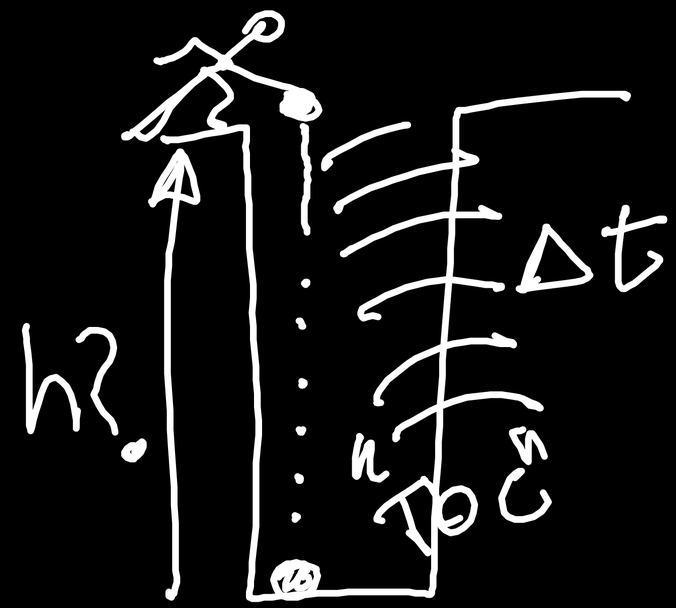
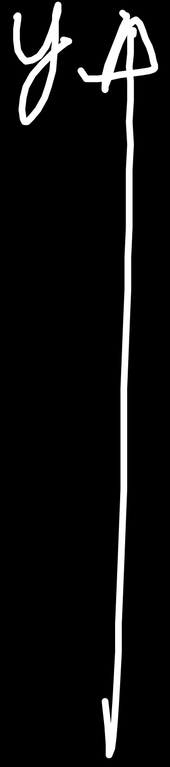




