

MOTION



What is motion?

→ When an object changes its position with time with respect to stationary object taken reference point is said to be in motion.

Motion and rest are relative in nature?

→ An object may appear to be moving to 1 person and the same object may appear to be at rest to another person.

e.g. - When a bus is moving on a road,

i) The road side tree appear to be moving backward to the passengers.

ii) A person standing on the road finds the bus and passengers moving forward.

iii) The person inside the moving bus finds his fellow passenger at rest.

Conclusion - So the state of rest and motion are relative in nature.

DISTANCE:-

- The distance travelled by an object is actual length of path covered by a moving object
- Distance is a scalar quantity.

DISPLACEMENT

- Displacement of an object is the shortest distance possible between initial and final position of a moving object

Scalar quantity:-

The physical quantities which has only magnitude and no direction is called scalar quantity

i.e - Distance, mass, volume, speed etc.

Scalar quantity either positive or zero, can't be negative.

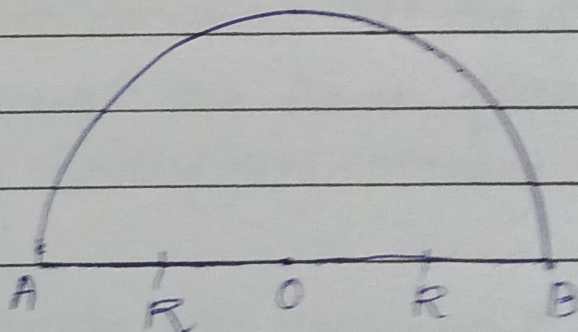
vector quantity :-

The physical quantity which have only magnitude and direction is called as vector quantity.

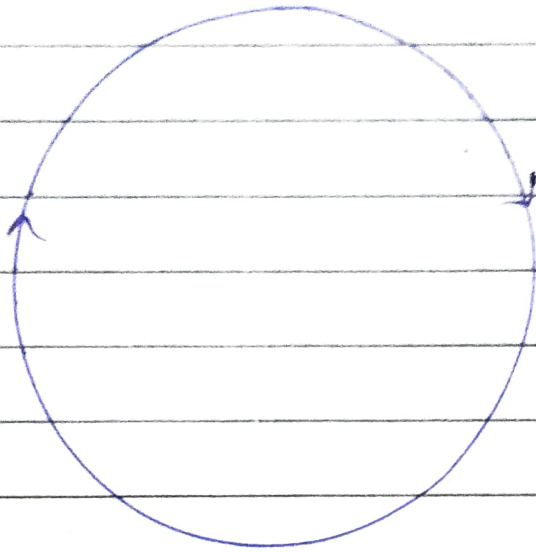
i.e. - Displacement, velocity, Acceleration, etc.

vector quantity are either negative, positive or zero.

- An object is moving in a circle of radius r .
Calculate the distance and displacement
- when it complete $\frac{1}{2}$ circle
 - when it complete ^{2πr} full circle



In half circle distance is πr
Displacement is $2r$ (\overline{AB})



When an object completes full circle, it travels from A to A. In circle, distance $2\pi r$

→ Displacement is 0 (Because initial position and final position is same)

Types of MOTION:-

1) Translatory motion:-

The motion in which all the particles of a body move through the same distance in the same time is called translatory.

i.e. - An athlete running on straight line.

2) Rotatory Motion:

The motion in which moves about a fixed axis without changing the radius of its motion is called rotatory motion.

3) Oscillatory Motion:

The to and fro motion described by an object as a whole, along the same path, without any change in the shape of the object is called oscillatory motion.

11) Vibratory Motion:

This is a kind of oscillatory motion in which the moving object undergoes a change in shape or size. In the motion, the body does not move as a whole.

ie - The plucked string of a guitar.

4) Periodic Motion:

A repetitive motion which repeats at regular interval of time is called Periodic Motion.



6. Non-periodic motion:

A non-periodic motion which repeats itself at irregular intervals of time is called non-periodic motion.

7) Multiple motion:

Sometimes an object can display combination of different types of motion.

SPEED

* The distance travelled by a body per unit time is called the speed of the body. Speed is a scalar quantity.

