1 MOTION AND TIME

INTRODUCTION :

We observe different types of objects around us. Some of them are at rest for us and some of them are in motion. For instance, tree, houses, etc. are at rest while flying birds, moving cars etc. are in motion.

"Motion is change in position of an object with time."

As we know that a motion could be along a straight line, circular or periodic.
The branch of physics which deals with the study of the motion of the object is known as Mechanics.It is further divided as.

(i) **Statics:** Which deals with the study of the objects at rest.
(ii) **Kinematics:** Which describe motion without going into the cause of motion.
(iii) **Dynamics:** Which deals with the study of the motion of the objects by taking into the account of the force which cause the motion in the objects.

REST AND MOTION :

When we look around, we find some objects are in motion whereas, some other objects are at rest. A moving bus, a moving car are in motion. To win a race, the athletes run. They are in motion.The water in a river is in motion. A book lying on the table, a lamp post, a table, a chair, a black board etc., all are at rest.When do we say that an object is in motion? When do we say that it is at rest?

An object in motion is the one that changes its position with respect to its surroundings whereas, an object which is at rest is the one that does not change its position with respect to surroundings.

The rest and motion are relative. An object at rest with respect to one observer may not be at rest with respect to another observer. The same can be said about motion. For a person inside a bus, the fellow passengers are at rest but the same passengers are in motion with respect to a person standing on the ground. If we closely observe the motion of different objects, we find them performing different kinds of motion. A car moving on a straight road, the rotation of blades of a table fan, the motion of a swing which moves to and fro are all different kinds of motion.

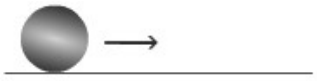
TYPES OF MOTION :

(i) **Random Motion :** Motion having no specific path.
Example : Motion of butterfly, Motion of kite.

(ii) **Translational Motion :** Motion in which all particles of a moving body describes identical trajectory. Rectilinear Motion

(a) **Rectilinear Motion :** When a body moves in straight line is known as rectilinear motion. It is also called linear motion.

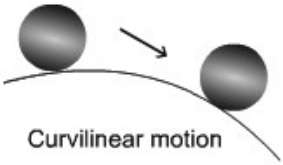
Examples : The motion of a moving car, a person running, a stone being dropped, motion of a train on a straight track



Rectilinear motion

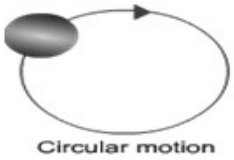
(b) **Curvilinear Motion :** When a body moves in a curve path, it is known as curvilinear motion.

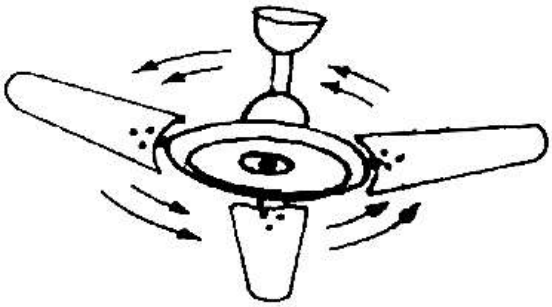
Examples : Car moving on a curved road.



(c) **Circular Motion :** When a body moves in a circular path, its motion is known as circular motion. In circular motion, the object remains at the same distance from a fixed point.

Examples : Motion of the tip of the clock's arm, motion of the earth around the sun, motion of blades of fan.

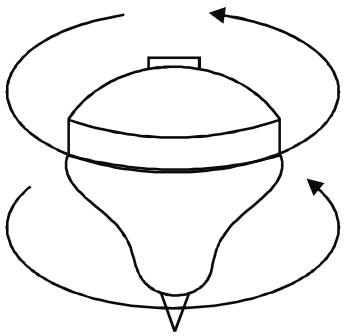




Motion of blades of fan

(iii) **Rotational Motion :** Motion in which a whole body move about an axis is called a rotational motion.

Examples : Motion of top, Rotation of earth

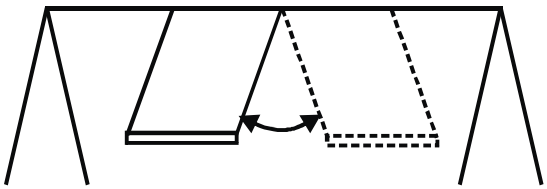


Motion of a top

(iv) **Periodic Motion :** Motion in which an object repeats its motion after a fixed interval of time is called periodic motion.

Examples :

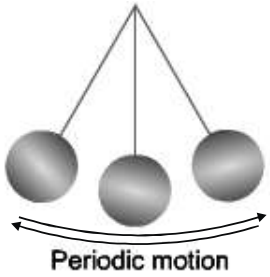
(ii) Motion of a swing.



The Motion of swing

(a) Oscillatory Motion : The to and fro periodic motion of a body around a fix point is called oscillatory motion.

Example : The motion of a simple pendulum, a body suspended from a spring (also called to and fro motion).



The Motion of Pendulum

FRAME OF REFERENCE :

To locate the position of object we need a frame of reference. A convenient way to set up a frame of reference is to choose three mutually perpendicular axes and name them x-y-z axes. The coordinates (x, y, z) of the particle then specify the position of object w.r.t. that frame.

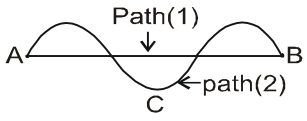
If any one or more coordinates change with time, then we say that the object is moving w.r.t. this frame.

DISTANCE AND DISPLACEMENT :

1. Distance :

Distance is the actual path travelled by a body in a given time. Consider a body travelling from A to B along any path between A and B. The actual length of the path that a body travels between A and B is known as the distance. Here if the body goes from A to B via C, the distance travel will be ACB.

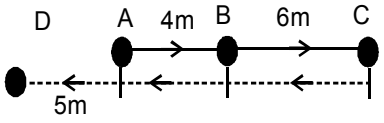
The distance travelled will be different for different paths between A and B. It is a **scalar quantity**.



2. Displacement :

The distance travelled in a given direction is the displacement. Thus displacement is the shortest distance between the given points. It is a **vector quantity**. S.I. **unit of distance and displacement is metre**.

e.g. : A body starts from A and moves according to given figure.



The distance and displaemcent are as follows for different path.

Path	Distance	Displacement
AB	4m	4m
ABC	10m	10m
ABCB	16m	4m
ABCA	20m	0m
ABCAD	25m	–5m

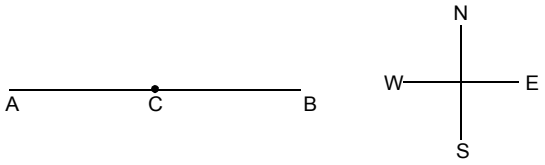
NOTE :

(i) : If a body travels in such a way that it comes back to its starting position, then the displacement is zero. However, distance travelled is never zero.

(ii) : $\frac{\text{Displacement}}{\text{Dis tan ce}} \leq 1$

Ex.1 A train starts from station A and moves towards station B along a straight path which is 100 km from A. Reaching B it turns back and stops midway between A and B. Find the distance and displacement of train. Neglect length of train.

Sol. Say the midpoint as C.



$\therefore$ Distance = AB + BC = 100 + 50 = 150 km

and Displacement = AC = 50 km or 50 km along east.

DIFFERENCE BETWEEN DISTANCE AND DISPLACEMENT :

Distance	Displacement
1. Distance is the length of the path actually traveled by a body in any direction.	1. Displacement is the shortest distance between the initial and the final positions of a body in the direction of the point of the final position.
2. Distance between two given points depends upon the path chosen.	2. Displacement between two points is measured by the straight path between the points.
3. Distance is always positive.	3. Displacement may be positive as well as negative and even zero.
4. Distance is a scalar quantity.	4. Displacement is a vector quantity.
5. Distance will never decrease.	5. Displacement may decrease.

SLOW OR FAST :

As you know that some vehicles move faster than others. For example : A car moves faster than a cycle. How can one say that an object is moving faster or slower. The distance moved by objects in a given interval of time can help us to decide.

UNIFORM AND NON-UNIFORM MOTION :

1. Uniform Motion :

A body has a uniform motion if it travels equal distances in equal intervals of time, no matter how small these time intervals may be. For example, a car running at a constant speed of say, 10 m/s, will cover equal distances of 10 metre, in every second, so its motion will be uniform.

Or

If it moves along a straigth line with a constant speed it is said to be in uniform motion.

2. Non-Uniform Motion :

A body has a non-uniform motion if it travels unequal distances in equal intervals of time. For example, if we drop a ball from the roof of a building, we will find that it covers unequal distances in equal intervals of time. It covers :

4.9 metre in the 1st second,

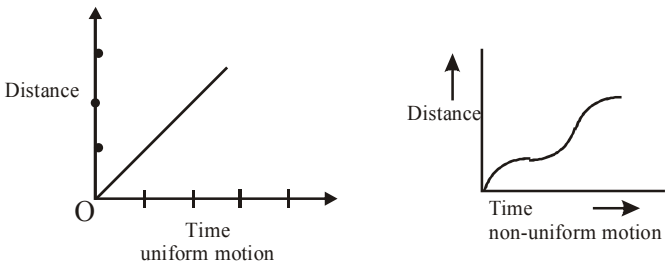
14.7 metre in the 2nd second,

24.5 metre in the 3rd second, and so on.

Or

If the speed of an object is not moving along a straight line keeps changing, its motion is said to be non-uniform.

Uniform and Non-uniform motion can be shown graphically also



SPEED :

It is the characterstic of an object which decide the motion of an object. Distance covered in a unit time is called speed.

$$\boxed{\text{Speed} = \frac{\text{distance}}{\text{time}}}$$

It is measured in m/sec.

