

MOTION IN STRAIGHT LINE

Distance	Displacement
Total length of an actual path covered in travelling from initial to final destination.	Shortest distance between the initial and final destination .
Scalar quantity	Vector quantity
SI unit : meter (m)	SI unit : meter (m)
Total length of an actual path covered in travelling from initial to final destination.	Shortest distance between the initial and final destination .

- Distance covered $\geq$ displacement

Speed	Velocity
Distance travelled by a body per unit time.	Displacement of a body per unit time.
Speed = Distance /Time	Velocity =Displacement / Time
Scalar quantity .	Vector quantity.
SI unit : (m/s)	SI unit : (m/s)

Average acceleration	Instantaneous acceleration
Ratio of change in velocity to the change in time for a given interval.	Ratio of change in velocity to infinitesimally small interval of time.
$\Rightarrow \Rightarrow$ $a_{avg} = \Delta v / \Delta t$	$\Rightarrow \Rightarrow$ $a_{inst} = dv / dt$
SI unit : (m/s ²)	SI unit : (m/s ²)

Equations of Motion:-

If $a = \text{constant}$

- $v = u + at$
- $S = ut + 1/2 at^2$
- $v^2 - u^2 = 2as$
- Displacement in n^{th} second
 $S_n = u + a/2 (2n - 1)$
- Stopping distance :-
 $d_s = u^2 / 2a$

Motion Under Gravity :-

- A mathematical treatment to describe the motion of a body in one-dimension under free fall

Vertically downward motion

- When object is released from $y = 0$
- $v = -gt$
- $y = -1/2 gt^2$
- $v^2 = -2gy$

Vertically upward motion

- $u \neq 0$, acceleration $a = -g$
- $v = u - gt$
- $S = ut - 1/2 gt^2$
- $v^2 = u^2 - 2gh$

Distance travelled during equal intervals of time by a body falling freely from rest is in ratio 1:3:5:7:9:11.. (Galileo's law)

Graphical Analysis

Position - Time (x-t) graph

- Slope = $dx/dt = \text{Velocity}$

Velocity - time (v - t) graph

- Slope = $dv/dt = \text{Acceleration}$
- Area = $\int v dt = \text{Displacement}$

Acceleration - time (a - t) graph

- Area = $\int a dt = \text{Change in velocity}$

Relative Motion :-

- Position of B with respect to an observer on A
 $x_{BA} = x_B - x_A$
- Velocity of B with respect to an observer on A
 $v_{BA} = v_B - v_A$
- Acceleration of B with respect to an observe
 $a_{BA} = a_B - a_A$