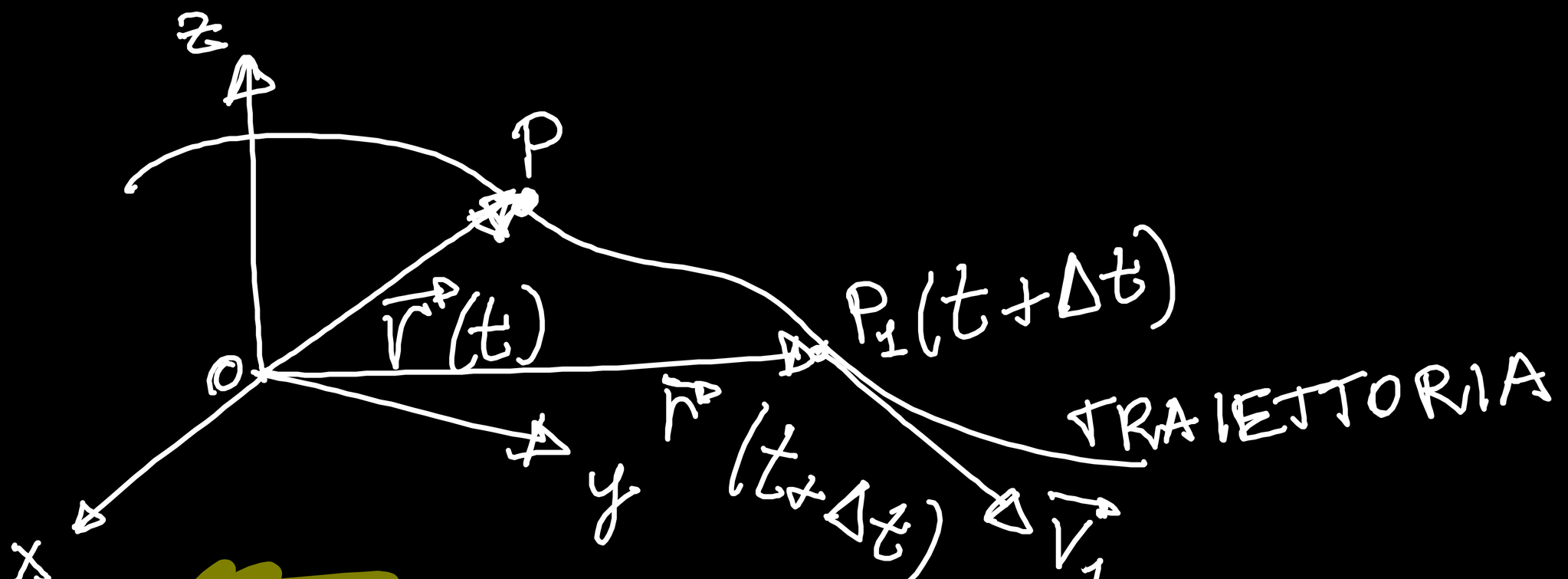
$$y(t) = h - \frac{1}{2} g t^2$$

$$0 = h - \frac{1}{2} g \Delta t^2$$

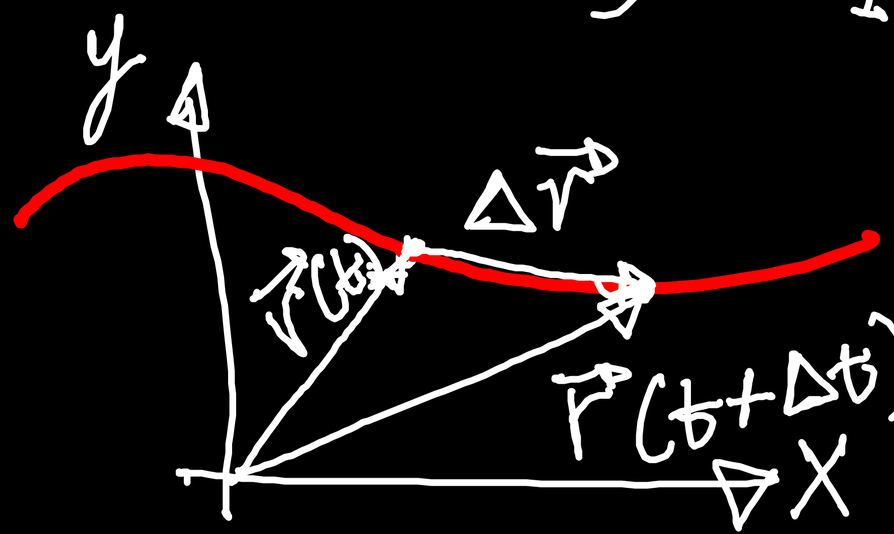
$$h = \frac{1}{2} g \Delta t^2$$

$h \approx 10\,m$ $\quad \Delta t \simeq 1.41\,s$ $\quad g = 9.81\ m/s^2$

$t_s \ll \Delta t$ $\quad t_s = \frac{h}{v_s} = \frac{10\,m}{330\,m/s} \simeq 30\,ms$