Unit of speed

The basic units of speed is meter/second, which can also be expressed in m/min, km/h etc.

Kind of speed:

(i) **Uniform speed :** Consider a car moving on a road such that it covers, say 10 m in one second. If it covers 10 m in every subsequent second, then its speed is said to be uniform. Thus, when a body covers equal distances in equal intervals of time, however small the time interval may be, then the speed of the body is said to be uniform.

(ii) **Non-uniform speed :** When a body covers unequal distances in equal intervals of time or when it covers equal distances in unequal intervals of time, then the speed of the body is said to be non-uniform. Motion of a bus after application of brakes is an example of non-uniform speed.

(iii) **Instantaneous Speed :** The speed of an object at any particular instant of time or at a particular point of its path is called the instantaneous speed of the object. It is measured by speedometer in an automobile.

(iv) **Average Speed :** For an object moving with variable speed, it is the total distance travelled by an object divided by the total time taken to cover that distance.

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

Ex.2 A bus leaves Delhi 7 PM and reaches Mumbai at 9 PM. The speed of the bus is 20 km/h. What is the distance between Mumbai and Delhi ?

Sol. Distance = Speed × Time = 20 × 2 = 40 km (Time = 9 – 7 = 2 hour)

Ex.3 A car travels at 10 m/s. Express the same speed in km/h.

Sol. Convert 10 m into km $\left(10\text{m} = \frac{10}{1000}\text{km}\right)$

Convert 1 s into hour $\left(1\text{s} = \frac{1}{60\times 60}\text{h}\right)$

$$\text{Speed} = \left(\frac{\frac{10}{1000}}{\frac{1}{60\times 60}}\right) = \frac{10\times 3600}{1000} = 36 \text{ km/h}$$

Ex.4 A car covers 1000 m in 10 sec and a cycle cover 50 m in 10 sec. Which one is faster ?

Sol. Speed of car = $\frac{\text{total distance}}{\text{time}} = \frac{1000}{10} = 100$ m/sec

Cycle = $\frac{50}{10} = 5$ m/sec

Hence car moves faster than cycle.

Ex.5 A car travels 30 km at a uniform speed of 40 km/h and the next 30 km at a uniform speed of 20 km/h. Find its average speed.

Sol. Given,

Total distance, d = (30 + 30) = 60 km

Speed for the first 30 km (u_1) = 40 km/h

Speed for the next 30 km (u_2) = 20 km/h

To calculate :

Average speed (v_{av}) = $\frac{\text{Total distance (d)}}{\text{Total time (t)}}$

(i) If time t_1 is for first 30 km, then $t_1 = \frac{30}{40} = \frac{3h}{4} = \frac{3}{4} \times 60 = 45$ min

(ii) If time t_2 is for next 30 km, then $t_2 = \frac{30}{20} = \frac{3h}{2} = \frac{3}{2} \times 60 = 90$ min.

= 1 hr 30 min = 90 min

Total time (t) = $t_1 + t_2 = 45 + 90 = 135$ min

or $t = \frac{135}{60}$ hr

Hence, $v_{av} = \frac{60 \times 60}{135} = \frac{80}{3}$ km/h

VELOCITY :

When an object moves with certain speed, it is not clear in which direction it is moving. To overcome the shortcoming, another term, velocity is used. In a way, velocity is speed in a specified direction. Thus, velocity consists of two parts out of which one part is direction. For example, a car moving with 10 ms^{-1} in east direction has the magnitude of velocity as 10 m s^{-1} and the direction is east.

It is the rate of change of displacement.

Therefore, velocity = $\frac{\text{Displacement}}{\text{Time}}$ or it is the distance travelled in unit time in a given direction.

velocity = $\frac{\text{Distance travelled in a given direction}}{\text{Time taken}}$

S.I. unit of velocity is m/s. It is a vector quantity.

(Magnitude of the velocity is known as speed)

1. **Uniform Velocity:** When a body moves with uniform speed in a specified direction, it is said to be moving with uniform velocity.

Thus, a body moves with uniform velocity when its magnitude as well as its direction remains the same.

Example: Aeroplane moving with 500 km/hr towards east.

2. **Variable velocity:** When a body moves such that either its magnitude or direction or both change, then it is said to be moving with variable velocity.

Example: A car moving on a straight road such that its speed changes from time to time has variable velocity. A car taking a turn has variable velocity as its direction changes.

3. **Instantaneous Velocity :**

The velocity of an object at any given instant of time at particular point of its path is called its instantaneous velocity.

4. **Average velocity:** When a body moves with variable velocity, the average velocity of the body is equal to the ratio of total displacement of the body to the total time taken.

Average velocity = Total displacement / Total time taken

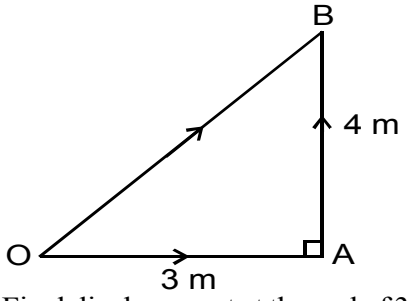
DIFFERENCE BETWEEN SPEED AND VELOCITY :

Speed	Velocity
1. It is a scalar quantity.	1. It is a vector quantity.
2. Speed = $\frac{\text{distance travelled}}{\text{time}}$	2. Velocity = $\frac{\text{displacement}}{\text{time}}$
3. It is rate of change of position of an object.	3. It is rate of change of position of an object in a specific direction.

Ex.6 An object travels with a velocity of 1.5 m/s eastwards for 2s and then with a velocity of 4 m/s northwards for 1s. What is its final displacement at the end of 3 s ? (Use property of right angles)

Sol. Displacement along OA = Velocity × Time = 1.5 × 2 = 3 m

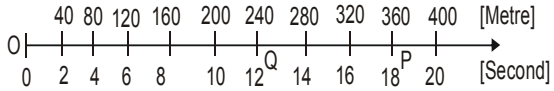
Displacement along AB = Velocity × Time = 4 × 1 = 4 m



Final displacement at the end of 3 s (OB)

$OB = \sqrt{OA^2 + AB^2} = \sqrt{3^2 + 4^2} = \sqrt{9+16} = \sqrt{25} = 5m.$

Ex.7 A car is moving along x-axis. As shown in figure it moves from O to P in 18 s and returns from P to Q in 6 sec. What is the average velocity and average speed of the car in going from (i) O to P and (ii) from O to P and back to Q.



Sol. **(i)** Average velocity $= \frac{\text{Displacement}}{\text{Time interval}} = \frac{360}{18} = 20\ \text{ms}^{-1}$

Average speed $= \frac{\text{Path length}}{\text{Time interval}} = \frac{360}{18} = 20\ \text{ms}^{-1}$

(ii) From O to P and back to Q

Average velocity $= \frac{OQ}{18+6} = \frac{240}{24} = 10\ \text{ms}^{-1}$

Average speed $= \frac{\text{Path length}}{\text{Time interval}}$

$= \frac{OP+PQ}{18+6} = \frac{360+120}{24} = 20\ \text{ms}^{-1}$

Ex.8 When the average speed of an object equal to the magnitude of its average velocity ? Give reason also.

Sol. As average speed $= \frac{\text{Total path length}}{\text{Time interval}}$

Also, average velocity $= \frac{\text{Total Displacement}}{\text{Time interval}}$

When an object moves along a straight line and in the same direction its total path length is equal to the magnitude of its displacement. Hence average speed is equal to the magnitude of its average velocity.

ACCELERATION :

Mostly the velocity of a moving object changes either in magnitude or in direction or in both when the object moves. Then the body is said to have acceleration.

The change in velocity of a body per unit time is called the acceleration or the rate of change of velocity is called the acceleration.

The SI unit of acceleration is ms^{-2}. The other units of acceleration are $cm\ s^{-2}$ and $km\ h^{-2}$.

Acceleration, $a = \frac{\text{change in velocity}}{\text{time}}$

$= \frac{v-u}{t}$

$= \frac{\text{Final velocity} - \text{initial velocity}}{\text{Time}}$

$a = \frac{v-u}{t} \Rightarrow v = u + at$

- **Types of Acceleration :**

(i) Positive acceleration: If the velocity of an object increases in the same direction, the object has a positive acceleration.

Eg. : A freely falling body.

(ii) Negative acceleration (retardation): If the velocity of a body decreases in the same direction, the body has a negative acceleration or it is said to be retardation.

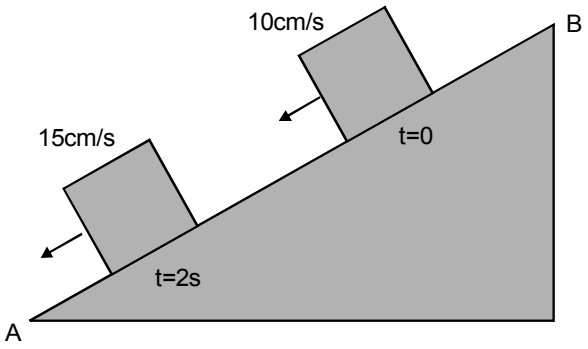
Eg: A train slows down.

Ex.9 The velocity of a car at 10 : 50 am is 60 km/h and at 10: 52 am it is 80 km/h. Assuming constant acceleration in the given period, find its value.

Sol. $a = \frac{v-u}{t} = \frac{(80\text{km/h}) - (60\text{km/h})}{2\,\text{min}} = \frac{20\text{km/h}}{(1/30)\text{h}} = 600\ \text{km/h}^2.$

Ex.10 An object is sliding down an inclined plane. The velocity changes at a constant rate from 10 cm/s to 15 cm/s in two seconds. What is its acceleration ?

