RECTILINEAR MOTION

Average Velocity (in an interval) :

$$v_{av} = \bar{v} = \langle v \rangle = \frac{\text{Total displacement}}{\text{Total time taken}} = \frac{\vec{r}_f - \vec{r}_i}{\Delta t}$$

Average Speed (in an interval)

$$\text{Average Speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

Instantaneous Velocity (at an instant) :

$$\vec{v}_{inst} = \lim_{\Delta t \to 0} \left(\frac{\Delta \vec{r}}{\Delta t} \right)$$

Average acceleration (in an interval):

$$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

Instantaneous Acceleration (at an instant):

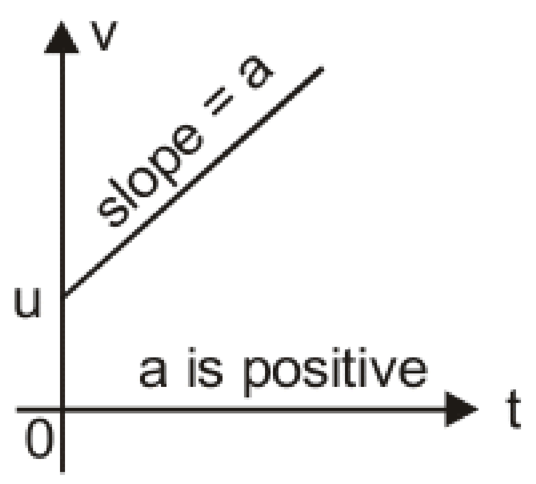
$$\vec{a} = \frac{d\vec{v}}{dt} = \lim_{\Delta t \to 0} \left(\frac{\overrightarrow{\Delta v}}{\Delta t} \right)$$

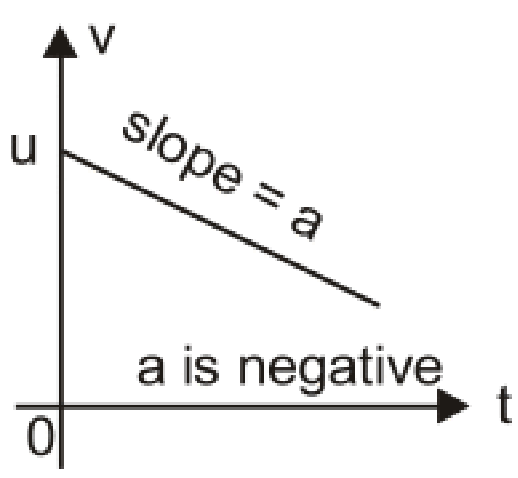
Graphs in Uniformly Accelerated Motion along a straight line ($a \neq 0$)

- x is a quadratic polynomial in terms of t. Hence x – t graph is a parabola.

x-t graph

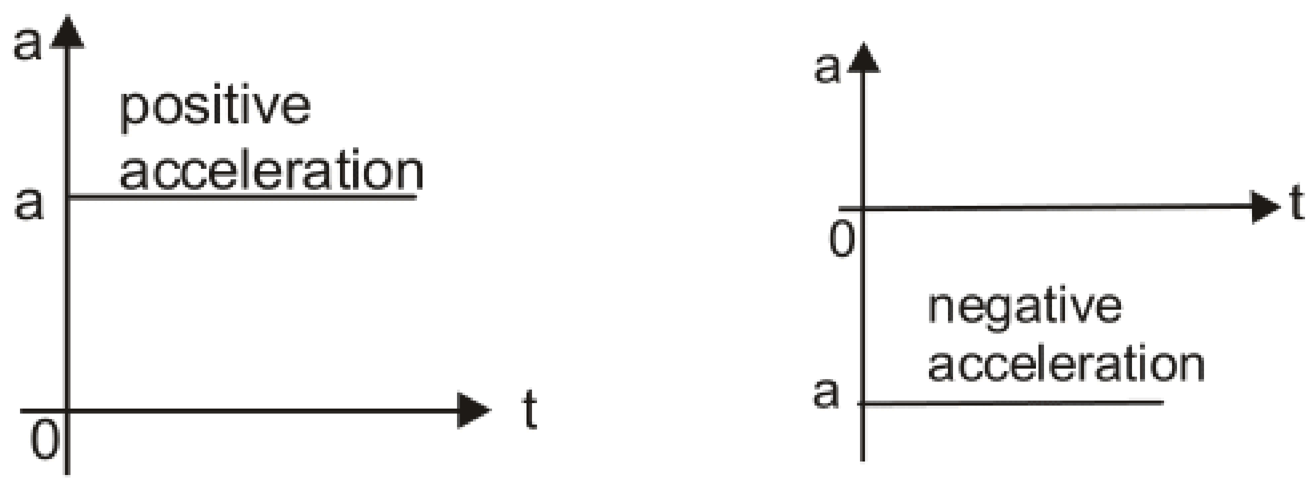
- v is a linear polynomial in terms of t. Hence v–t graph is a straight line of slope a.





v-t graph

- a–t graph is a horizontal line because a is constant.



a-t graph

Maxima & Minima

$$\frac{dy}{dx} = 0 \ \& \ \frac{d}{dx}\left(\frac{dy}{dx}\right) < 0 \text{ at maximum}$$

and $\frac{dy}{dx} = 0 \ \& \ \frac{d}{dx}\left(\frac{dy}{dx}\right) > 0$ at minima.

Equations of Motion (for constant acceleration)

(a) $v = u + at$

(b) $s = ut + \frac{1}{2}at^2$ $\quad s = vt - \frac{1}{2}at^2$ $\quad x_f = x_i + ut + \frac{1}{2}at^2$

(c) $v^2 = u^2 + 2as$

(d) $s = \frac{(u+v)}{2}t$ $\quad$ (e) $s_n = u + \frac{a}{2}(2n-1)$

For freely falling bodies : (u = 0)
(taking upward direction as positive)

(a) $v = -gt$

(b) $s = -\frac{1}{2}gt^2$ $\quad s = vt + \frac{1}{2}gt^2$ $\quad h_f = h_i - \frac{1}{2}gt^2$

(c) $v^2 = -2gs$

(d) $s_n = -\frac{g}{2}(2n-1)$