7th – Time & Motion I

Time: Time is defined as a limited period between two successive events.

Need to Measure Time: Time plays are important role in our life. In every civilization there has been evidence of people keeping track of time. In ancient times, people closely followed the movement of the sun, moon and the stars. They noticed that once the sun rose in the morning, it would set after a considerable period. They could do many things from sunrise to sunset. This gave them a concept of 'time'. Today, we measure time for a variety of applications. The dictionary defines time as the period between two events. For example, sunrise and sunsets can be taken as two events.

Then the period between sunrise and sunset on a particular day would be the 'time' between the sunrise and sunset.

Measurement of Time: In the beginning, people used calendars to keep a track of years, which were divided into months and days. Later, people started keeping track of the time of the day. They started building various instruments to divide the day into smaller parts. An instrument used to measure time is called a clock.

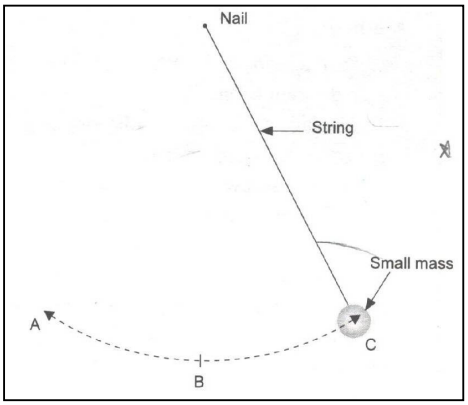
People used instruments such as sundials and hourglass to keep track of time. The movement of the shadow changed direction with the movement of the sun across the sky, was used to make crude sundials. An hourglass consisted of two rounded glass bulbs connected by a narrow neck of glass. The top bulb was filled with sand and a measured amount of sand particles streamed down from the top bulb into the bottom bulb, giving the time. An instrument known as water clock was also used in different parts of the world. It worked on the principle of regulated flow of water.

These devices were not very accurate and there was a need to improve accuracy. A major breakthrough came in 1656, when Christiana Huygens made the first pendulum clock. It consisted of weight and a swinging pendulum. Another major advancement in timekeeping was the invention of the atomic clock, which is very accurate. Today, clocks do not just tell us the time of the day; they are also used as timers in ovens, in stopwatches, in various athletic events, etc. the SI unit of time is the second.

60 second	1 minute
60 minute	1 hour
24 hours	1 day
3651/4 days	1 year
10 years	1 decade
10 decades	1 century
10 centuries	1 millennium

Measurement of Time Using Periodic Motion: In order to measure time, we need a motion that repeats itself in equal intervals. Such a motion is called periodic motion. Some examples of periodic motion are the rotation of the earth about its axis, the revolution of the earth around the sun, the revolution of the moon around the earth, the to-and-fro movement of a spring, and the oscillation of a pendulum.

Simple pendulum: A small mass that is suspended from a fixed point and allowed to swing freely under the influence of gravity is called a pendulum.



An ideal, simple pendulum consists of a small mass (like a stone or a metal ball) called a bob suspended by a string. When pendulum is at rest, it is in its mean positions. When the bob moves from one position and returns to the same position, it is said to complete one oscillation. The time taken to complete one oscillation is called the time period of the pendulum. For example, if the bob starts from point A, goes to point B and C, and returns to point A, it completes one oscillation. The observations can be summarized as follows:

- The time taken by a pendulum to complete one oscillation (i.e., its time period) does not depend on the extent to which the bob of the pendulum is displaced.
- The time period does not depend on the mass of the bob used (within reasonable limits)

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• The time period depends on the length of the string or wire used, greater the length of the string, greater is the time period (assuming that the string itself has negligible mass). This means that if the length of the pendulum is fixed, its time period is constant.

Motions: Motions can be defined as a change in position of body with respect to time and another body motion is relative in physics.

Different Types of Motion:

Motion along a straight line The simplest type of motion is the motion along a straight line. For example, motions of a train on a straight track, of an apple falling from a tree, of raindrops falling from the clouds are example of motion in a straight line.

The objects concerned are moving along a (nearly) straight path. We call all such motions as 'rectilinear or simply as linear motion'.

Slow and Fast Motion: Objects may travel fast or slow. For example, we may observe that an aeroplane travels very fast while a bicycle is slow. What, precisely, do we mean when we use the terms 'fast' and 'slow'? When we say a body moves fast (or slow) we refer to its speed. The speed of an object is defined as the distance travelled by it in unit time.

The SI unit of speed is mete per second (m/s).

Calculation of speed: We can calculate the speed of an object if we know the distance it travels in a given amount of time. Let us see how this is done. In example, let us say it was a 100 m race. Shreya ran the race in 20 s. what is shreya's speed ? As speed is the distance travelled in unit time, shreya's speed is the distance travelled in unit time. Shreya's speed can be calculated by dividing the distance she ran by the time she took to cover that distance. Therefor, shreya's speed is

$$\frac{\text{distance travelled}}{\text{time taken to travel the distance}} = \frac{100\ m}{20\ s} = 5\ m/s$$

Average speed: Average speed is defined as the total distance travelled divided by the total time taken to travel that distance.

Different units of speed: The SI unit of speed is meter per second. Another commonly used is kilometer per hour. When we talk about speed of aeroplanes and cars, it would be more appropriate to use km/h than m/s.

Q Convert in m/sec:

a. 72 km/hr b. 60km/hr c. 100 km/hr

Q Convert in Km/hr:

a. 45m/sec b. 1.5 m/sec c. 840m/sec

The instrument/ meter measuring the speed of the vehicle is called a speedometer. The distance travelled by the vehicle is given by an instrument called odometer.

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