The SI unit of speed is m/s .

* If a body covers equal distance in equal interval of time then it is known as uniform motion.

* It is a scalar quantity.

VELOCITY

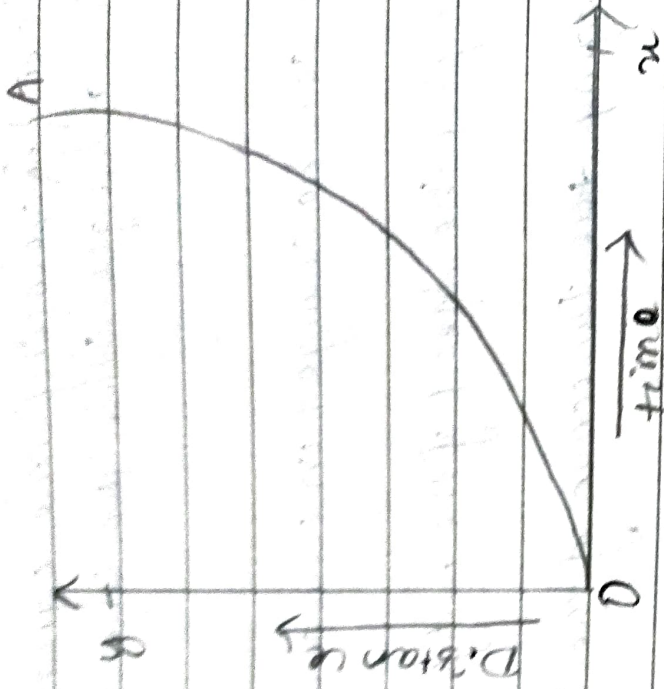
- * It is a distance travelled by body in unit time in a particular Direction.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

- * It is a vector quantity
- * It can be zero, negative, positive.

NOTE:

- * When speed & velocity are equal then the object moves in a single straight line path with a uniform speed.
- i) By changing the speed of the object
- ii) By changing the Direction of the body.



Average speed

Average speed is equal to total distance travel
total time taken

* CONSTANT SPEED OR UNIFORM SPEED

A body has a uniform speed if it travels equal distances in equal intervals of time

$$\text{Convert km/h to m/s} = \frac{5}{18} \times 1000$$

$$= 1000 \times \frac{5}{18}$$

$$100 \times \frac{5}{18} = 20 \text{ m/s}$$

$$\frac{20}{5}$$

i) 72 km/h

ii)

$$72 \times 5 = 20 \text{ m/s}$$

A train travel a distance of 120 km in 3 hr . whereas a bus travel a distance of 200 km in 5 hr .

→ A train travel a distance = 120 km

$$\text{Time} = 3 \text{ h}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{time}}$$

$$= \frac{120}{3} = 40 \text{ km/hr}$$

→ Bus travel a distance = 200 km

$$\text{Time} = 5 \text{ h}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{time}}$$

$$= \frac{200}{5} = 40 \text{ km/hr}$$

So, both the medium of transport have same speed.

A car travel a distance of 300 km from delhi to ambala toward north in 5 hr . Calculate the Speed & velocity of the car.

→ Car travel a distance = 300 km

$$\text{Time} = 5 \text{ h}$$

$$\text{Speed} = \frac{300}{5} = 60 \text{ km/h}$$

Acceleration

The rate of change of velocity with time is known as acceleration.

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

Initial velocity = u

Final velocity = v

Time = T

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

= $\frac{\text{Final velocity} - \text{Initial velocity}}{\text{time}}$

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

→ SI unit of Acceleration = m/s^2

A car increases its speed from 36 km/h to 108 km/h in 10 minutes. Find acceleration.

$$\rightarrow \text{Final} = 108 \text{ km/h} = \frac{108 \times 5}{18} = 30 \text{ m/s}$$

$$\text{Initial} = 36 \text{ km/h (u)} = \frac{36 \times 5}{18} = 10 \text{ m/s}$$

$$t = 10 \text{ min}$$

$$= 10 \times 60$$

$$= 600 \text{ s}$$