# SCIENCE

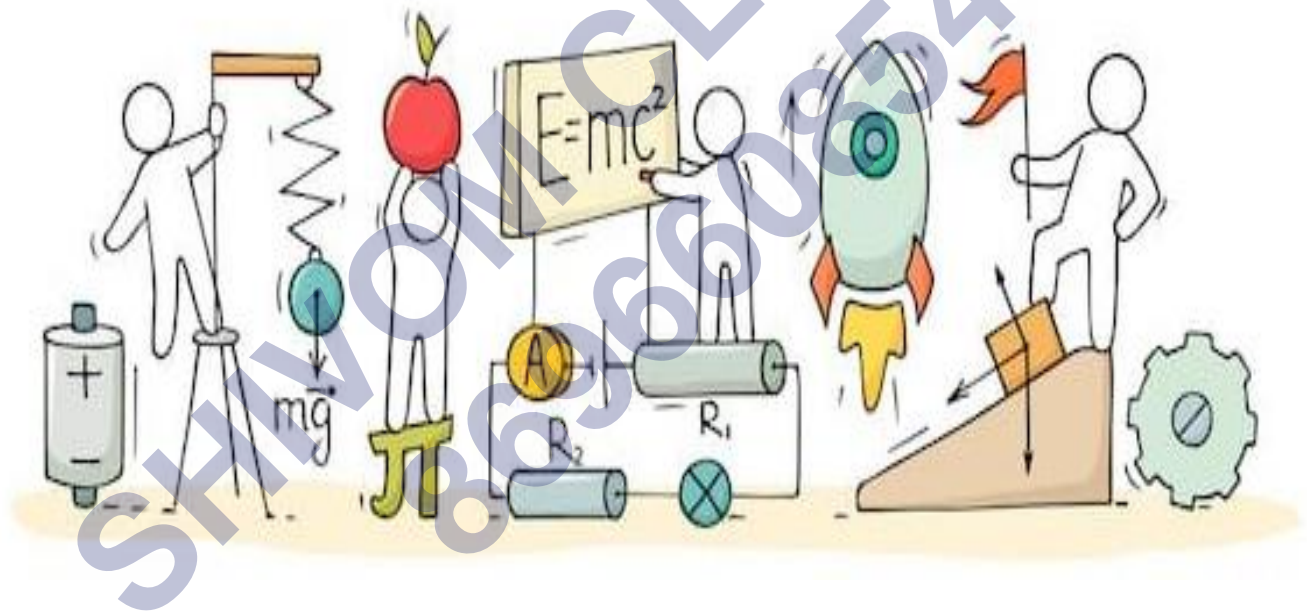## CHAPTER-13: MOTION AND TIME

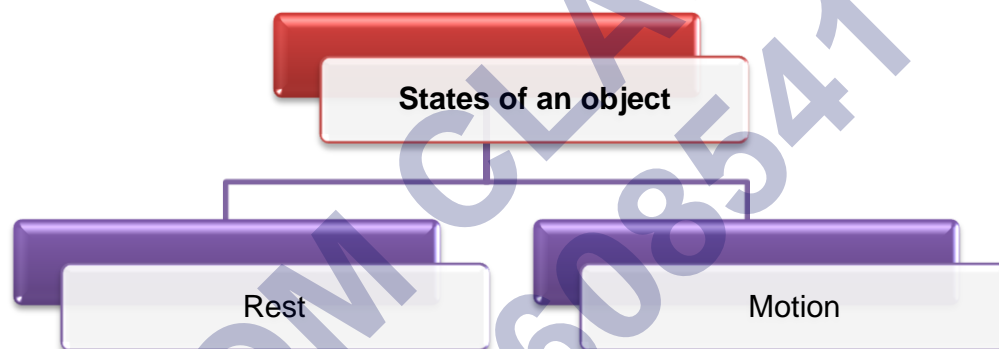# Motion and Time

## Motion



- Motion refers to the change in the position of an object with respect to time.
- There are two states of an object:

```
                States of an object
                    /         \
                  Rest       Motion
```

- When a body does not change its position with respect to time, then the body is said to be at rest.

   **Examples:** Chairs of a dining table, a flower vase, table, blackboard etc.

- When the body changes its position with respect to time, then the body is said to be in motion.

