Motion in a straight line.

Objects in motion :- An object is said to be in motion if its position changes with respect to the surroundings.

Rest and Motion are relative terms :- A person sitting in a moving train is at rest with respect to fellow passengers but is in motion with respect to objects outside the train.

Point object - An object is said to be a point object if it changes its position by distances which are much greater than its size.

Frame of reference :- The object with respect to which the rest or motion of an object is described.

Inertial frame of reference - a frame of reference which is at rest or moving with constant velocity along a straight line.

Eg. a parked car,

Non inertial frame of reference - A frame of reference which is accelerated is called non-inertial frame of reference.

Eg. accelerating car,

Distinguish between distance and displacement

distance	displacement.
1. actual path length of a moving object.	1. shortest distance from initial position to final position.

2. Scalar	2. vector
3. distance of a moving object is positive.	3. magnitude of displacement can be negative or positive.
4. Distance cannot be less than displacement.	4. displacement ≤ distance.

Unit - m Dimension - $M^0L^1T^0$

Speed - rate of change of distance is speed.

S.I. unit → m/s. cgs unit → cm/s.

Dimension $[M^0L^1T^{-1}]$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$. It is a scalar.

Uniform speed :- An object is said to be in uniform speed if it covers equal distances in equal intervals of time, how ever small these intervals may be.

Average speed - it is the ratio of the total distance to total time of a moving object. Average speed is calculated when the speed of a moving object changes.

$$V_{av} = \frac{\text{Total distance}}{\text{Total time}}.$$

Instantaneous speed.- The speed of an object at an instant of time is called instantaneous speed.

$$V_{\text{instaneous}} = \frac{dx}{dt}.$$

$$1 \text{ km/hr} = \frac{5}{18} \text{ m/s}.$$

Uniform motion :- A body is said to be in uniform motion if it travels along a straight line and covers equal distances in equal intervals of time.

Non - uniform motion :- An object is said to be in non - uniform motion if it covers unequal distances in equal intervals of time.

Velocity :- rate of change of displacement.

S.I. unit → m/s dimension - LT^{-1}.

vector quantity

uniform velocity :- A body is said to move with uniform velocity if it covers equal displacements in equal intervals of time.

Average velocity :- is the ratio of total displacement with total time.

$$\text{Average vel.} = \frac{\text{Tot. displacement}}{\text{Total time}}.$$

Instantaneous velocity :- it is the velocity of a particle at any instant of time.

$$V_{\text{instantaneous}} = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}.$$

(derivative of displacement w.r.t. time).

Acceleration (a)

It is the rate of change of velocity

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

S.I. unit is m/s^2. Vector.

Dimension - $M^0 L^1 T^{-2}$

v - final velocity, u → initial velocity & t → time.

Uniform acceleration.

If an object travels along a straight line and its velocity increases in equal amounts in equal intervals of time.

Instantaneous acceleration - is the acceleration at any instant of time.

$$a = \frac{dv}{dt} = \frac{d}{dt}(dx/dt) = \frac{d^2x}{dt^2}.$$

Average acceleration.

Average Acceleration = $\frac{\text{Total change in vel.}}{\text{total time}}$.

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}.$$

* If the velocity reduces with increase of time the body is said to be retarded or decelerated.
* The average acceleration of an object is equal to instantaneous acceleration if the body is in uniform acceleration.
* Average speed of an object is equal to its average velocity if the body travels along a straight line.
* Average speed of an object is equal to the instantaneous speed if the body is in uniform motion.