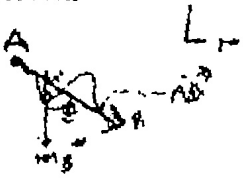
$dW = F_T\, ds = m \frac{dv}{dt} ds = m v\, dv$



$L_{\text{forza peso}}$: $L = \int_A^B m\vec{g} \cdot d\vec{s} = \dots$

$L = mg(y_A - y_B) = U_{PA} - U_{PB}$

$L_{\text{forza elastica 1D}}$: $L = \int_A^B -kx\, dx = -\frac{1}{2}k\,[\dots]_A^B$

$L_{\text{forza d'attrito}} = \int_A^B \vec{f} \cdot d\vec{s} = \int_A^B \mu_d N \hat{u}_v \cdot d\vec{s}$

$dW = \vec{F} \cdot d\vec{s} = F_x dx + F_y dy + F_z dz = -dE_p$

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

$\vec{F} = -\vec{\nabla} E_p$ → $F = mg \Rightarrow \frac{dE_p}{dz} = F = mg$ → $E_p = -mgz$

→ $F = -kx \Rightarrow \frac{dE_p}{dx} = -kx$ → $E_p = \frac{1}{2}kx^2$

$\vec{L}_O = \vec{r} \times \vec{p} = \vec{r}_O \times m\vec{v}$ $\quad \vec{r}_O = \vec{OO'} + \vec{r}_{O'}$ $\Rightarrow \vec{L}_O = \vec{OO'} \times \vec{p} + \vec{r}_{O'} \times \vec{p}$

$\vec{L}_O = \vec{OO'} \times \vec{p} + \vec{L}_{O'}$

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

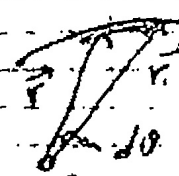
$\vec{M}_O = \vec{r} \times \vec{F}$ $\quad \vec{M}_{O'} = \vec{M}_O + \vec{O'O} \times \vec{F}$ $\quad \vec{M} = \sum \vec{r}_B \times \vec{F}_i = \vec{r} \times \sum \vec{F}_i$ $\quad \vec{r} = \vec{r}$

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

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

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

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



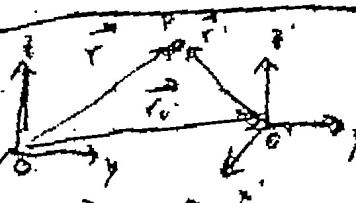
$dA = \frac{1}{2} r \cdot r\, d\theta$ $\quad \frac{dA}{dt} = \omega \frac{1}{2} r^2$ $\quad \frac{dA}{dt} = \frac{L}{2m}$ $\quad \int_0^{\dots} dA = \int_0^T \frac{L}{2m} dt$

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

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

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

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



$\vec{r} = \vec{r}_0 + \vec{r}'$

$\vec{v} = \frac{d\vec{r}}{dt} = \frac{d\vec{r}_0}{dt} + \frac{dx'}{dt}\hat{x}' + \frac{dy'}{dt}\hat{y}' + \frac{dz'}{dt}\hat{z}' + x'\frac{d\hat{x}}{dt} + y'\frac{d\hat{y}}{dt} + z'\frac{d\hat{z}}{dt}$

$= \vec{v}_0 + \vec{v}' + \vec{\omega} \times (x'\hat{x}' + y'\hat{y}' + z'\hat{z}') = \vec{v}_0 + \vec{v}' + \vec{\omega} \times \vec{r}'$

$\omega = \dot{\theta}$