   **Examples:** The blades of a rotating fan, the hands of a working wall clock etc.

### Slow and Fast Motion

- An object is said to be moving slowly if it covers lesser distance in a given time interval.
- A slow moving object has low speed.
- An object is said to be moving quickly if it covers more distance in a given time interval.
- A fast moving object has high speed.

### Rectilinear Motion

- Motion in a straight line is called rectilinear motion.

## Circular Motion

- When an object moves in a circular path, it is said to perform circular motion.

## Rotational Motion

- When an object turns/spins about a fixed axis, it is said to perform rotational motion.

## Periodic Motion

- The motion which repeats itself after regular intervals of time is called periodic motion.
- It is also called oscillatory motion

## Speed

- Speed is the distance covered by an object in unit time.
- If a body covers equal distances in equal intervals of time, then it is said to be moving with uniform speed.
- If a body covers unequal distances in equal intervals or equal distances in unequal intervals, then it is said to be moving with non-uniform speed.
- Speed is calculated as

- $$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

- The basic unit for speed is metre per second (m/s).
- It is also measured in kilometre per hour (km/h) and kilometre per min (km/min).

## Average Speed

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

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$
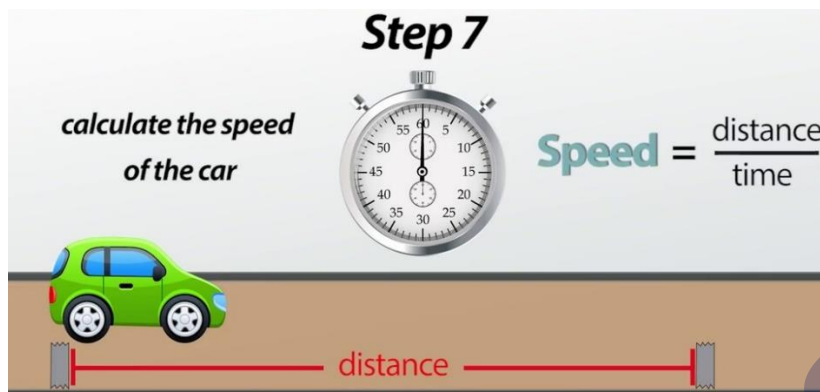
## Measurement of Speed

- Speed is how fast or slow an object is moving.
- Measuring speed means observing the distance and the time taken by the object.

## Speedometer

- It is an instrument used in vehicles to show the speed with which the vehicle is moving.
- Not all moving vehicles have a speedometer.

   **Example:** A bicycle does not have a speedometer, whereas a car has a speedometer.

- The speedometer has a needle which indicates the speed.

**Odometer**

- An odometer is a device on vehicles to track the distance covered.

## Measurement of Time

- Certain events in nature help us track time.
  **Example:** The phases of the moon indicate the time of the month.
- Man-made structures are also constructed to measure time.
  **Example:** The Jantar Mantar in Jaipur is a Sun clock which is used to measure the time.



- Water clocks and sand clocks were used hundreds of years ago to measure time.
- The basic unit of time is a second, and it is represented by the symbol 's'.
- Larger units of time are minute (min) and hour (h).
- A pendulum is also used to measure time. It consists of a small metal ball called a bob, attached to an inextensible string, which is fixed to a rigid support.

- The length of the pendulum is the distance from the point of suspension to the centre of gravity.
- The time taken by the bob of the pendulum to make one complete oscillation is called its time period.
- If the time period of a simple pendulum is two seconds, then the pendulum is called a second's pendulum.
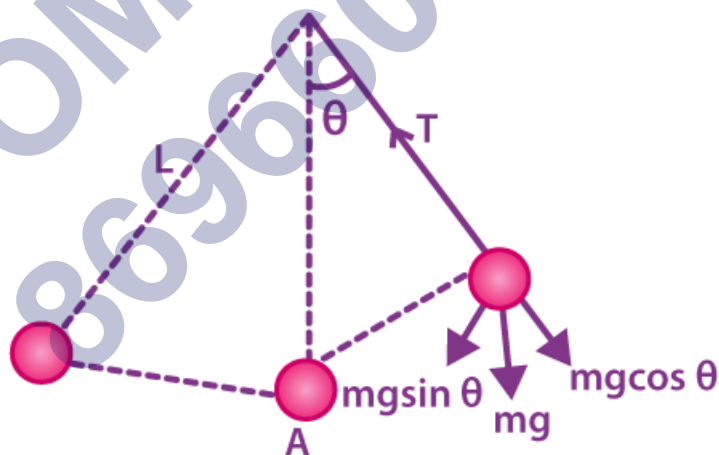


fig. simple pendulum

## Distance-Time Graph

- A distance-time graph is a visual representation of the collected data.
- The graph has a horizontal 'x-axis' which represents the time, and a vertical 'y-axis' which represents the distance.

