Cinematica
legge oraria

Velocita' e Accelerazione scalare

cinematica
parto dalla legge oraria

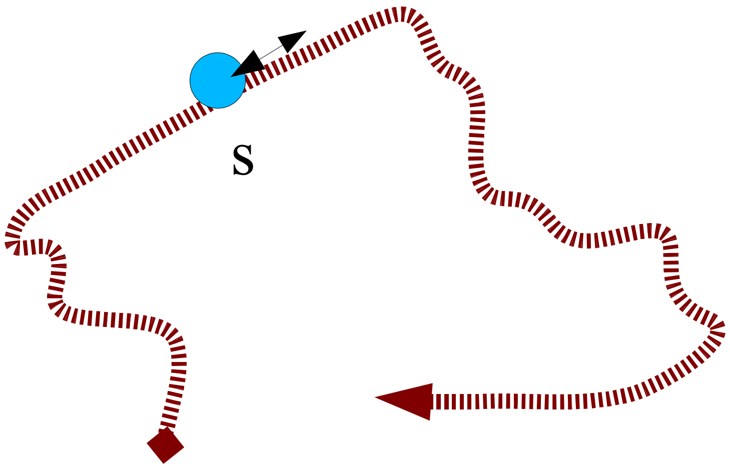
$$s = s(t)$$

$$v(t) = \frac{ds(t)}{dt}$$

$$a(t) = \frac{d^2 s(t)}{dt^2}$$

sufficiente?