Sol. $a = \frac{v-u}{t} = \frac{15\text{cm/s} - 10\text{cm/s}}{2\text{s}} = 2.5\ \text{cm/s}^2.$



MEASUREMENT OF TIME :

Time plays an important role in our life. Any change, or movement which takes place, is understood in terms of a physical dimension called 'time'.

There are many phenomenon by which we can understand time.

(i) The time between one sunrise and the next is called a solar day.

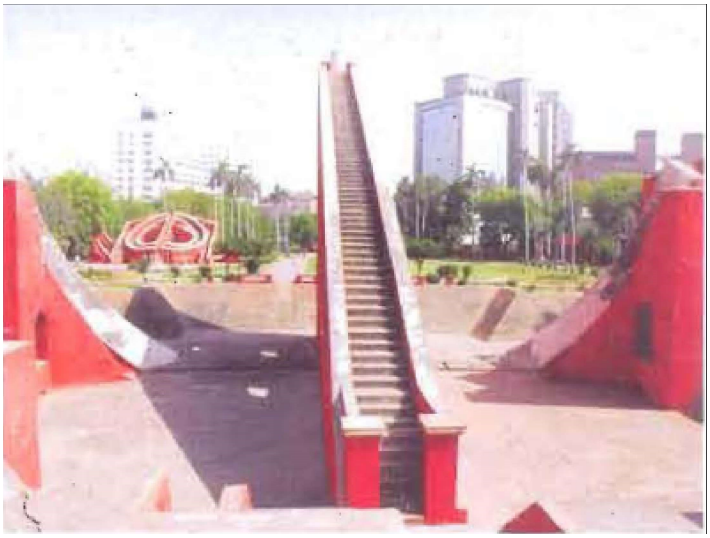
(ii) A month is measured from one new moon to the next.

(iii) The time taken by the earth to complete one revolution around the sun is called year.

The early scientist developed many devices to measures time intervals. All of them make use of some periodic motion.

SUNDIAL :

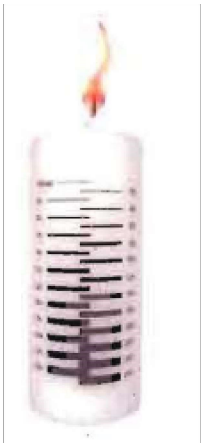
People in older times measured intervals of time shorter than a day with a device called sundial The device worked on the principle that as the position of the sun in the sky changed, so did the position and length of the shadow cast by an object. The decrease and then increase in the length of the shadow during day time was used to measure time in sundials. The sundial has a triangular metallic plate called gnomon fixed vertically at the centre of a circular plate. The device is placed in the open in such a way that gnomon points in the north south direction. The shadow of gnomon on the circular scale shows the time at that particular moment. Sundials indicate time quite accurately but the problem with them is that they cannot be used after sunset or on a cloudy day they can also not be carried along to different places. One sundial can be seen at Jantar Mantar in New Delhi.



Jantar Mantar

CANDLE CLOCKS AND SAND CLOCKS :

Romans actually used sand clocks which worked on the principle that a definite amount of sand takes constant time to fall from the upper chamber to the lower chamber. That constant time was the unit of measurement of time commonly called an hour. The sand clock is also called an hourglass. Once the upper chamber is emptied completely, the hourglass is turned upside down to record the time again.



Candle Clocks

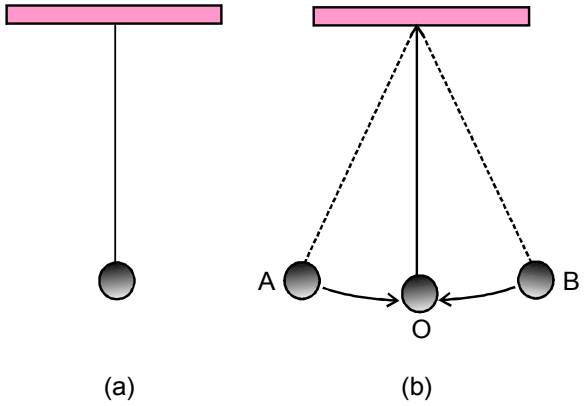
Sand Clocks

SIMPLE PENDULUM :

Any event or motion which repeats itself after a constant time is called periodic motion.One of the most common periodic motion is that of a simple pendulum.

A simple pendulum consists of a small metallic ball or a piece of stone suspended from a rigid stand by a thread. The metallic ball is called the bob of the pendulum.

Figure (a) shows the pendulum at rest in its mean position. When the bob of the pendulum is released after taking it slightly to one side, it begins to move to and fro, in figure (b). The to and fro motion of a simple pendulum is an example of a periodic or an oscillatory motion.



The pendulum is said to have completed one oscillation when its bob, starting from its mean position O, moves from A to B and back to O. The pendulum also completes one oscillation when its bob moves from one extreme position A to the other extreme position B and comes back to A. The time taken by the pendulum to complete one oscillation is called its time period.

UNITS OF TIME :

The basic unit of time is second. Its symbol is s or sec. Other units are minutes (1 hour = 60 min), (1 min = 60 sec), hour day (1 solar day = 24 hours), 1 year (365 days).

1 solar day = 24 × 60 × 60 = 86400 s

1 second = 1/86400th of a solar day

Note :

(i) The symbols of all units are written in singular.

(ii) Other smallest units of time 1 second = 10^6 microsecond; 1 sewcond = 10^9 nanosecond.

MEASURING SPEED :

After knowing the measurement of time and distance we can measure speed of a given object.

If we roll a ball on the ground and note the distance covered in given time we can easily measure the speed of the object.

For example, let a ball covers 10 meter in 5 sec. than the speed will be

$$\text{speed} = \frac{\text{Total distance}}{\text{time taken}} = \frac{10\,\text{m}}{5\,\text{sec}} = 2\ \text{m/sec.}$$

There are many devices by which speed can be measured directly one of them is **speedometer**, which is fitted on the top of a scooter, or a motor cycle, car etc.

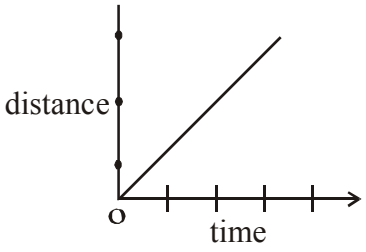
There is another device, which measures the distance moved by the vehicle called an **odometer**.

DISTANCE - TIME GRAPH :

Let us try to understand the nature of motion of an object.

Time	Odometer reading	Distance from the strating points
8.00 am	1000 km	0 km
8.30 am	1100 km	100 km
9.00 am	1200 km	200 km
9.30 am	1300 km	300 km
10.00 am	1400 km	400 km

If we plot the graph between distance and time.



A straight line is obtained. Which mean that its a uniform motion and the speed of the object is constant.
While ploting a graph, one must keep in mind.

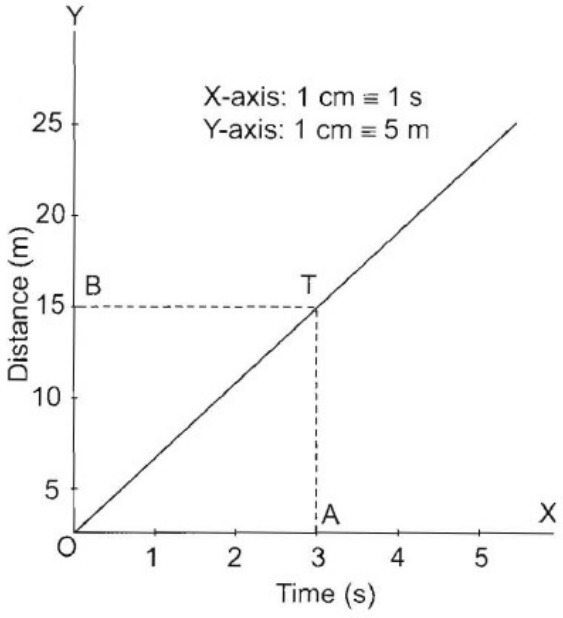
(a) The difference between the highest and the lowest values of each quantity.

(b) The intermediate values of each quantity, so that with the scale chosen, it is convenient to mark the values on the graph.

(c) To utilise the maximum part of the paper on which the graph is to be drawn.

Ex.11 The figure given below shows the graphical representation of the movement of a body. Find its speed after three seconds. What information do you get from the graph?

Sol. Draw a perpendicular on the X-axis from point A (i.e., three seconds on time scale) which intersects the graph at point T. Now draw a line from T, parallel to X-axis which intersects the Y-axis at point B. You can now calculate the speed ofthe moving body after three seconds.



