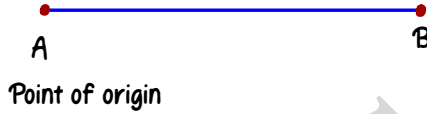


What is Motion?

• Relative change in position

↳ What is needed?

↳ Reference point



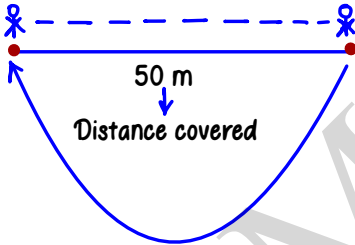
Two physical quantities

Distance

Displacement

↳ Shortest part between two points (is a straight line)

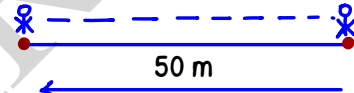
Case 1



Distance = 50 m

Displacement = 50 m

Case 2

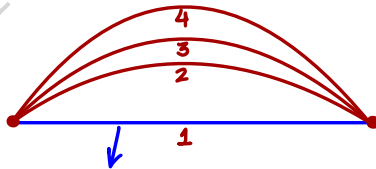


Distance = 100 m

Displacement = 0

↳ Displacement: vector quantity

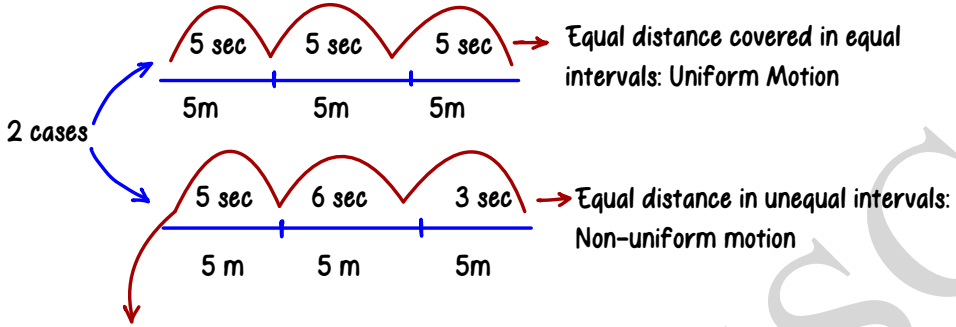
↳ Distance: scalar quantity



Case 1: shortest distance

Displacement

Types of Motion



• Wind speed is decreasing after increasing: Retardation

Rate of change of motion → Called as speed

↓
Time involved

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

→ m/km
→ s/hr

SI Unit: m/s → Represented

$$\text{Km/hr} \rightarrow \text{m/sec}$$

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

$$\text{m/s} \rightarrow \text{Km/hr}$$

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

When motion is non-uniform

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

1 An object travels 16 m in 4 s and then another 16 m in 2 s. What is the average speed of the object?

1 एक वस्तु 4 सेकंड में 16 मीटर की यात्रा करती है और फिर 2 सेकंड में 16 मीटर और। क्या है वस्तु की औसत गति?

$$\rightarrow \text{Avg. speed} = \frac{16\text{m} + 16\text{m}}{4 + 2}$$

$$= \frac{32}{6} = \frac{16}{3} \text{ m/s}$$

Speed + Direction = Velocity

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



Unit: m/s

Scalar quantity

- Only represents numerical value
- Distance
- Speed
- Time

Vector quantity

- Numerical value + Direction
- Displacement
- Velocity

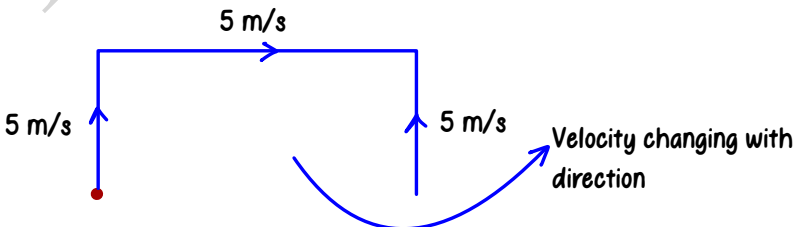
Usha swims in a 90 m long pool. She covers 180 m in one minute by swimming from one end to the other and back along the same straight path. Find the average speed and average velocity of Usha.

