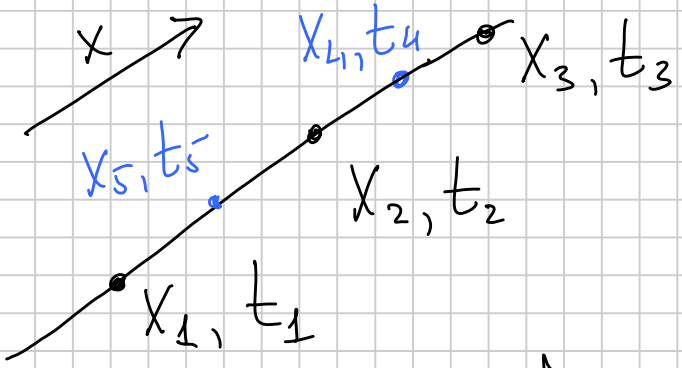
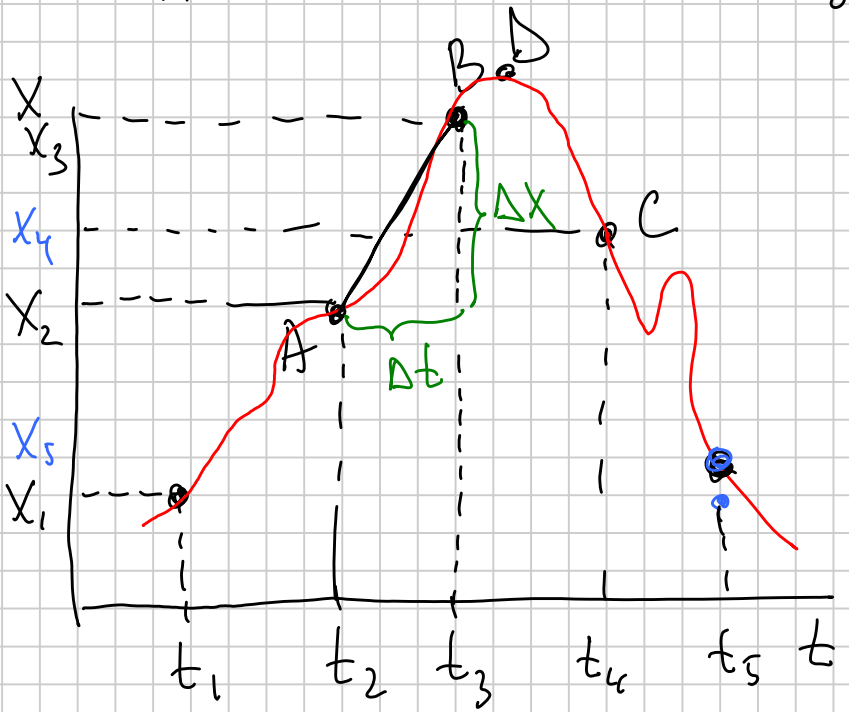
Lecture 2. Position, velocity, acceleration. Motion along a straight line.

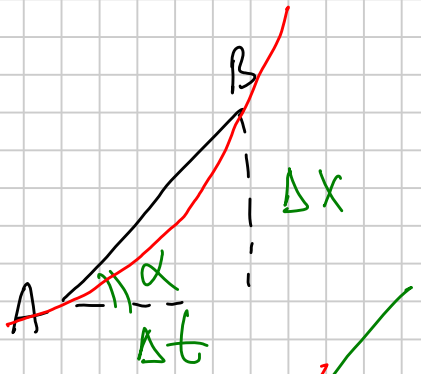
Note Title 9/8/2011



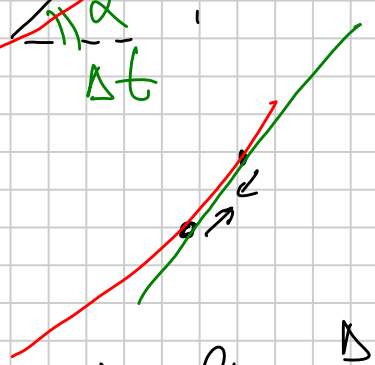
$$\overline{v}_{t_1,t_2} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

↑ average





$$v_{avg} = \frac{\Delta x}{\Delta t} = \tan\alpha$$



$$v_t = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

↑ instantaneous velocity

$$\boxed{v_t = \frac{dx}{dt}}$$

$$\overline{a}_{t_1,t_2} = \frac{v_{t_2} - v_{t_1}}{t_2 - t_1} = \frac{\Delta v}{\Delta t} \qquad \frac{m/s}{s} = \frac{m}{s^2}$$

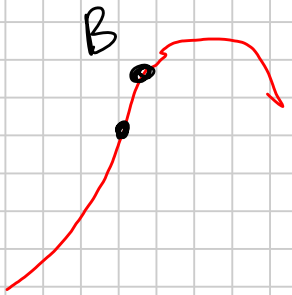
↑ avg

$$a_t = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

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

$$\boxed{a = \frac{dv}{dt}}$$

$$\boxed{a = \frac{d^2x}{dt^2}}$$



$a = const$

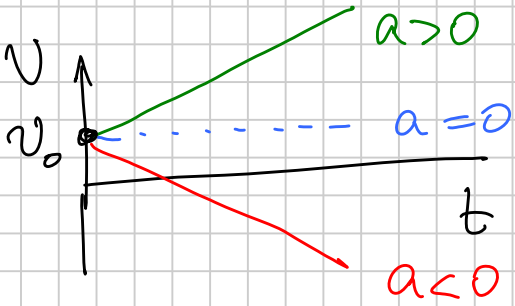
$a = \frac{dv}{dt} \rightarrow \quad a\,dt = dv$

$$\int dv = v = \int a\,dt = a\int dt = at + const$$

$$v = at + const$$

$t = 0 \quad v_{t=0} = const = v_0$

$$\boxed{v = v_0 + at}$$



$v = \frac{dx}{dt} \qquad dx = v\,dt$

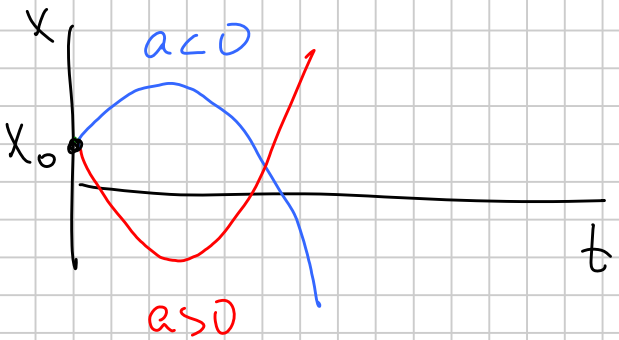
$$x = \int v\,dt = \int (v_0 + at)\,dt = \int v_0\,dt + \int at\,dt$$

$$\int v_0\,dt \rightarrow v_0 t \qquad \int at\,dt \rightarrow a\int t\,dt = a\frac{t^2}{2}$$

$$x = v_0 t + \frac{1}{2}at^2 + const$$

$t = 0 : \quad x = const = x_0$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$



$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$a = const$

$$|a| = g = 9.8 \ m/s^2$$

$$\begin{cases} a = g \\ v = v_0 - gt \\ x = x_0 + v_0 t - \frac{1}{2} g t^2 \end{cases}$$