$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}} = \frac{OB}{OA} = \frac{15m}{3s} = 5 \text{ m/s}.$$

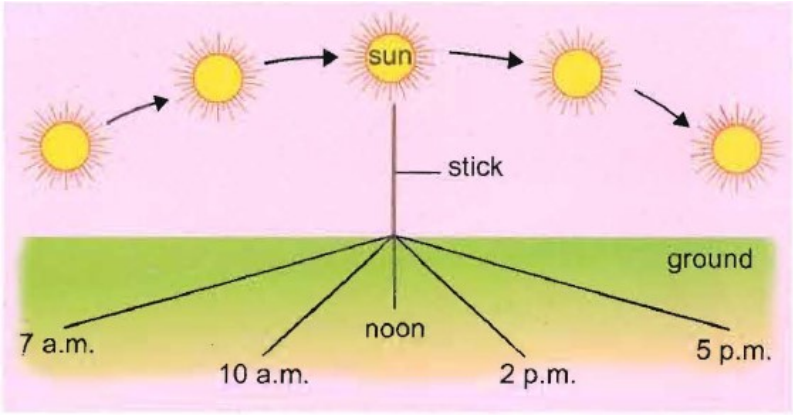
The information provided by a distance-time graph is as follows:

- The distance travelled by the body at a particular point of time
- The speed of the moving body
- The speed of the moving body is uniform

EXTENDED LEARNING – ACTIVITIES AND PROJECTS

1. To observe the length of shadows during day time :

- Take a stick for this purpose and fix it in the open ground away from trees and buildings as shown in figure.
- Now observe the length of the shadow of the stick at different times of the day.
- Use a measuring tape to measure the length of the shadow. You will observe that the length of the shadow of the stick is smallest at noon when the sun is just above it. It is longest in the morning and evening when the sun is low in the sky. The shadow of the stick falls in a direction opposite to that of the source of light, i.e., the sun. So, the shadow moves according to the change in the position of the sun relative to the stick.



Shadow of a stick at different times of the day

2. Collect information about time-measuring devices that were used in the ancient times in different parts of the world. Prepare a brief write up on each one of them. The write up may include the name of the device, the place of its origin, the period when it was used, the unit in which the time was measured by it and a drawing or a photograph of the device, if available.

(i) Rolling Ball clock. invented in 17th century by French engineer Nicolas Grollier. unit of time-15 seconds-1 min.

(ii) Candle clock.
used as early as A.D. 520 in China
unit of time-30 min to hrs.

(iii) Water clock
used in 16th century B.C. in Babylon
Uses steady flow of water to keep track of time.

3. You can perform an interesting activity when you visit a park to ride a swing. You will require a watch. Make the swing oscillate without anyone sitting on it. Find its time period in the same way as you did for the pendulum. Make sure that there are no jerks in the motion of the swing. Ask one of your friends to sit on the swing. Push it once and let it swing naturally. Again measure its time period. Repeat the activity with different persons sitting on the swing.

(i) Compare the time period of the swing measured in different cases.

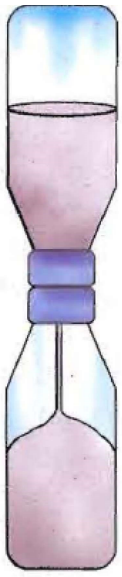
(ii) What conclusions do you draw from this activity?

(i) Time is same in every case.

(ii) Time period does not depend upon mass.

4. To make an hourglass or sand clock :

- Take two transparent plastic bottles of equal size.
- Cut a cardboard disc large enough to cover the mouths of the bottles and make a small hole in the centre of the cardboard.
- Put some sand in one bottle and place the cardboard disc on its mouth.
- Now invert the other bottle over the disc and with the help of a tape, seal the mouth of the two bottles as shown in figure. You r sand clock is ready. Invert the sand clock and watch the flow of sand. Note the time taken by the sand to flow from the bottle on top to the bottle at the bottom. Repeat the procedure. Note the time taken in each case.There is no difference in the time taken for the bottle to empty in both cases. You can measure a particular span of time with this sand clock.



Hourglass

5. To observe slow and fast motion and calculate the average speed :

- For this activity, you can use the football field or even the playground.
- With the help of a measuring tape, measure and mark a distance of 200 metres.
- Now ask your friends/classmates to travel this distance:
  (a) walking slowly
  (b) walking briskly
  (c) running
  (d) on a bicycle
- Measure the time taken by each one to travel this distance with the help of a stopwatch and note your observations as shown in the example in Table.

Time taken to cover a distance of 200 metres

Student	Time and speed	Walking slowly	Walking briskly	Running	On a bicycle
Alka	Time taken (in s)	95	75	59	13
	Speed (in m/s)	$p=\frac{200}{95}$	$=\frac{200}{75}$	$=\frac{200}{59}$	$=\frac{200}{13}$
		= 2.1	= 2.6	= 3.38	= 15.3

You will observe that :

- Minimum time is taken to travel the distance on a bicycle, thus it has the maximum speed.
- Maximum time is taken to travel the distance while walking slowly, so the speed is minimum here.
- The order of time taken is: slow walk> brisk walk> ru nning> cycling.
- The order of speed is: slow walk < brisk walk < running < cycling ,

Motion is dependent on the speed of the body. Higher the speed, faster is the motion and vice versa.

6. To find the speed of a moving ball :

- Take a ball, a measuring tape, a stopwatch and three of your friends to a playground.
- Put a mark or line on the ground and ask your friends to gently slide or throw the ball in one direction from this mark.
- When the ball comes to rest, mark this position also.
- Now measure the distance between the two markings which gives the distance travelled by the ball.
- Also measure the time taken by the ball to reach the state of rest with the help of the stopwatch.
- Put the values of distance and time taken in Table against the name of the boy/girl and also calculate the speed as shown in the given example.

Table : Distance travelled and time taken by a moving ball

S. No.	Name	Distance travelled by the ball (m)	Time taken to cover this distance (s)	Speed = $\frac{\text{Distance travelled}}{\text{Time taken}} = \frac{\text{m}}{\text{s}}$
1.	Nitika	9.0	3	9/3 = 3 m/s
2.				
3.				
The speed of the ball thrown by different boys/girls is different.				

LET US RECAPITULATE

1. Measurement of time:

(i) For measuring the time, our ancestors used sundials, water clocks and sand clocks.

(ii) The watches (or clocks) used today make use of some periodic motion. One of the most well-known periodic motions is that of a simple pendulum, e.g., Wall clock, table clock, Digital clock etc.

2. Simple Pendulum:

(i) A simple pendulum consists of a small metallic ball called bob, suspended from a rigid stand by a thread.

(ii) When the bob of the pendulum is released after taking it slightly to one side, it begins to move to and fro. The to and fro motion of a simple pendulum is an example of an oscillatory or a periodic motion.

(iii) One oscillation: The pendulum has said to have completed one oscillation when its bob moves from one extreme position to the another extreme position and comes back to first extreme position.

(iv) Time period: Time taken by the pendulum to complete one oscillation is called its time period.

3. Units of time and speed :

(i) The basic unit of time is second. Its symbol is's'.

(ii) The basic unit of speed is m/s.
However, it could be expressed in other units also such as m/min or km/h.

4. Speedometer: It is a device to record the speed (of vehicle). It records the speed directly in km/h.

5. Odometer: It is a device to measure the distance moved by the vehicle.

6. Graphical representation of data: We can represent the data in pictorial form by three ways:
(i) Bar graph (ii) Pie chart (iii) Line graph

7. Motion of an object can be presented in pictorial form by their distance-time graph. The distance-time graph for the motion of an object moving with a constant speed is a straight line.

8. Speed of objects help us to decide which one is moving faster than the other.

9. A pendulum of about 25 cm length takes exactly one second to complete one oscillation.

10. The average speed of a Fox - 42 mph, Lion - 50 mph, Horse - 55 mph, Cheetah - 70-80 mph (mph- miles per hour)

KEYWORDS

1. **Bar graph:** A graph in which quantities are represented in form of bars of different heights.

2. **Graphs:** It is mathematical pictorial representation of the relation between two inter-dependent physical quantities.

3. **Non-uniform motion:** If a body covers unequal distances in equal intervals of time or equal distances in unequal intervals of time, then it is said to be in a non-uniform motion.

4. **Oscillatory motion:** The to and fro motion of a simple pendulum about its mean position is called oscillatory motion.

5. **Speed:** It is defined as the distance travelled per unit time. Thus

$$\text{Speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$

6. **Time period:** Time taken by the pendulum for one oscillation is called time period.

7. **Uniform motion:** It can be defined as the motion in which a body travels equal distances in equal intervals of time.

8. **Unit of time:** The S.I. unit of time is second.

CONCEPT APPLICATION LEVEL - I [NCERT Questions]

Q.1 Classify the following as motion along a straight line, circular or oscillatory motion:
(i) Motion of your hands while running.
(ii) Motion of a horse pulling a cart on a straight road.
(iii) Motion of a child in a merry-go-round.
(iv) Motion of a child on a see-saw.
(v) Motion of the hammer of an electric bell.
(vi) Motion of a train on a straight bridge.

Ans. (i) Oscillatory (ii) Straight line (iii) Circular (iv) Oscillatory (v) Oscillatory (vi) Straight line

Q.2 Which of the following are not correct?
(i) The basic unit of time is second.
(ii) Every object moves with a constant speed.
(iii) Distance between two cities is measured in kilometres.
(iv) The time period of a given pendulum is not constant.
(v) The speed of a train is expressed in m /h.

Ans. (ii), (iv), (v)

Q.3. A simple pendulum takes 32 sec. to complete 20 oscillations. What is the time period of the pendulum?

Ans. Given here,

No. of oscillations = 20

Total time taken = 32 sec.

We know that time period of a pendulum is the time taken by it to complete one oscillation. Thus,

$$\text{Time period} = \frac{\text{Total time taken}}{\text{No. of oscillations}} = \frac{32\ \text{sec.}}{20} = 1.6 \text{ seconds}$$

Therefore, time period of this pendulum will be 1.6 sec.

Q.4 The distance between two stations is 240 km. A train takes 4 hours to cover this distance. Calculate the speed of the train.

Ans. Here, it is given that,
The distance between two stations = 240 km
Time taken to cover this distance = 4 hr.

Now, $$\text{Speed} = \frac{\text{Distance}}{\text{time}} = \frac{240\text{km}}{4\text{hr}} = 60\text{km/h}$$

Therefore, speed of the train will be 60 km/h.