$$\rightarrow \text{Avg. speed} = \frac{180}{60} = 3 \text{ m/s}$$

$$\text{Avg. velocity} = \frac{0}{60} = 0 \text{ m/s}$$

उषा 90 मीटर लंबी नाव में तैरती है। वह एक मिनट में 180 मीटर की दूरी तय करती है एक छोर से दूसरे छोर तक तैरकर और उसी सीधे रास्ते पर वापस। औसत गति और औसत ज्ञात कीजिए उषा का वेग.

Rate of change in velocity → is called Acceleration



Change in velocity = Final speed - Initial speed

$$\text{Acceleration} = \frac{\text{m/s}}{\text{s}} = \text{m/s}^2$$

\downarrow
 a_c

Starting from a stationary position, Rahul paddles his bicycle to attain a velocity of 6 m s⁻¹ in 30 s. Then he applies brakes such that the velocity of the bicycle comes down to 4 m s⁻¹ in the next 5 s. Calculate the acceleration of the bicycle in both the cases.

→

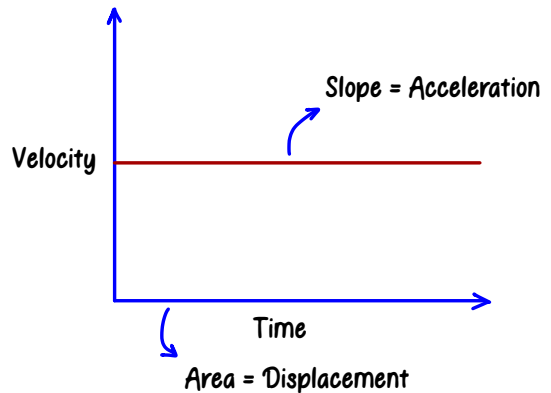
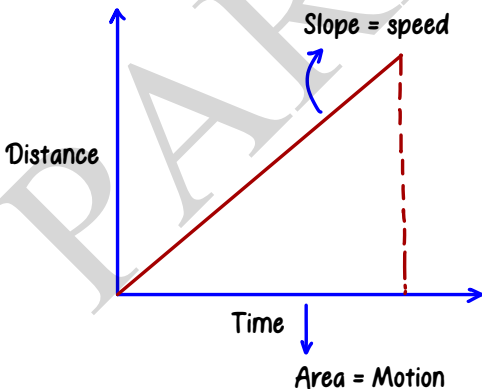
Case 1

$$\left. \begin{array}{l} \text{Initial speed} = 0 \\ \text{Final speed} = 6 \text{ m/s} \end{array} \right\} 30 \text{ s} \rightarrow a_c = \frac{6 - 0}{30} = \frac{1}{5} = 0.2 \text{ m/s}^2$$

Case 2

$$\left. \begin{array}{l} \text{Initial speed} = 6 \text{ m/s} \\ \text{Final speed} = 4 \text{ m/s} \end{array} \right\} 5 \text{ s} \rightarrow a_c = \frac{4 - 6}{5} = \frac{-2}{5} = -0.4 \text{ m/s}^2$$

Graph Representation



Numerical of Motion in straight line: The 'UTSAV' Concept

3 equations of motions

- 1 $v = u + at$
 - 2 $s = ut + \frac{1}{2}at^2$
 - 3 $v^2 - u^2 = 2as$
- ↪ Horizontal motion
- u = initial velocity
 - t = time
 - s = distance
 - a = acceleration
 - v = final velocity