segue v e a



Scalare

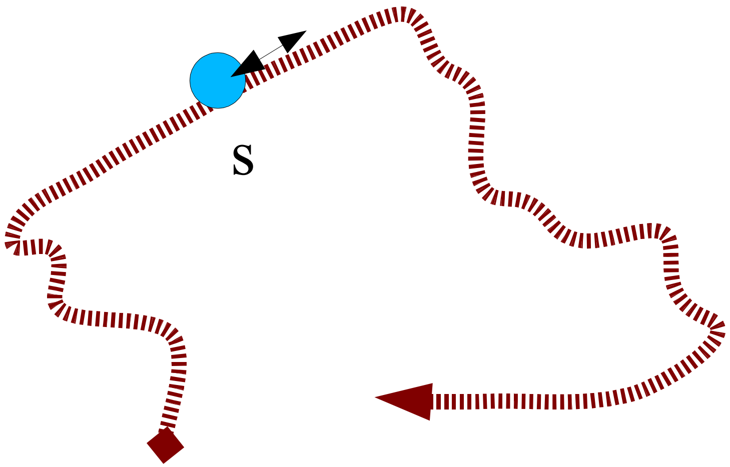
Dinamica
parto dalla accelerazione

$$v(t) = \int_0^t a(t')\,dt' + v_0$$

$$s(t) = \int_0^t v(t')\,dt' + s_0$$

$$s(t) = \int_0^t \int_0^{t_1} a(t')\,dt'\,dt_1 + v_0 t + s_0$$

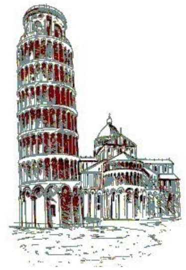
ricavo la legge oraria



Cinematica

legge oraria

vettori



Vettori

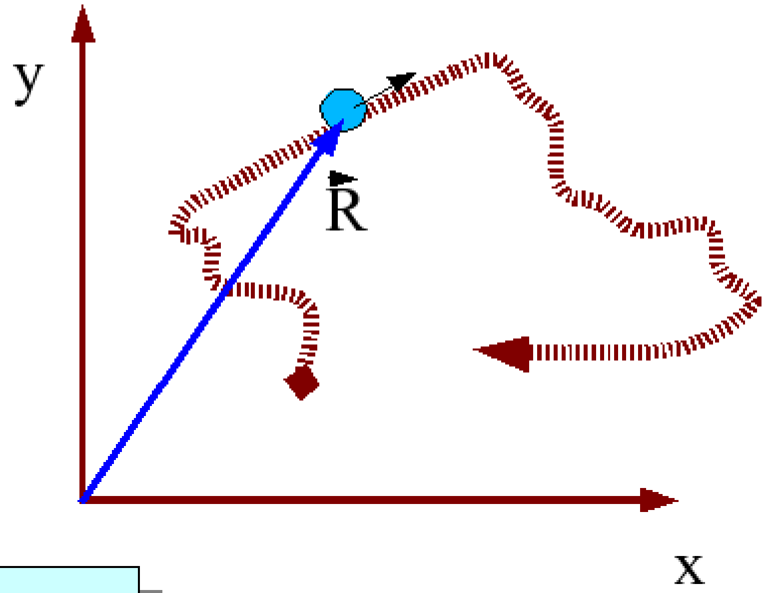
cinematca ↓

$$\vec{R} = \vec{R}(t)$$

$$\vec{v} = d\vec{R}/dt$$

$$\vec{a} = d\vec{v}/dt$$

dinamica ↑



$$\vec{R}(t) = \int_0^t \int_0^{t_1} \vec{a}(t')\,dt'\,dt_1 + \vec{v}_0 t + \vec{R}_0$$

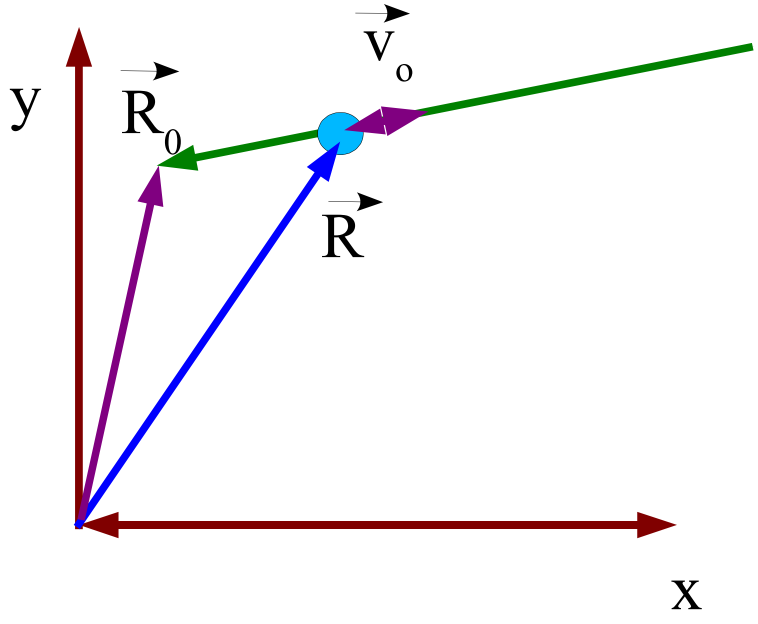
Cinematica
Moto rettilineo uniforme

$$\vec{R}(t) = \vec{v}_0 t + \vec{R}_0 \equiv \begin{cases} x = v_{x0} t + x_0 \\ y = v_{y0} t + y_0 \end{cases}$$

$$\vec{v} = d\vec{R}/dt = \vec{v}_0 \equiv \begin{cases} v_x = v_{x0} \\ v_y = v_{y0} \end{cases}$$

$$\vec{a} = d\vec{v}/dt = 0 \equiv \begin{cases} a_x = 0 \\ a_y = 0 \end{cases}$$

$$\vec{F} = 0$$



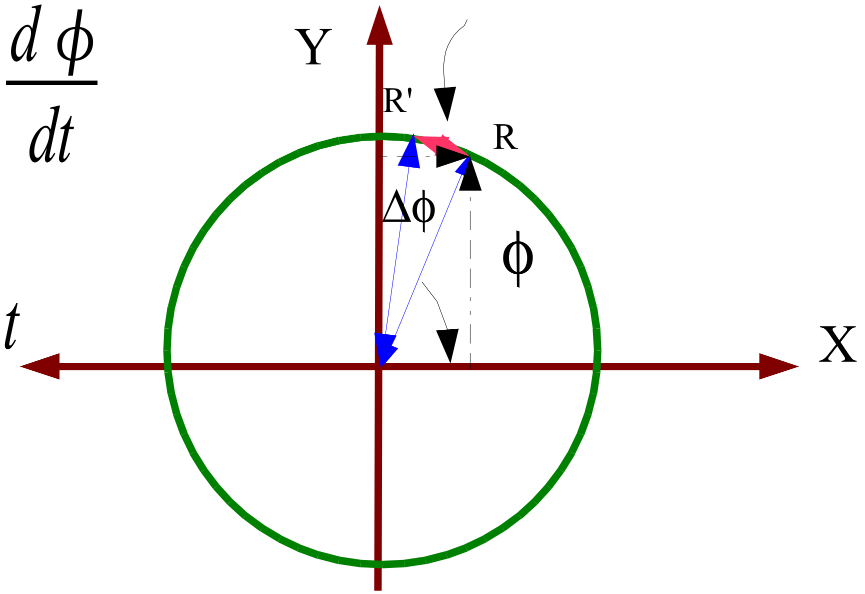
Cinematica

Circolare uniforme

$\rho = Cost.$

$\phi = \omega * t + \phi_0$ $\omega = \lim \frac{\Delta\phi}{\Delta t} = \frac{d\phi}{dt}$