Q.5 The odometer of car reads 57321.0 km when the clock shows the time 08 : 30 AM. What is the distance moved by the car, if at 08 : 50 AM, the odometer reading has changed to 57336.0 km? Calculate the speed of the car in km/min during this time. Express the speed in km/h also.

Ans. In this question, it is given that,
Initial reading of odometer = 57321.0 km
Final reading of odometer = 57336.0 km
Initial time = 08.30 AM
Final time = 08.50 AM
Now, total distance covered = Final reading of odometer –Initial reading of odometer
= 57336.0 km – 57321.0 km = 15.0 km

Total time taken = Final time – Initial time

= 08.50 AM – 08.30 AM = 20 min

We know that, speed = $\frac{\text{Distance covered}}{\text{Time taken}} = \frac{15\text{km}}{20\,\text{min}} = 0.75$ km/min

Speed in km/h = 0.75 × 60 (1 hr = 60 min)

= 45 km/hr

Therefore, the distance moved by the car = 15 km

and the speed of the car = 0.75 km/min and 45 km/h.

Q.6 Salma takes 15 minutes from her house to reach her school on a bicycle. If the bicycle has a speed of 2 m/s, calculate the distance between her house and the school.

Ans. According to the question,

Speed of the bicycle = 2 m/s

Total time taken = 15 min = 900 sec.

We know that,

The distance covered = Speed × Time

= 2 m/s × 900 sec. = 1800 m

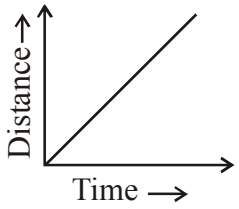
Therefore, the distance between her house and the school will be 1800 m or 1.8 km.

Q.7 Show the shape of the distance-time graph for the motion in the following cases:

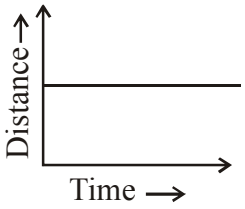
(i) A car moving with a constant speed.

(ii) A car parked on a side road.

Ans.



(i) distance-time graph of a car moving with a constant speed



(ii) distance-time graph of a car parked on a side road

Q.8 Which of the following relations is correct?

(i) Speed = Distance × Time

(ii) Speed = $\frac{\text{Distance}}{\text{Time}}$

(iii) Speed = $\frac{\text{Time}}{\text{Distance}}$

(iv) Speed = $\frac{1}{\text{Distance} \times \text{Time}}$

Ans. (ii) Speed = $\frac{\text{Distance}}{\text{Time}}$

Q.9 The basic unit of speed is :

(i) km/min (ii) m/min (iii) km/h. (iv) m/s

Ans. (iv) m/s

Q.10 A car moves with a speed of 40 km/h for 15 minutes and then with a speed of 60 km/h for the next 15 minutes. The total distance covered by the car is :

(i) 100 km (ii) 25 km (iii) 15 km (iv) 10 km

Ans. (ii) 25 km

Q.11 Figure shows the distance-time graph for the motion of two vehicles A and B. Which one of them is moving faster?

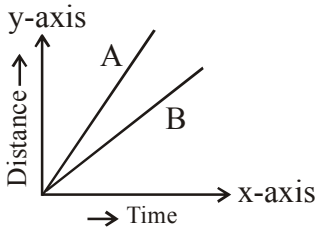
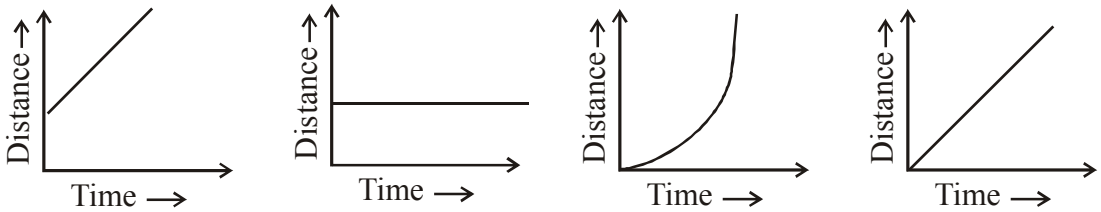


Fig. Distance-time graph for the motion of two cars

Ans. A is moving faster.

Q.12 Which of the following distance-time graphs shows a truck moving with speed which is not constant?



Ans. (ii) and (iii)

CONCEPT APPLICATION LEVEL - II

Slow or Fast :

Q.1 Make a list of four slow moving vehicles.

Ans. Bullock cart, rickshaw, bicycle, horse cart, etc.

Q.2 Name few fast moving vehicles.

Ans. Train, bus, aeroplane, car, etc.

Q.3 What is motion?

Ans. Motion can be taken as the opposite of rest. A body is said to be in a state of motion when it continuously changes its position in respect to its surroundings.

Q.4 In the following table some common examples of motion are given, identify the type of motion in each case (straight line, circular or periodic):

Soldiers in a march past	
Bullock cart moving on a straight road	
hands of a athelete in a race	
Pedal of a bicycle in motion	
Motion of the earth around the sun	
Motion of a swing	
Motion of a pendulum	

Ans.

Soldiers in a march past	Straight line
Bullock cart moving on a straight road	Straight line
hands of a athelete in a race	Periodic
Pedal of a bicycle in motion	Cirular
Motion of the earth around the sun	Periodic / ciruclar
Motion of a swing	Periodic
Motion of a pendulum	Periodic

Q.5 How can we say that the speed of an object is faster than the other?

Ans. An object can be said to have a faster speed if it covers longer distance than the other, during a given period of time.

Speed :

Q.1 What is speed?

Ans. The distance travelled by an object per unit time, is called its speed.

Q.2 What are the basic units of time and speed?

Ans. The basic unit of time is second and that of speed is metre/second.

Q.3 How can speed of an object be calculated?

Ans. Speed of an object can be calculated by dividing the total distance covered by the total time taken.

Q.4 What is uniform and non-uniform motion?

Ans. Uniform motion can be defined as the motion in which a body travels equal distances in equal intervals of time.

Non-uniform motion can be defined as the motion in which a body that covers unequal distances in equal intervals of time or equal distances in unequal intervals of time.

Q.5 What is speedometer?

Ans. Speedometer is a device, used in vehicles to record the speed directly in km/h.

Q.6 For what purpose odometer is used?

Ans. Odometer is a device, used in vehicles to measure the distance covered by the vehicle.

Measurement Of Time :

Q.1 Name some ancient clocks used by our ancestors.

Ans. Sundials, water clocks and sand clocks.

Q.2 What is common in most of the clocks?

Ans. All of them show periodic motion.

Q.3 What were the definitions of a day, a month and a year for our ancestors?

Ans. Day: Time between one sunrise and the next. Month: Time between one new moon to the next. Year: Time taken by the earth to complete one revolution of the sun.

Q.4 What is a simple pendulum? How does it perform an oscillatory motion?

Ans. A simple pendulum consists of a small metallic ball suspended from a rigid stand by a thread. The metallic ball is called the bob of the pendulum. When the bob of the pendulum is released after taking it slightly to one side it begins to move to and fro. The to and fro motion of a simple pendulum is an example of an oscillatory motion.

Q.5 On what factors the time period of a pendulum depends?

Ans. Two factors are there:

(i) Length of the pendulum (ii) Acceleration due to gravity.

Q.6 What is time period of a pendulum? Does it remain constant in all cases?

Ans. The time taken by the pendulum to complete one oscillation is called its time period. The time taken for one complete oscillation or time period remains the same whether the amplitude of oscillations of a pendulum is large or small

Q.7 What are the modern clocks called?

Ans. Digital clocks.

Q. 8 Give contribution of Galileo to the development of clocks.

Ans. While sitting in a church, Galileo noticed that the lamp suspended from its ceiling with a chain is moving to and fro. He also observed that his pulse beat the same number of time during the interval in which the lamp completed one oscillation. This observation led to the development of pendulum clocks and other watches.

Q. 9 What are the time intervals that have to deal with nowadays?

Ans. Nowadays we have to deal with a wide range of time intervals such as ages of stars and planets very large time intervals, which is expressed in billion of years to the very small time intervals like microseconds and nanoseconds for scientific works.

Q.10 What are quartz clocks?

Ans. The clocks or watches having an electric circuit with one or more cells are called quartz clocks.

Q.11 What is the advantage of using quartz clocks?

Ans. The time measured by quartz clocks is much more accurate than the clocks used earlier.

Measuring Speed :

Q.1 What is an odometer?

Ans. An odometer is a device in vehicles which measures the distance moved by it.

Q.2 The odometer of a car reads 36580 km when the clock shows 9.00 AM. What is the distance moved by the car if at 10 AM the odometer reading has changed to 36620 km? Calculate the speed of the car in km/h during this time.

Ans. Initial reading of the odometer = 36580 km

Final reading of the odometer = 36620 km

Initial time = 9.00 A.M.

Final time = 10.00 A.M.

Total distance travelled = 36620 – 36580 km = 40 km

Total time taken = 10.00 A.M. – 9.00 A.M. = 1.00 hr

We know that speed = $\frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{40\,\text{km}}{1\,\text{hr}} = 40$ km/hr

Therefore, the speed of the car will be 40 km/hr.

Q.3 Rajiv takes 10 minutes to reach the post office from his house on °a rickshaw. If the speed of rickshaw is 3 m/s, calculate the distance between his house and post office.

Ans. Speed of rickshaw = 3 m/s

Total time taken = 10 min = 600 sec.