Straight line motion → Rectilinear motion

Horizontal

Vertical

Vertical motion

$a = g$ → Acceleration due to gravity

Free fall → $u = 0$

↪ Initial speed

- $v = u + gt$
- $h = ut + \frac{1}{2}gt^2$
- $v^2 - u^2 = 2gh$

↪ ($a = -g$)
Against the gravity

- $v = u - gt$
- $h = ut - \frac{1}{2}gt^2$
- $v^2 - u^2 = -2gh$

↪ Final point = 0

↪ Final velocity = 0

A train starting from rest attains a velocity of 72 km/h in 5 minutes. Assuming that the acceleration is uniform, find (i) the acceleration and (ii) the distance travelled by the train for attaining this velocity

एक ट्रेन विश्राम से प्रारंभ होकर 5 मिनट में 72 किमी/घंटा का वेग प्राप्त कर लेती है। यह मानते हुए कि त्वरण एक समान है, (i) त्वरण और (ii) इस वेग को प्राप्त करने के लिए ट्रेन द्वारा तय की गई दूरी ज्ञात कीजिए।

$$\begin{aligned} \rightarrow u &= 0 \\ v &= 72 \text{ km/hr} \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} 5 \text{ min} \rightarrow 5 \times 60 = 300 \text{ s}$$

$$72 \times \frac{5}{18} = 20 \text{ m/s}$$

$$a = \frac{20-0}{300} = \frac{20}{300} = \frac{1}{15} \text{ m/s}$$

$$s = ut + \frac{1}{2} at^2$$

$$s = 0 + \frac{1}{2} \times \frac{1}{15} \times (300)^2$$

$$= 3000 \text{ m}$$

$$s = 3 \text{ km}$$

A car accelerates uniformly from 18 km/h to 36 km/h in 5 s. Calculate (i) the acceleration and (ii) the distance covered by the car in that time.

एक कार समान रूप से गति करती है, 5 सेकंड में 18 किमी/घंटा से 36 किमी/घंटा-1 तक।

(i) त्वरण और (ii) की गणना करें
इतने समय में कार द्वारा तय की गई दूरी।

$$\rightarrow \begin{aligned} u &= 18 \text{ km/h} \times \frac{5}{18} \\ a &= \frac{10-5}{5} = \frac{5}{5} = 1 \text{ m/s} \end{aligned}$$

$$= 5 \text{ m/s}$$

$$v = 36 \times \frac{5}{18} = 10 \text{ m/s}$$

$$\begin{aligned} s &= ut + at^2 \\ &= 5(5) + \frac{1}{2} \times (5)^2 \end{aligned}$$

$$= 37.5 \text{ m}$$

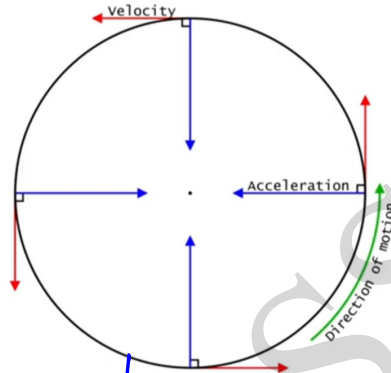
Uniform Circular Motion → motion of a body moving with speed along the circular path

Uniform = speed

$$a_c = \frac{v^2}{r}$$

Centripetal acceleration

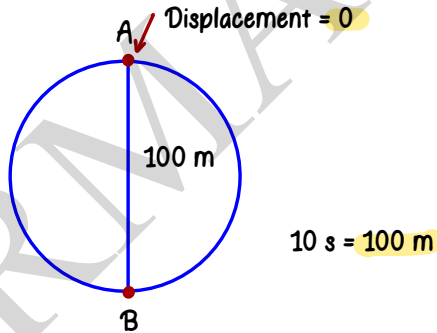
Acceleration towards the centre in circular path



Change in velocity at every point

An athlete completes one round of a circular track of diameter 100 m in 20 s. What will be the displacements after 1 minute and 10 s, respectively ?

→



1 min = 60 sec

One Liners (MCQs)

- Distance in a particular direction is called velocity
- Displacement = $\frac{\text{velocity}}{\text{Time}}$