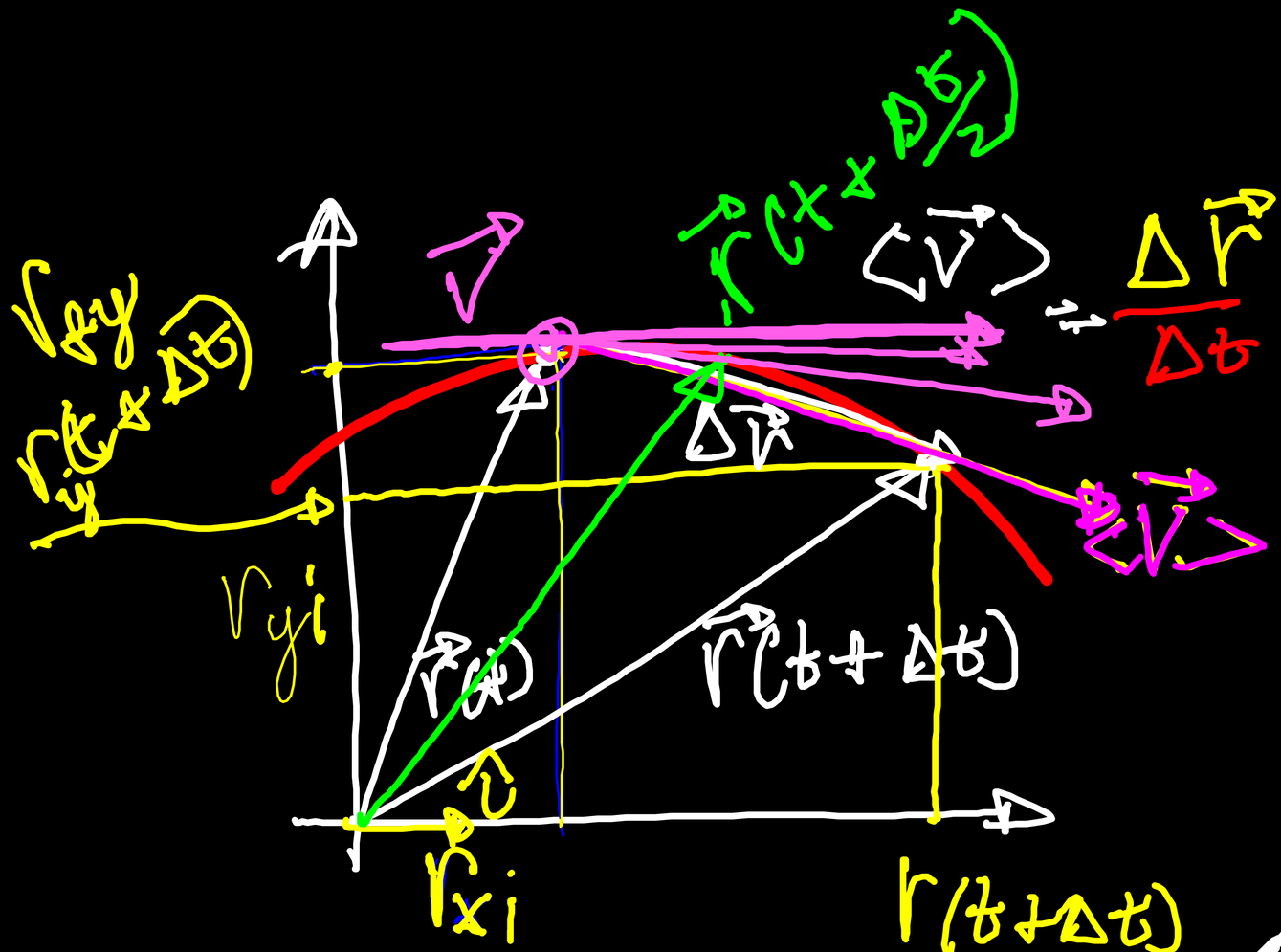


2D



$$\langle \vec{v} \rangle = \frac{\Delta \vec{r}}{\Delta t}$$

$$\vec{v} = \lim_{\Delta t \to 0} \frac{\Delta \vec{r}}{\Delta t}$$



$$\frac{\Delta \vec{r}}{\Delta t} = \frac{\vec{r}(t+\Delta t) - \vec{r}(t)}{\Delta t}$$

$$= \left(\frac{r_{fx} - r_{ix}}{\Delta t}\right)\hat{i} + \left(\frac{r_{fy} - r_{iy}}{\Delta t}\right)\hat{j}$$