We know that,

The distance covered = Speed × Time

= 3 m/s × 600 sec. = 1800 m

Therefore, the distance between his house and the post office will be 1800 m or 1.8 km.

Distance-Time Graph :

Q.1 What are x-axis and y-axis in a graph?

Ans. The horizontal line in a graph is called the x-axis while the vertical line is called the y-axis.

Q.2 What do you mean by origin in a graph?

Ans. The point where the two axis cut each other is called origin.

Q.3 What are independent variables?

Ans. The variables whose value increases or decreases freely and does not depend on other variables are called independent variables e.g., time, place, age, etc.

Q.4 On which axis the dependent variable is represented?

Ans. The dependent variable is represented on y-axis.

Q.5 What is the characteristic of distance-time graph for the motion of an object moving with a constant speed?

Ans. It is a straight line inclined on x-axis at some angle.

Q.6 What is the characteristic ofthe distance-time graph for an object standing on the side of a road ?

Ans. It is a straight line parallel to x-axis.

Q.7 Describe various steps to construct a graph using the data given in the following table:

S. No.	Time	Distance
1	0	0
2	1 min	1 km
3	2 min	2 km
4	3 min	3 km
5	4 min	4 km
6	5 min	5 km

Ans. We can make the graph in the following steps given below:

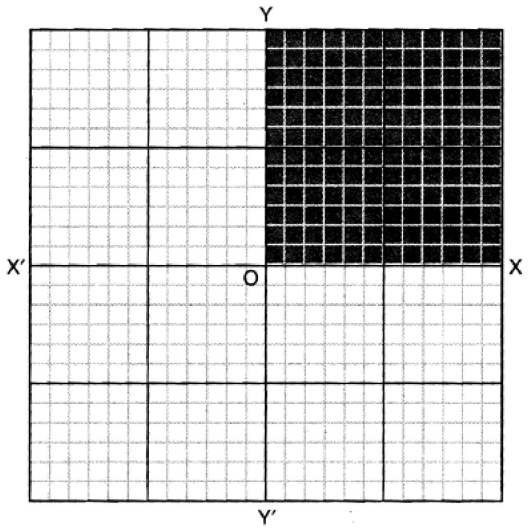
(i) Draw two perpendicular lines to represent the two axis and mark them as OX and OY as in Fig.

(ii) Decide the quantity to be shown along the x-axis and that to be shown along the y-axis. In this case, we show the time along the x-axis and the distance along the y-axis.

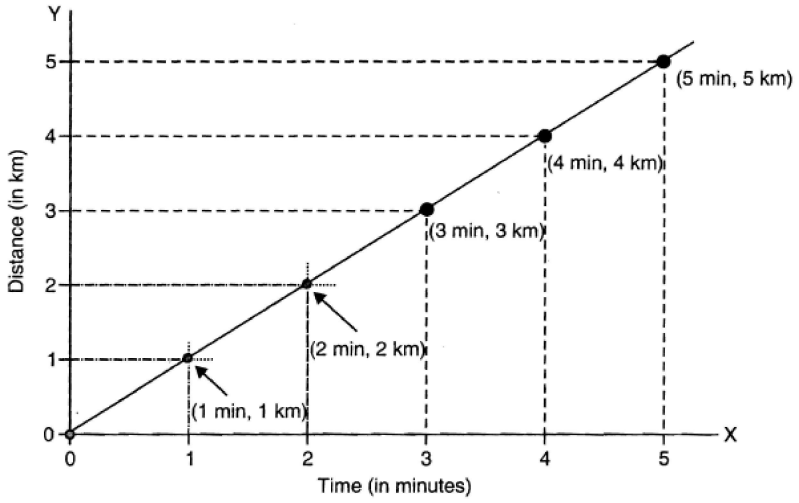
(iii) Choose a scale to represent the distance and another to represent the time on the y-axis and x-axis respectively.

(iv) Mark the values of the time and the distance on the respective axis according to the scale chosen.

(v) Now mark the points on the graph paper to represent each set of values for distance and time (Fig.).



(vi) Join all the points on the graph. This is the distance time graph for the motion of the car.

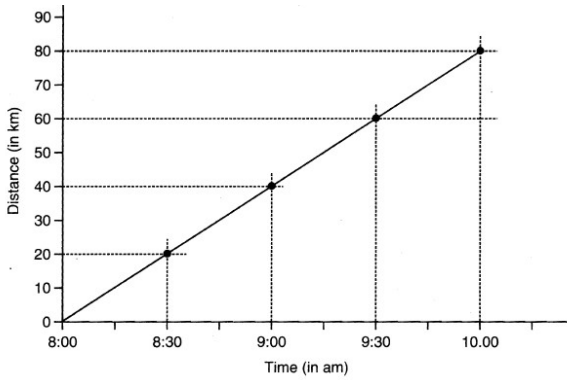


Q.8 (i) How can we choose a suitable scale? Explain by giving example.
(ii) What are the uses of distance-time graph?

Ans. (i) We should keep the following points in mind while choosing the most suitable scale for drawing a graph: (a) The difference between the highest and lowest values of each quantity; (b) The intermediate values of each quantity, so that with the scale chosen, it is convenient to mark the values on the graph; and (c) To utilise the maximum part of the paper on which the graph is to be drawn. Suppose that we have a graph paper of size 25 cm x 25 cm and we have to accommodate following data:

Time (AM)	Odometer reading	Distance from the starting point
8:00 AM	36540 km	0 km
8:30 AM	36560 km	20 km
9:00 AM	36580 km	40 km
9:30 AM	36600 km	60 km
10:00 AM	36620 km	80 km

One of the scales will be:
Distance: 5 km = 1 cm and
Time: 6 min = 1 cm
Using this scale we can draw a distance-time graph as given below:



(ii) Uses of distance-time graph: Distance-time graph provides a varieties of information about the motion.

1. The distance of a moving body at any time unit can be evaluated.
2. The nature of motion is given at a glance.
3. The relative motion at various intervals can be judged.
4. The region of acceleration or retardation can be estimated without any calculations.

Q. 9 Rajesh made a graph to show the relationship between the side of a cube and its volume. Look at the graph given below and answer the following questions:

(i) What has Rajesh shown and on which axis?

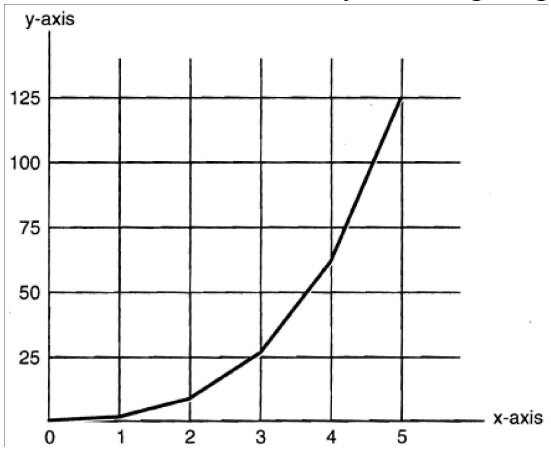
(ii) What is the scale of the graph?

(iii) What is the volume of a cube whose side is 2 cm?

(iv) Roughly how long is the side of a cube whose volume is 100 cm^3?

(v) Roughly how much is the volume of a cube of side 3 cm?

(vi) Can we find the volume of a cube of side 6 cm by extending the graph?



Ans.

(i) Rajesh has shown the side of the cube on x-axis and volume of the cube on y-axis.

(ii) On the x-axis 1 cm = 1 cm (side of the cube)
On the y-axis 1 cm = 25 cm^3 (volume).

(iii) The volume of the cube whose side is 2 cm is 8 cm^3.

(iv) Side of the cube of volume 100 cm^3 = 4.6 cm approx.

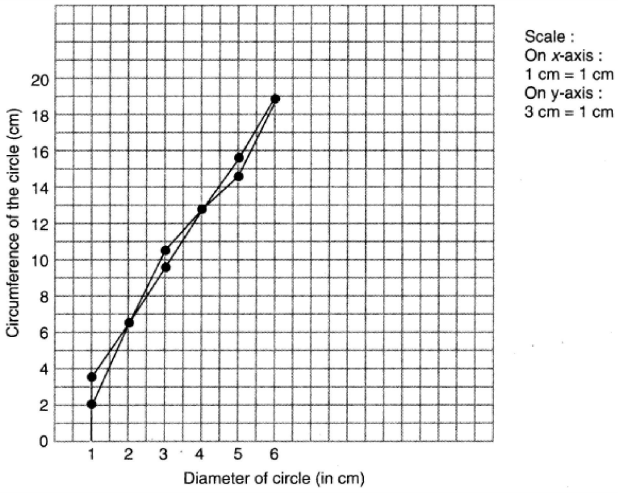
(v) Volume of the cube of side 3 cm = 27 cm^3.

(vi) Yes, by extending the graph we can find the volume of cube having side 6 cm.

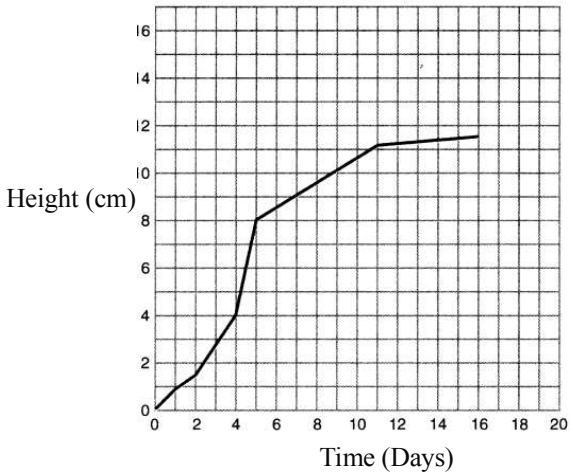
Q.10 Using the data given in the following table, show graphically the relationship between the diameter and circumference of a circle:

Diameter of the circle (*cm*)	Circumference of the circle (*cm*)
1.0	*3.2*
2.0	*6.3*
3.0	*9.4*
4.0	*12.6*
5.0	*15.7*
6.0	*18.8*

Ans. This graph can be prepared by taking diameter of the circle on the x-axis and the circumference on y-axis. On x-axis 1 cm diameter is shown by 1 cm and on the y-axis, 3 cm of circumference is shown by 1 cm.