$\omega \rho \Delta t = |\vec{R}' - \vec{R}| = \rho \Delta \phi = \Delta s$



$v_0 \Delta t = \Delta s = \rho \Delta \phi$ $\Delta s = \rho \omega \Delta t$

X Y

$$\vec{R}(t) \equiv (\rho\cos(\phi), \rho\sin(\phi)) = (\rho\cos(\omega t), \rho\sin(\omega t))$$

Cinematica

Circolare uniforme

$$x(t)=\rho\cos(\phi)=\rho\cos(\omega t)$$
$$y(t)=\rho\sin(\phi)=\rho\sin(\omega t)$$

$$v_x(t)=\dot{x}=\frac{d\,\rho\cos(\phi)}{dt}=-\rho\sin(\phi)\frac{d\phi}{dt}=-\omega\rho\sin(\omega t)=-\omega y$$
$$v_y(t)=\dot{y}=\frac{d\,\rho\sin(\phi)}{dt}=\rho\cos(\phi)\frac{d\phi}{dt}=\omega\rho\cos(\omega t)=\omega x$$

in coordinate polari???

Nota $\qquad |\vec{v}|=\rho\,\omega \qquad \vec{v}\cdot\vec{R}=0$

Cinematica

Circolare uniforme

accelerazione

$$a_x(t) = \frac{-d\,\omega\rho\sin(\omega t)}{dt} = -\omega^2\rho\cos(\omega t) = -\omega^2 x$$

$$a_y(t) = \frac{d\,\omega\rho\cos(\omega t)}{dt} = -\omega^2\rho\sin(\omega t) = -\omega^2 y$$

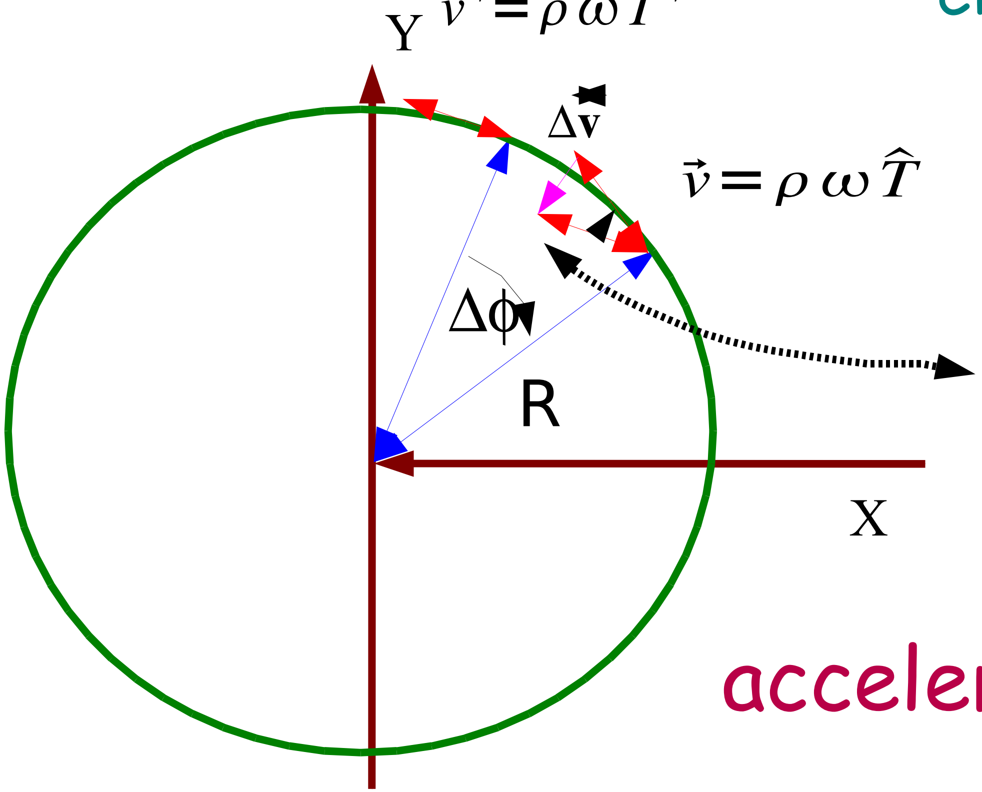
?