- If the line on the graph is horizontal, then it implies that the object is stationary.

- If the line on the graph is straight but with a slope, then the object is moving at a steady speed.

- If the line on the graph is steeper (shown by a blue line), then the speed of the object is greater.
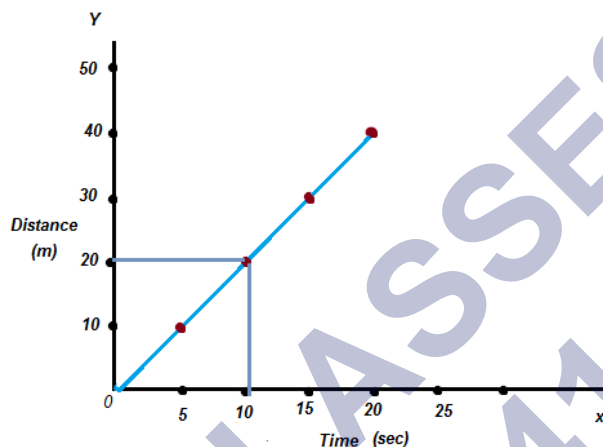


## How to Draw Distance-Time Graphs

(1) We use a graph paper to draw distance-time graph.

(2) The graph paper has 1 centimetre squares marked on it. Each centimetre square has 100 smaller squares in it (which are millimetre squares).

(3) The side of bigger square on the graph paper is 1 cm and that of the smaller square is 1 mm.

(4) To draw the distance-time graph for a moving object, we need a graph paper, and the readings of distances travelled by the object and the corresponding time values which have been obtained experimentally.

(5) We should draw a horizontal line on the graph paper to represent x-axis. Label the x-axis by writing Time. The unit of time should be written in bracket such as Time (s), Time (min) or Time (h). An arrow should be put in front of the labelling of time and its unit like Time (min).

(6) Draw a vertical line on the left side of the graph paper to represent y-axis. Label the y-axis by writing the word Distance. The unit of distance should be written in bracket such as Distance (m), Distance (cm) or Distance (km). An arrow should be put in front of the labelling of distance and its unit like Distance (km). The point of intersection of x-axis and y-axis is called 'origin' and marked as O.

(7) We should choose suitable scales so as to represent the large values of 'time' and 'distance' conveniently on the small graph paper. The scales to be used depend on the range of time and distance values, and hence vary from question to question.

(8) Take the first value of time and the first value of distance from the data given in the

question and mark one point on the graph paper where the graph lines representing these two values meet. Then take second, third, fourth and fifth sets of values of time and distance and mark corresponding points (as pencil dots) on the graph paper.

(9) Join all the marked points (or pencil dots) with a pencil line graph to obtain the required distance time graph.

## Advantages of distance-time graphs

**1.** The variation of distance travelled by an object with time can be seen more easily from a distance-time graph than from the distance and time values given in the table form.

**For example :**

a) A straight line distance-time graph tells us that the moving object covers equal distances in equal time intervals, so its speed is constant (or uniform).

b) A curved line distance-time graph tells us that the moving object covers unequal distances in equal time intervals and hence its speed is not constant (it is non-uniform).

c) A straight line distance-time graph parallel to the time-axis (or a horizontal line graph) tells us that the distance moved by the object does not change with time, so its speed is zero (it is stationary)

**2.** The data given in table form may give information about the distance moved by the object only at certain definite time intervals but from a distance-time graph we can find the distance moved by the object at any point of time.

**3.** The speed of an object can be obtained from its distance-time graph. By using distance-time graph, we can find the distance moved by the object between any two time readings. And if we divide this distance by time (given by the difference in the two time readings), we will obtain speed of the object.