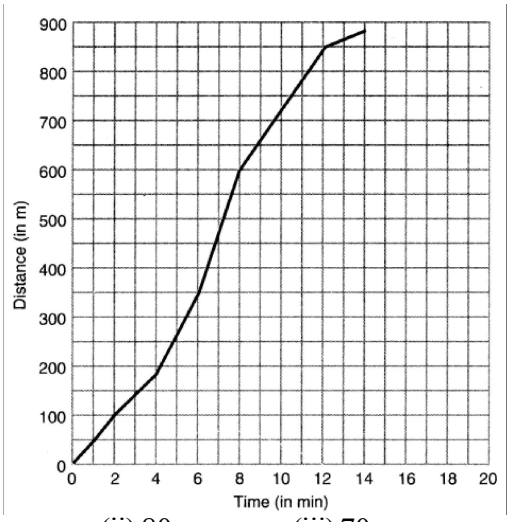


Q.11 The graph given below shows the increase in the height of a plant with time.
(i) Write down the scale used.
(ii) What was the height of the plant on the eighth day and the twelfth day?
(iii) Make your comments on the growth of the plant.



Ans. (i) On the x-axis 1 cm =1 day and on the y-axis 1 cm = 1 cm height.
(ii) The height on eighth day was 9.5 cm and on twelfth day height was 11.2 cm.
(iii) Comments on the growth of the plant: The growth of plant from 0 to 2 days is less than the growth from 2 days to 4 days.
During next two days, i.e., from 4th day to 6th day the growth of plant is slightly less than the double of the growth between 2nd day to 4th day.
From 6th day to 10th days, the growth of plant shows reduction. The growth reduced continuously even after 10th day.
In brief the plant is growing continuously. But the growth in first week is more than the growth in second week.

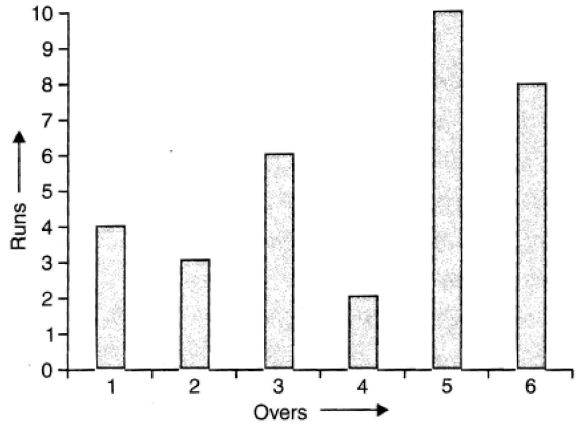
Q. 12 The following graph shows the distance travelled by Rajni from home to school and the time taken. Study it and answer the following questions:
(i) What distance did Rajni travel in first two minutes?
(ii) What distance did Rajni travel in the next two minutes?
(iii) What distance did Rajni cover between 8 minutes and 10 minutes from the start?
(iv) Are these distances equal?
(v) What was the distance travelled between 12 minutes and 14 minutes?



Ans. (i) 100 m (ii) 80 m (iii) 70 m
(iv) No, these distances are not equal (v) 60 m

Q.13 In a cricket match a team scored 4, 3, 6, 2, 10 and 8 runs in first 6 overs respectively. Show these runs by a bar graph.

Ans.



CONCEPT APPLICATION LEVEL - III

Section–A

Q.1 Match the items given in Column I with Column II:

Column I	Column II
(*i*) *Years*	(*a*) *Rotation period of earth on its axis*
(*ii*) *Hour*	(*b*) *Time to complete 100 m race*
(*iii*) *Minute*	(*c*) *Gestation period in humans*
(*iv*) *Days*	(*d*) *Age of a person*
(*v*) *Second*	(*e*) *In scientific research*
(*vi*) *Month*	(*f*) *Age of stars*
(*vii*) *Microseconds*	(*g*) *Time to reach your school*
	(*h*) *Train reaches from one city to other*

Section–B

Q.2 Fill in the blank space in the following statements:
(i) The distance covered by an object in a ..... is called its speed.
(ii) Time between one sunrise and the next sunrise was called a ..... .
(iii) In a simple pendulum, the metallic ball suspended by thread is called its
(iv) Time period of a pendulum depends on its ..... .
(v) The symbols of all units are written in ..... .
(vi) A .... is one billionth of a second.
(vii) Motion of objects can be presented in pictorial form by their ..... graph.
(viii) The distance-time graph for the motion of an object moving with a constant speed is a .....

Section–C

Q.3 Choose the true and false statements from the following:
(i) Faster vehicle has a higher speed.
(ii) All the clocks make use of some periodic motion.
(iii) The basic unit of speed is km/h.
(iv) The symbols of all units are written in singular.
(v) The basic unit of time is second.
(vi) Age of a person is expressed in days.
(vii) The distance-time graph of standing vehicle is a straight line parallel to x-axis.
(viii) Periodic events are used for the measurement of time.

Section–D

OBJECTIVE TYPE QUESTIONS

Q.1 Nearly all the clocks make use of
(A) straight line motion (B) periodic motion
(C) random motion (D) circular motion

Q.2 A simple pendulum takes 42 sec. to complete 20 oscillations. What is its time period?
(A) 2.1 s (B) 4.2 s (C) 21 s (D) 8.40 s

Q.3 Time period of simple penduclum depends upon its
(A) weight of bob (B) length (C) both (A) and (B) (D) None of these

Q.4 One millionth of a second is called
(A) micro second (B) nano second (C) pico second (D) femto second

Q.5 What part of a second is nano second?
(A) One millionth (B) One thousandth (C) One hundredth (D) One billionth

Q.6 What is the relation between distance and speed?
(A) Distance = Speed × Time (B) Distance = Speed/Time
(C) Distance = Time/Speed (D) None of these

Q.7 How will you convert the speed given in km/h to m/s?
(A) By multiplying with 5/16 (B) By multiplying with 6/5
(C) By multiplying with 18/5 (D) By multiplying with 5/18

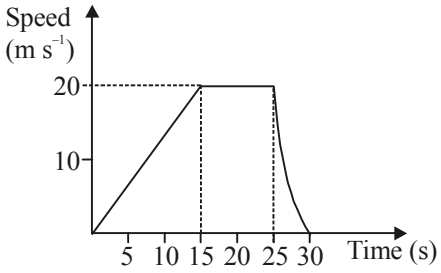
Q.8 On which axis is dependent variable represented?
(A) x-axis (B) y-axis (C) On any axis (D) Depends on the data

Q.9 Which one records the distance travelled by a vehicle?
(A) Speedometer (B) Manometer (C) Motometer (D) Odometer

Q.10 The distance-time graph for the motion of an object moving with a constant speed is
(A) a curved line leaving towards x-axis
(B) a curved line inclined towards y-axis
(C) a straight line inclined at some angle towards x-axis
(D) none of these

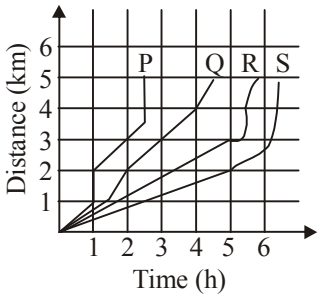
Q.11 The distance-time graph for a vehicle standing on a road side will be
(A) straight line inclined by some angle to x-axis
(B) straight line parallel to x-axis
(C) straight line parallel to y-axis
(D) none of these

Q.12 The graph shows how the speed of a car changes with time. How far does the car travel before the brakes are applied ?



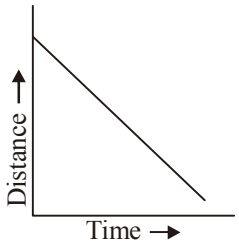
(A) 200 m (B) 250 m (C) 300 m (D) 350 m

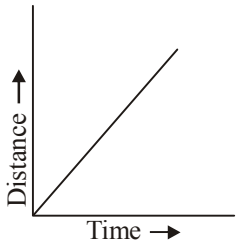
Q.13 The graph given here shows the motion of four runners -P, Q, R and S in a 5 km marathon. Whose motion is the fastest ?

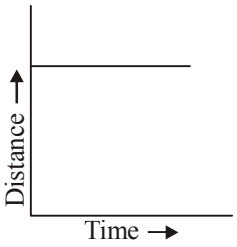


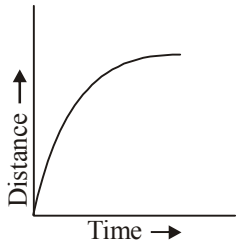
(A) P (B) Q (C) R (D) S

Q.14 Which of the following graphs does NOT represent constant speed ?