Nota $\vec{v}\cdot\vec{a}=0$ $\vec{a}\cdot\hat{R}=-\omega^2\rho$

L'accelerazione non e' nulla.....perche'?

Cinematica

Circolare uniforme geometricamente



Circolare uniforme

$$\vec{a}(t)=\lim\frac{\vec{v}\,'-\vec{v}}{\Delta t}=\lim\frac{\overrightarrow{\Delta v}}{\Delta t}$$

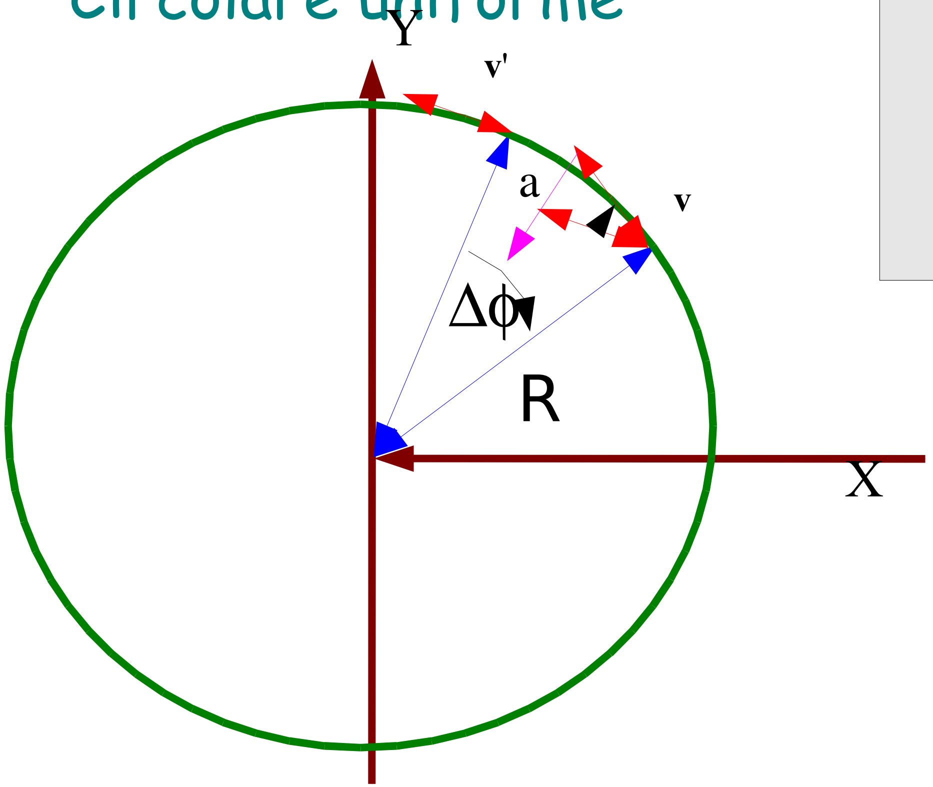
$$\vec{\Delta}\,v=\rho\omega(\hat{T}\,'-\hat{T})=-\rho\,\omega\,\Delta\,\phi\,\hat{R}$$

$$\vec{a}=-\rho\,\omega\frac{\Delta\,\phi}{\Delta\,t}\hat{R}=-\omega^{2}\rho\,\hat{R}$$

accelerazione centripeta

Cinematica
Derivata di un versore

Circolare uniforme



derivate dei versori

$$\vec{R}=\rho\,\hat{R} \qquad \vec{v}=\rho\,\omega\,\hat{T}$$

$$\vec{v}=\frac{d\,\vec{R}}{dt}=\frac{d\,\rho\,\hat{R}}{dt}=\rho\frac{d\,\hat{R}}{dt}=\rho\,\omega\,\hat{T}$$

$$\frac{d\,\hat{V}}{dt}=\omega\,\widehat{V_N}$$

Regola

$$\vec{a}=\rho\,\omega\frac{d\,\hat{T}}{dt}=\rho\,\omega\,\widehat{T_N}=-\rho\,\omega^2\,\hat{R}$$