## Other Types of Graphs

Line graphs show the variation of distance travelled by a moving object (car, bus, truck, etc.) with time. There are two other kinds of graphs.

**Bar Graph**

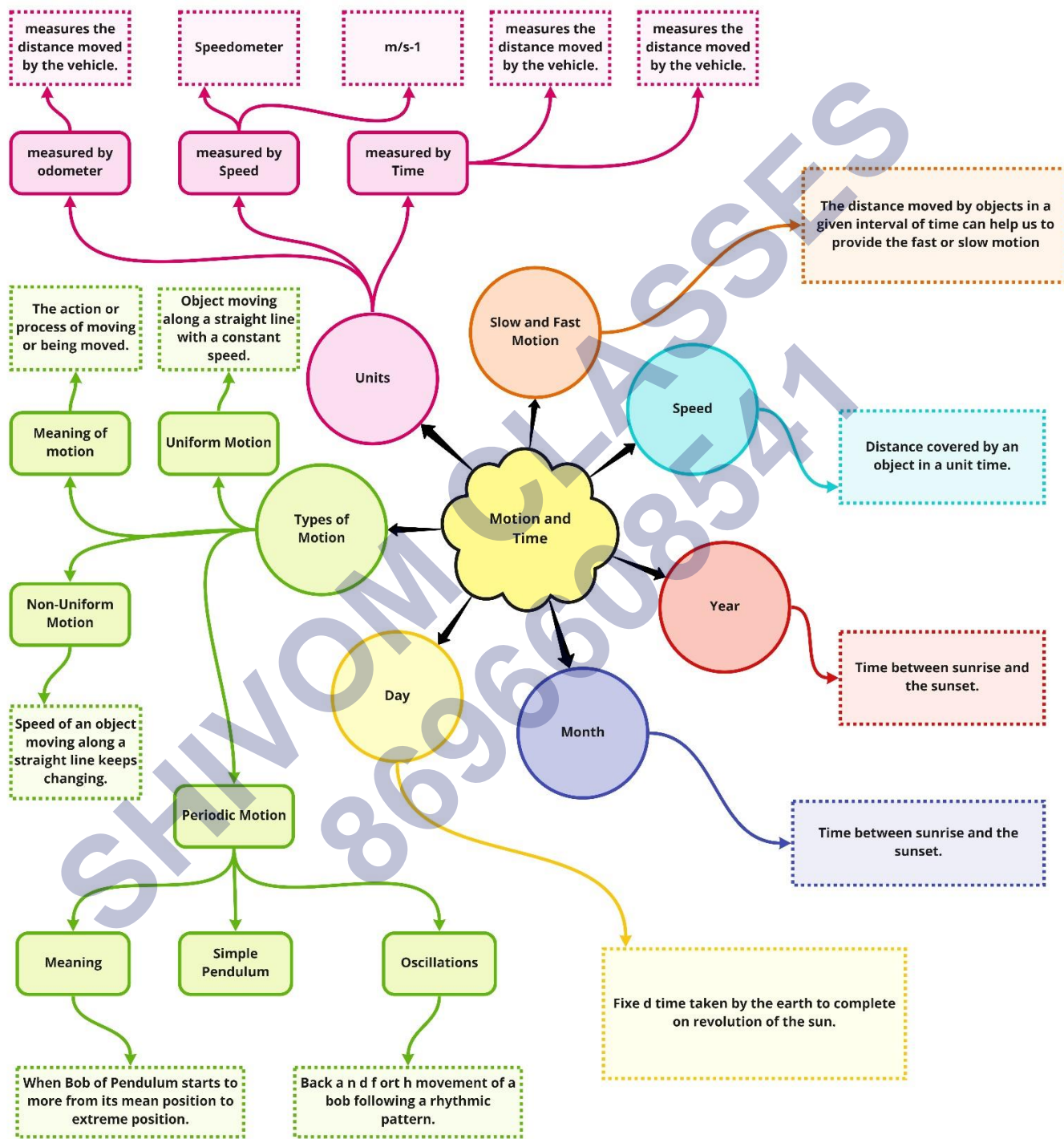A bar graph is a diagram which shows information as bars (thin rectangles) of different heights in a bar graph, the positions and heights of the bars represent the values of the variable quantity about which information is being given.

