$dW = \vec{F} \cdot d\vec{s} = m \frac{d\vec{v}}{dt} \cdot d\vec{s} = m \vec{v} \cdot d\vec{v} \qquad \int_A dW = \int_{v_A} m\, v\, dv = \frac{1}{2} m v^2 \Big|_{v_A} = E_{k_B} - E_{k_A}$

L forza peso: $L = \int_A^B m\vec{g} \cdot d\vec{s} = m\vec{g} \cdot \int_A^B d\vec{s} = m\vec{g} \cdot \vec{AB} = -mg(z_B - z_A)$

$L = mg(z_A - z_B) = E_{PA} - E_{PB} = -\Delta E_P$

L forza elastica 1D: $L = \int_A^B -kx\, dx = -\frac{kx^2}{2}\Big|_A^B = -\Delta E_P, \quad E_P = \frac{1}{2}kx^2$

L forza attrito: $L = \int_A^B \vec{f} \cdot d\vec{s} = \int_A^B \mu_d N \hat{u}_v \cdot d\vec{s} = \mu_d N \int_A^B ds = \mu_d N \Delta S$ (ΔS = spazio percorso)

$dW = \vec{F} \cdot d\vec{s} = F_x dx + F_y dy + F_z dz = -dE_P$ se F è cons.

$\oint dW = 0 \Rightarrow \exists f(x,y,z)$ t.c. $F_x = -\frac{\partial f}{\partial x}, \; F_y = -\frac{\partial f}{\partial y}, \; F_z = -\frac{\partial f}{\partial z} \qquad f = E_P$

$\vec{F} = -\vec{\nabla} E_P \longrightarrow F = mg \Rightarrow \frac{dE_P}{dz} = F = mg \quad E_P = \int mg\, dz = mgz$

$\longrightarrow F = -kx \Rightarrow \frac{dE_P}{dx} = -kx \quad E_P = \int kx\, dx = k\frac{x^2}{2}$

$\vec{L}_o = \vec{r}_o \times \vec{p} = \vec{r}_o \times m\vec{v} \qquad \vec{r}_o = \vec{OO'} + \vec{r}_{o'} \Rightarrow \vec{L}_o = \vec{OO'} \times \vec{p} + \vec{r}_{o'} \times \vec{p}$

$\vec{L}_o = \vec{OO'} \times \vec{p} + \vec{L}_{o'}$

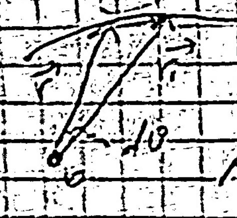
$\vec{L} = \vec{r} \times m(\vec{v}_r + \vec{v}_o) = \vec{r} \times m\vec{v}_\theta$

$\vec{M}_o = \vec{r}_o \times \vec{F} \qquad \vec{M}_{o'} = \vec{M}_o + \vec{O'O} \times \vec{F} \qquad \vec{M} = \sum \vec{r}_i \times \vec{F}_i = \vec{r} \times \sum \vec{F}_i = \vec{r} \times \vec{R}$

$\frac{d\vec{L}}{dt} = \frac{d\vec{r}}{dt} \times \vec{p} + \vec{r} \times \frac{d\vec{p}}{dt} = \cancel{\vec{v} \times m\vec{v}} + \vec{r} \times \vec{F} = \vec{M}$

$\vec{v} = \frac{d\vec{r}}{dt} = \frac{dr}{dt}\hat{u}_r + r\frac{d\hat{u}_r}{dt} = v\hat{u}_r + r\frac{d\theta}{dt}\hat{u}_\theta \qquad \vec{L} = \vec{r} \times m r \frac{d\theta}{dt} \hat{u}_\theta$

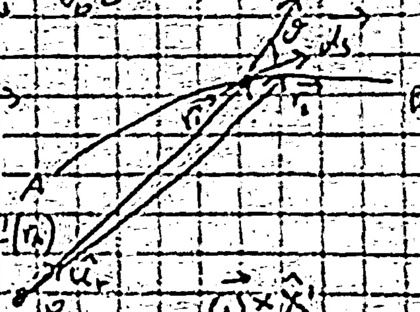
Se O sta nel piano del moto, $\vec{r} \perp \hat{u}_\theta \Rightarrow L = mr^2 \frac{d\theta}{dt}$



F centrale $\Rightarrow L = \text{cost.} \Rightarrow \frac{1}{2} r^2 \frac{d\theta}{dt} = \text{cost.} \qquad \frac{dA}{dt} = \frac{1}{2} r^2 \frac{d\theta}{dt}$

$dA = \frac{1}{2} r\, r\, d\theta \qquad \frac{dA}{dt} = \text{cost.} \qquad \frac{dA}{dt} = \frac{L}{2m} \qquad \int_{Area} dA = \int_0^T \frac{L}{2m} dt$

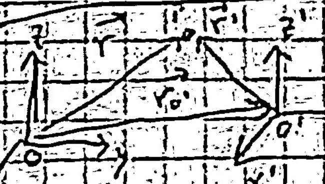
$A = \frac{L}{2m} T$ periodo: $T = \frac{2mA}{L}$



Lavoro forze centrali: $L = \int_A^B \vec{F} \cdot d\vec{s} = \int_A^B F(r)\, \hat{u}_r \cdot d\vec{s}$

$ds \cos\theta = dr \Rightarrow \hat{u}_r \cdot d\vec{s} = dr \Rightarrow L = \int_A^B F(r)\, dr = f(r_B) - f(r_A)$

$d\vec{r} = r\, d\theta\, \hat{u}_\theta \qquad |d\vec{r}| = r\, d\theta = dr$



$\vec{r} = \vec{r}_o + \vec{r}' \qquad \vec{v} = \frac{d\vec{r}}{dt} = \frac{d\vec{r}_o}{dt} + \frac{dx'}{dt}\hat{x}' + \frac{dy'}{dt}\hat{y}' + \frac{dz'}{dt}\hat{z}' + x'\frac{d\hat{x}'}{dt} + y'\frac{d\hat{y}'}{dt} + z'\frac{d\hat{z}'}{dt}$ ($\frac{d\hat{x}'}{dt} = \vec{\omega} \times \hat{x}'$)

$= \vec{v}_o + \vec{v}' + \vec{\omega} \times (x'\hat{x}' + y'\hat{y}' + z'\hat{z}') = \vec{v}_o + \vec{v}' + \vec{\omega} \times \vec{r}'$