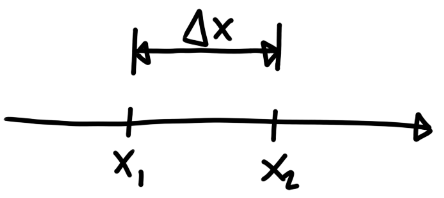
Particle Kinematics

Statics $\Sigma F = ma$ assme $a=0$, $\Sigma F = 0$

Dynamics $\Sigma F = ma$ no assumption



it takes Δt to move from x_1 to x_2

average vel $= \dfrac{\Delta x}{\Delta t}$

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

v_1 at x_1 and v_2 at x_2

$\Delta v = v_2 - v_1$

average acceleration $= \dfrac{\Delta v}{\Delta t}$

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

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

$$= v\frac{dv}{dx}$$

$v = \dfrac{dx}{dt}$ $\quad dx = v\,dt$ $\quad \displaystyle\int_{x_1}^{x_2} dx = \int_{t_1}^{t_2} v(t)\,dt$ $\quad \displaystyle x_2 - x_1 = \int_{t_1}^{t_2} v(t)\,dt$

$a = \dfrac{dv}{dt}$ $\quad dv = a\,dt$ $\quad \displaystyle\int_{v_1}^{v_2} dv = \int_{t_1}^{t_2} a(t)\,dt$ $\quad \displaystyle v_2 - v_1 = \int_{t_1}^{t_2} a(t)\,dt$

$a = v\dfrac{dv}{dx}$ $\quad v\,dv = a\,dx$ $\quad \displaystyle\int_{v_1}^{v_2} v\,dv = \int_{x_1}^{x_2} a(t)\,dx$ $\quad \displaystyle \frac{1}{2}(v_2^2 - v_1^2) = \int_{x_1}^{x_2} a(x)\,dx$

assume v const

$x = x_0 + vt$

assume a const

$v = v_0 + at$ $\qquad \displaystyle x_2 - x_1 = \int_{t_1}^{t_2} v_0 + at\,dt$

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

$v^2 = v_0^2 + 2a(x - x_0)$