**Pie Chart**

A pie chart is a kind of graph or diagram which shows the percentage composition of something in the form of slices of a circle (the whole circle representing 100 per cent).

## Mind Map

**Motion and Time**

**Units**
- measured by odometer → measures the distance moved by the vehicle.
- measured by Speed → Speedometer
- measured by Time → m/s-1, measures the distance moved by the vehicle., measures the distance moved by the vehicle.

**Types of Motion**
- Meaning of motion → The action or process of moving or being moved.
- Uniform Motion → Object moving along a straight line with a constant speed.
- Non-Uniform Motion → Speed of an object moving along a straight line keeps changing.
- Periodic Motion
  - Meaning → When Bob of Pendulum starts to more from its mean position to extreme position.
  - Simple Pendulum
  - Oscillations → Back a n d f ort h movement of a bob following a rhythmic pattern.

**Slow and Fast Motion** → The distance moved by objects in a given interval of time can help us to provide the fast or slow motion

**Speed** → Distance covered by an object in a unit time.

**Year** → Time between sunrise and the sunset.

**Month** → Time between sunrise and the sunset.

**Day** → Fixe d time taken by the earth to complete on revolution of the sun.
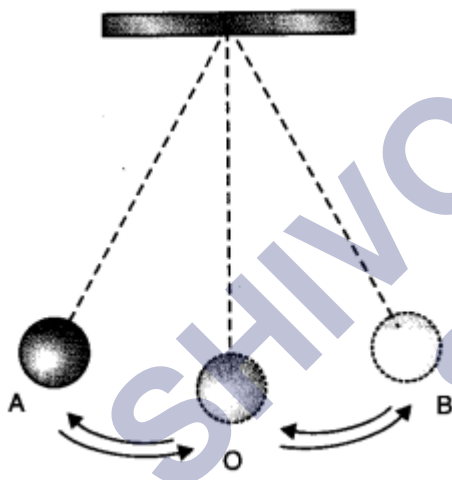
# Important Questions

## ➢ Multiple Choice Questions:

Question 1. A bus travels 54 km in 90 minutes. The speed of the bus is

(a) 0.6 m/s

(b) 10 m/s

(c) 5.4 m/s

(d) 3.6 m/s

Question 2. The formula for distance is

(a) time = $\frac{Speed}{Distance}$

(b) Speed = $\frac{Time}{Distance}$

(c) Speed = $\frac{1}{Time}$ × Distance

(d) Speed = distance × time

Question 3. Observe the figure given below:



The time period of a simple pendulum is the time taken by it to travel from

(a) A to B and back to A

(b) O to A, A to B and B to A

(c) B to A, A to B and B to O

(d) A to B

Question 4. Nearly all the clocks make use of

(a) straight line motion

(b) periodic motion

(c) random motion

(d) circular motion

Question 5. 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

Question 6. Time period of a simple pendulum depends upon its

(a) weight of bob

(b) length

(c) both (a) and (b)

(d) None of these

Question 7. Which of the following cannot be used for measurement of time?

(a) A leaking tap

(b) Simple pendulum

(c) Shadow of an object during the day

(d) Blinking of eyes

Question 8. On which axis is dependent variable represented?

(a) x-axis

(b) y-axis

(c) On any axis

(d) Depends on the data

Question 9. The correct symbol to represent the speed of an object is:

(a) 5 m/s

(b) 5 mp

(c) 5 m/s-1

(d) 5 s/m

Question 10. Boojho walks to his school which is at a distance of 3 km from his home in 30 minutes. On reaching he finds that the school is closed and comes back by a bicycle with his

friend and reaches home in 20 minutes. His average speed in km/h is

(a) 8.3

(b) 7.2

(c) 5

(d) 3.6

## ➤ Fill In the Blanks:

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

2. …………….. is the SI unit of time.