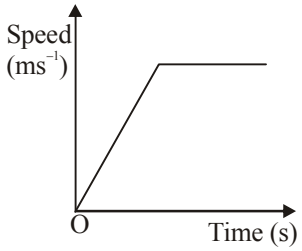
(A) 

(B) 

(C) 

(D) 

Q.15 The graph shows the first few seconds of a car's journey. From the graph it can be seen that the car travels



(A) At increasing speed and then stops
(B) At constant speed and then slows down
(C) With constant acceleration and then at constant speed
(D) With constant acceleration and then stops

Q.16 The average velocity of a body is equal to mean of its initial velocity and final velocity. The acceleration of the body is :
(A) Variable (B) Zero (C) Negative (D) Uniform

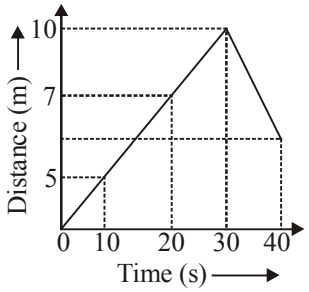
Q.17 Which of the following is not caused by friction or resistive forces ?
(A) A match lightning as it strikes a match box
(B) A car braking to a stop
(C) A pebble accelerating as it falls to the ground
(D) A meteor glowing as it falls through the atmosphere

Q.18 Match the Column-I with Column-II and select the correct option from the codes given below.

	Column-I		**Column-II**
(a)	Body moving with uniform speed	(i)	Straight line parallel to the time axis
(b)	Body moving with non-uniform speed	(ii)	A curve having increasing slope
(c)	When a body is at rest	(iii)	Straight line inclined to the axis

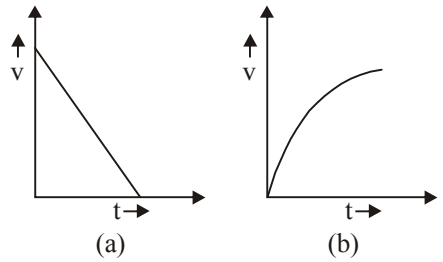
(A) (a)-(iii), (b)-(ii), (c)-(i) (B) (a)-(i), (b)-(iii), c-(ii)
(C) a-(ii), b-(i), (c)-(iii) (D) (a)-(i), (b)-(ii), (c)-(iii)

Q.19 Study the distance-time graph of a toy car, given in the figure and choose the incorrect statement from the following.



(A) The toy car is fastest during first 10 seconds
(B) The toy car is slowest in between 10 and 20 seconds
(C) Distance travelled during last 10 seconds is 5 m
(D) None of these

Q.20 What conclusions do you draw about the nature of motion of an object from the given velocity-time graphs ?



(A) In graph (a) object is moving with retardation and in graph (b) object is moving with constant acceleration

(B) In graph (a) object is moving with retardation and in graph (b) object is moving with variable acceleration

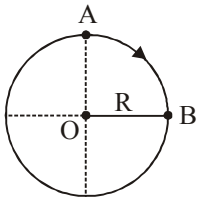
(C) In graph (a) object is moving with positive acceleration and in graph (b) object is moving with variable acceleration.

(D) In graph (a) object is moving with positive acceleration and in graph (b) object is moving with constant acceleration

Q.21 Mohan takes 15 minutes to go from his home to school and 30 minutes for the return journey. If the distance between the school and the home is 4.5 km, what is his average velocity ?

(A) 0 (B) 5 m s^{-1} (C) 4 m s^{-1} (D) 3 m s^{-1}

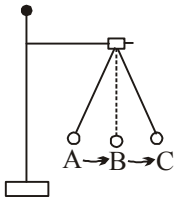
Q.22 An object start moving in a circular path of radius R, from point A. The magnitude of displacement of the object, when it reaches point B is :



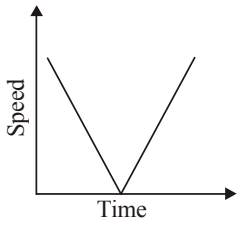
(A) πR (B) $\sqrt{2}\,R$ (C) $\sqrt{2}\,\pi R$ (D) $\frac{\pi R}{2}$

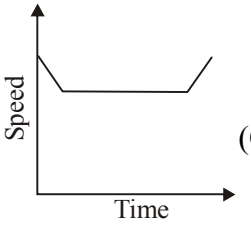
Q.23 A pendulum is oscillating as shown in the figure. If it takes 0.4 s to swing from A to B, then how long will it take to make 5 oscillations ?

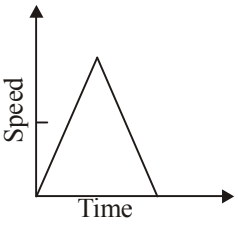
(A) 1.6 s
(B) 3.2 s
(C) 8.0 s
(D) 4.2 s

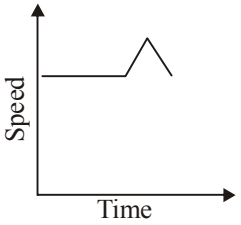


Q.24 Which of the following speed-time graphs represents the case of a body first decelerating then moving with a constant speed and finally accelerating ?

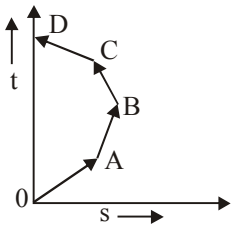
(A) 

(B) 

(C) 

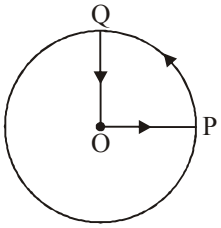
(D) 

Q.25 Which of the following options is correct for the object having a straight line motion represented by the graph shown in figure ?



(A) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity.
(B) Velocity of the object increases uniformly
(C) Average velocity is zero
(D) The graph shown is impossible

Q.26 A cyclist starts from the centre O of a circular park of radius 1 km, reaches the edge P of park, then cycles along the circumference and returns to the centre along QO as shown in figure. If the round trip takes 10 minutes, then the average speed of cyclist is :



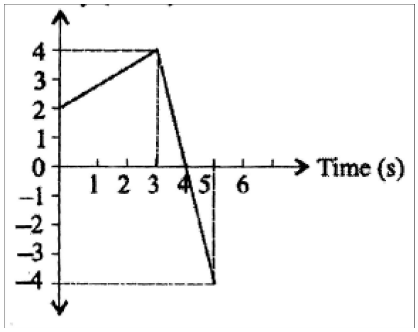
(A) $\frac{\pi+4}{10}$ km per minute (B) $\frac{\pi+4}{20}$ km per minute

(C) $\frac{\pi}{4}$ km per minute (D) π km per minute

Q.27 Two boys, P and Q are running along the same path. P is 10 m ahead of Q initially. However, Q catches up with P, after running 50 m. Assuming that both boys are running at a constant speed, what is the ratio of the speeds of P and Q ?
(A) 6 : 5 (B) 5 : 6 (C) 4 : 1 (D) 4 : 5

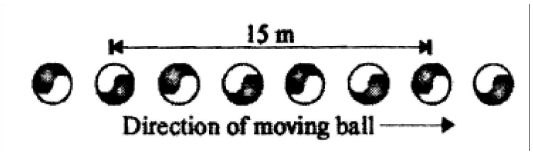
Q.28 Komal and Kavita start at one end of a street (the origin), run to the other end, and then head back. On the way back, Komal is ahead of Kavita. Which of the given statements is correct, regarding the distance covered and the displacement from the origin at the moment ?
(A) Kavita has run greater distance, but her displacement is less than that of Komal
(B) Kavita has run a greater distance and her displacement is greater than that of Komal
(C) Komal has run a greater distance, but her displacement is less than that of Kavita
(D) Komal has run a greater distance and her displacement is greater than that of Kavita

Q.29 The diagram shows Velocity (m s^{-1}) the velocity against time graph for the motion of a body. What is its displacement in the first 5 s ?



(A) 11 m (B) 13 m (C) 7.5 m (D) 9 m

Q.30 The given diagram shows a series of images of a moving ball captured by a camera.



The ball was moving at a constant velocity and the images were taken at a constant rate of 10 per second. What is the speed of the ball ?
(A) 30 m s^{-1} (B) 20 m s^{-1} (C) 45 m s^{-1} (D) 15 m s^{-1}

Q.31 An old man moves along a semi-circular track of radius 40 m during morning walk. If he starts at one end of the track and reaches the other end, the distance covered and displacement of the man with respect to the starting point are respectively _____ .
(A) 120 m, 40 m (B) 126 m, 80 m (C) 110 m, 60 m (D) 50 m, 120 m

ANSWERS

CONCEPT APPLICATION LEVEL - III

Section–A

Q.1

Column I	Column II
(*i*) Years	(*d*) Age of a person
(*ii*) Hour	(*h*) Train reaches from one city to other
(*iii*) Minute	(*g*) Time to reach your school
(*iv*) Days	(*a*) Rotation period of earth on its axis
(*v*) Second	(*b*) Time to complete 100 m race
(*vi*) Month	(*c*) Gestation period in humans
(*vii*) Microseconds	(*e*) In scientific research

Section–B

Q.2 (i) unit time (ii) day (iii) bob (iv) length (v) singular
(vi) nanosecond (vii) distance-time (viii) straight line

Section–C

Q.3 (i) True (ii) True (iii) False (iv) True (v) True (vi) False
(vii) True (viii) True

Section–D

OBJECTIVE TYPE QUESTIONS

Q.1	B	Q.2	A	Q.3	B	Q.4	A	Q.5	D
Q.6	A	Q.7	D	Q.8	B	Q.9	D	Q.10	C
Q.11	B	Q.12	D	Q.13	A	Q.14	D	Q.15	C
Q.16	D	Q.17	C	Q.18	A	Q.19	C	Q.20	B
Q.21	A	Q.22	D	Q.23	C	Q.24	B	Q.25	C
Q.26	B	Q.27	D	Q.28	C	Q.29	D	Q.30	A
Q.31	B								