$$\langle v_x \rangle \qquad \langle v_y \rangle$$

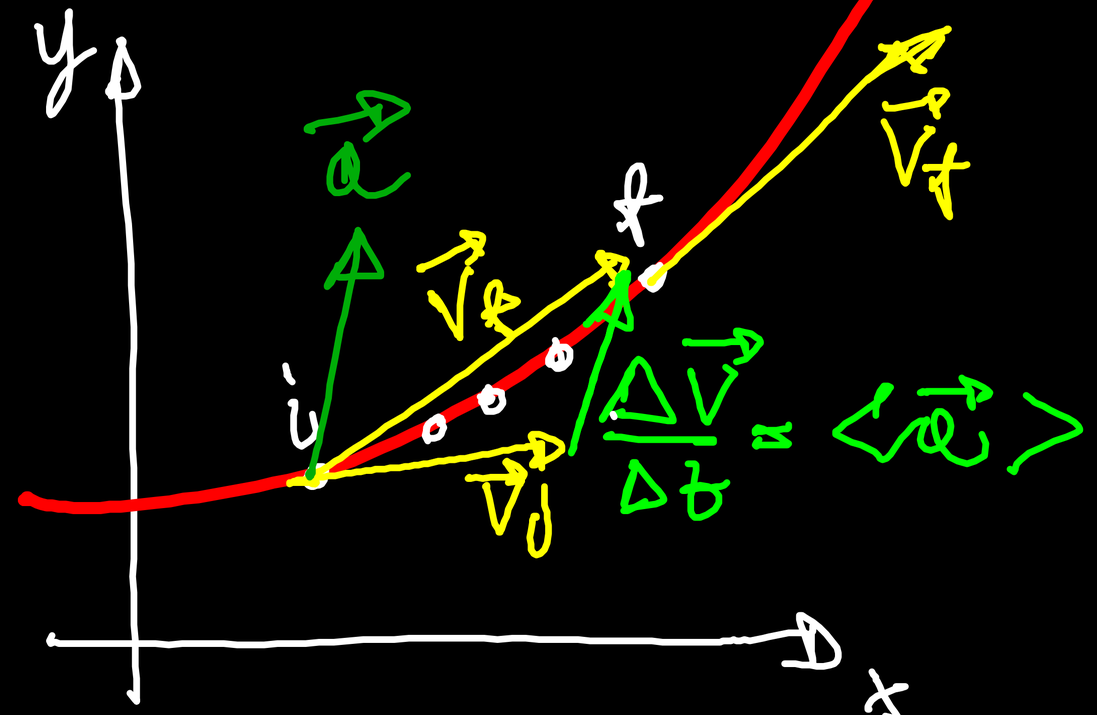
$$\vec{v} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j}$$

$$= \frac{d\vec{r}}{dt}$$

$$\lim_{\Delta t \to 0} \frac{\Delta \vec{r}}{\Delta t} = \lim_{\Delta t \to 0} \frac{\Delta r_x}{\Delta t}\hat{i} + \lim_{\Delta t \to 0} \frac{\Delta r_y}{\Delta t}\hat{j}$$

$i \to f$

$\Delta t \to 0$



$$\langle \vec{a} \rangle = \frac{\Delta \vec{V}}{\Delta t} = \frac{\vec{V}_f - \vec{V}_i}{\Delta t}$$

$$\vec{a} = \lim_{\Delta t \to 0} \frac{\Delta \vec{V}}{\Delta t}$$

$$= \lim_{\Delta t \to 0} \left(\frac{\Delta V_x}{\Delta t} \hat{i} + \frac{\Delta V_y}{\Delta t} \hat{j} \right)$$

$$\frac{d^2x}{dt^2}\hat{i} + \frac{d^2y}{dt^2}\hat{j} \longleftarrow = \frac{dV_x}{dt}\hat{i} + \frac{dV_y}{dt}\hat{j}$$

CERCHIO OSCULATORE

C

$\vec{a}$

$\vec{a}_c$

$\vec{a}_T$

$\phi < 90°$

$|\vec{V}_f| > |\vec{V}_i|$

$\vec{V}_f$

$\vec{V}_i$

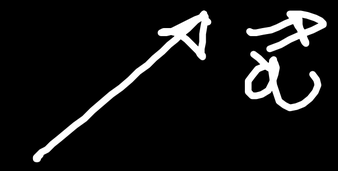
$\Delta\vec{V}$

$\phi > 90°$

$|\vec{V}_f| < |\vec{V}_i|$

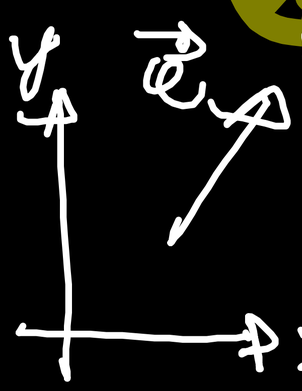
2D

$\vec{a} = \text{cost}$



$\vec{V}(t) = \vec{V}_0 + \vec{a}\,t$

$\vec{r}(t) = \vec{r}_0 + \vec{V}_0 t + \frac{1}{2}\vec{a}\,t^2$



a_x, a_y

$$\begin{cases} x(t) = x_0 + V_{0x} t + \frac{a_x}{2} t^2 \\ y(t) = y_0 + V_{0y} t + \frac{a_y}{2} t^2 \end{cases}$$