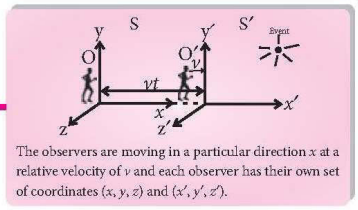
BRAIN MAP

CLASS XI

MOTION IN A STRAIGHT LINE

Motion
If a body changes its position as time passes w.r.t. frame of reference, it is said to be in motion.

Frame of Reference
A system consisting a set of coordinates and with reference to which observer describes any event.



The observers are moving in a particular direction x at a relative velocity of v and each observer has their own set of coordinates (x, y, z) and (x', y', z').

Distance
The actual path length covered by moving particle.

Displacement
The change in position vector.

Speed
The rate of distance covered with time is called speed,
$$v = \frac{\text{distance}}{\text{total time}} = \frac{d}{t}$$

Average Speed
$$v_{av} = \frac{\text{total distance}}{\text{total time}}$$

Instantaneous Speed
$$v = \underset{\Delta t \to 0}{\text{Lt}} \frac{\Delta d}{\Delta t}$$

differentiating with respect to time

Velocity
The rate of change of position per unit time,
$$\vec{v} = \frac{\text{displacement}}{\text{time}} = \frac{\Delta \vec{x}}{\Delta t}$$

Average Velocity
$$\vec{v}_{av} = \frac{\Delta \vec{x}}{\Delta t}$$

Instantaneous Velocity
$$\vec{v} = \underset{\Delta t \to 0}{\text{Lt}} \frac{\Delta \vec{x}}{\Delta t} = \frac{d\vec{x}}{dt}$$

Average Acceleration
$$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t}$$

Instantaneous Acceleration
$$\vec{a} = \underset{\Delta t \to 0}{\text{Lt}} \frac{\Delta \vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$

Acceleration
The time rate of change of velocity, $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

differentiating with respect to time

Uniform Acceleration
Magnitude of velocity changes by equal amounts in equal intervals of time.

Non-uniform Acceleration
Acceleration changes with time.

Kinematic Equations
A mathematical treatment to describe the motion of a body in 1-dimension.

Constant Acceleration

For Uniformly Accelerated Motion

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $v^2 = u^2 + 2as$
- $S_n = u + \frac{a}{2}(2n-1)$

Acceleration changes with time

For Motion with Variable Acceleration

If $a = f(t) \rightarrow$ a function of time

- $v = u + \int_0^t f(t)dt$
- $s = ut + \int_0^t (f(t)dt)dt$

For Motion Under Gravity

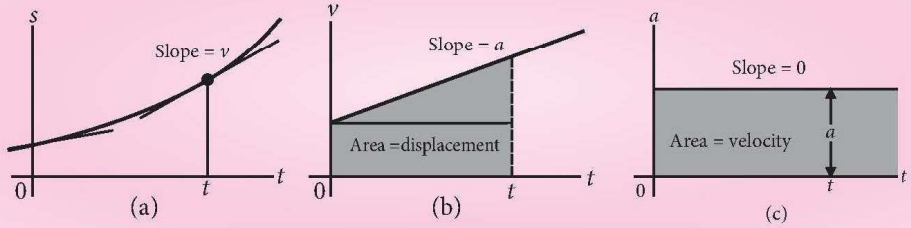
Vertically downward motion
(Free fall case) $u = 0, a = g$

- $v = gt$
- $h = 1/2\, gt^2$
- $v^2 = 2gh$

Vertically upward motion
$v = 0$, acceleration $a = -g$

- $u = gt$
- $h = ut - 1/2\, gt^2$
- $u = \sqrt{2gh}$

Graphical Representation of Uniformly Accelerated Motion



Relative Velocity
The velocity with which an object moves with respect to another object is called relative velocity

$V_{AB} = (V_A - V_B)$

$V_{AB} = \{V_A - (-V_B)\}$

$V_{AB} = (V_A + V_B)$