3. The distance moved by an object in a unit time is called its ……………..

4. Speed of the vehicle is shown by the instrument …………….. fitted on the vehicle.

5. Distance time-graph representing a non-uniform motion of an object is of …………….. shape.

6. The distance-time graph for the motion of an object moving with a constant speed is a ……………..

## ➤ True or False:

1. Each and every object in this universe moves with a constant speed.

2. The motion of a spinning top is rotational motion.

3. The motion of earth around the sun is called rectilinear motion.

4. The smallest time interval which can be measured with commonly available clocks and watches is one second.

5. A sundial measures time by the position of the shadow cast by the sun.

6. Vehicles which covers more distance in small interval of time have slow speed.

## ➤ Very Short Question:

1. What is the SI unit of distance?

2. Name an object that shows oscillatory motion.

3. What is the motion of our hands while running?

4. What is the motion of a child in a merry-go-round?

5. What is motion?

6. What is circular motion?

7. Give an example of vibratory motion.

8. Name the device on vehicles to track the distance covered.

9. Define average speed.

10. What do you mean by the statement; "car is moving with the speed of 50 Km per hour"?

## ➢ Short Questions:

1. What do you mean by non-uniform speed?

2. A child is on see-saw, what kind of motion he have and why? Explain.

3. Explain how in ancient time a day, a month and a year were measured.

4. Define velocity along with its unit.

5. What are quartz clocks?

6. How do we know an object is moving faster compared to the speed of another object?

7. If a car is moving with a speed of 5Km/h on highway then find the distance travelled by the car in 4 hours?

8. How can you say that motion and rest are relative?

## ➢ Long Questions:

1. What is the function of RBCs?

2. Does transpiration serve any useful function in the plants? Explain.

3. Explain stomata and its function in plants.

## ✓ Answer Key-

## ➢ Multiple Choice Answers:

1. (b) 10 m/s

2. (c) Speed = $\frac{1}{Time}$ × Distance

3. (a) A to B and back to A

4. (b) periodic motion

5. (a) 2.1 s

6. (b) length

7. (d) Blinking of eyes

8. (b) y-axis

9. (d) 5 s/m

10. (b) 7.2

## ➢ Fill In the Blanks:

1. time period
2. Second
3. speed
4. speedometer
5. any
6. straight line

## ➤ True or False:

1. False
2. True
3. False
4. True
5. True
6. False

## ➤ Very Short Answers:

1. Answer: Meter
2. Answer: Pendulum
3. Answer: oscillatory motion
4. Answer: straight line motion
5. Answer: Motion is a change in the position of an object with time.
6. Answer: Motion of an object in a circular path is called circular motion e.g., Motion of the hands of a clock.
7. Answer: Simple Pendulum
8. Answer: An odometer
9. Answer: The average speed of a moving object is defined as the total distance covered by it divided by the total time taken.
10. Answer: Car is moving with the speed of 50 Km per hour it means it will cover a distance of 50 Km in one hour.

## ➤ Short Answers:

1. Answer: 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.
2. Answer: On a see-saw child goes up and comes down from mean position and repeats itself.

So there is oscillatory motion.

3. Answer: In ancient time the time between one sunrise and the next was called a day. A month was measured from one new moon to the next and a year was fixed as the time taken by the earth to complete one revolution of the sun.

4. Answer: Velocity can be defined as the rate of change of displacement.SI unit of velocity is m/s (meter/second Velocity is a vector quantity.

5. Answer: It is a special type of clock or watch which have an electric circuit with one or more cells are called quartz clocks.

6. Answer: By finding the distance travel by a moving body in unit time 1 hr. or 1 sec we know the speed of an object that help us to know which one is moving faster i.e. having greater speed.

7. Answer:  We know distance travelled by a body = speed × time

   So, distance travelled by the car = 5 × 4 = 20 km

8. Answer: We have observed that the position of stars and planets change while you remain stationary. In reality the earth is moving too. Thus, an object which appears to be at rest, may actually be in motion. Therefore, motion and rest are relative terms.

## ➢ Long Answers:

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

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

3. Answer:  Following are different types of motion:

   - Translatory Motion: In Translatory motion the particle moves from one point in space to another. This motion may be along a straight line or along a curved path.

   - Rectilinear motion: Motion along a straight line is called rectilinear motion. Example: A car moving on a straight road

   - Curvilinear motion: Motion along a curved path is called curvilinear motion. Example: A car negotiating a curve

   - Rotatory Motion: In rotatory motion, the particles of the body describe concentric circles

about the axis of motion

- Vibratory Motion: In vibratory motion the particles move to and from about a fixed point.