

# 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) :**

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

**Average acceleration (in an interval):**

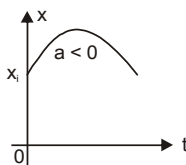
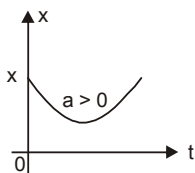
$$\bar{a}_{av} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

**Instantaneous Acceleration (at an instant):**

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

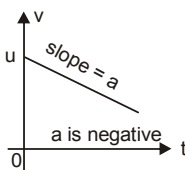
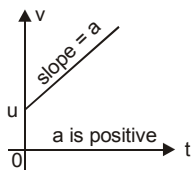
**Graphs in Uniformly Accelerated Motion along a straight line ( $a \neq 0$ )**

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



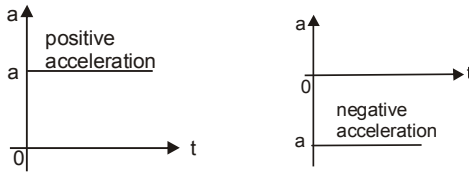
**$x-t$  graph**

- $v$  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

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

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

### Equations of Motion (for constant acceleration)

(a)  $v = u + at$

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

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

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

For freely falling bodies : ( $u = 0$ )

(taking upward direction as positive)

(a)  $v = -gt$

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

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

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