the X-axis and the other along the Y-axis, after choosing suitable scales for both. Place the all values on X-axis and Y- axis with a points
- Join the all points, and your graph is ready.

Scale:
x-axis-2 units-15 mins
y-axis-2 units-10 km
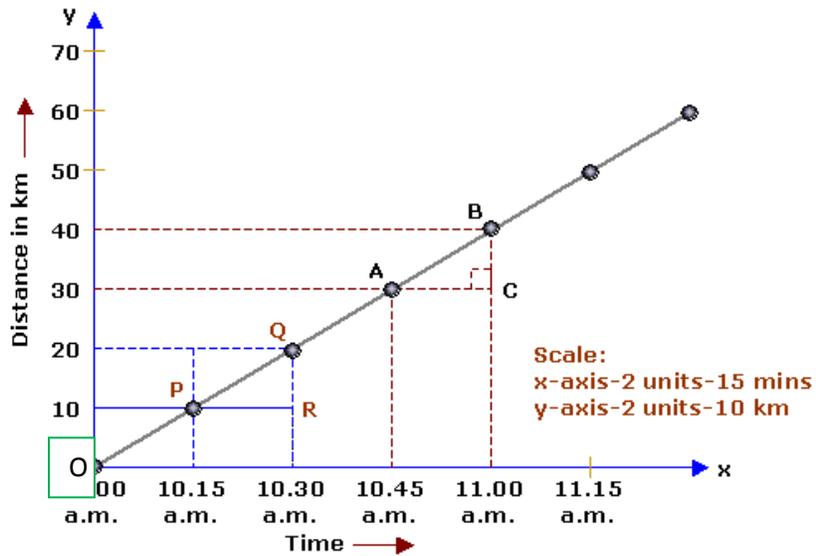
Body in uniform motion:

The graph for a body in uniform motion will be straight line making angle horizontally.

Body in non-uniform motion:

For a body in non-uniform motion, the graph is not a straight line.