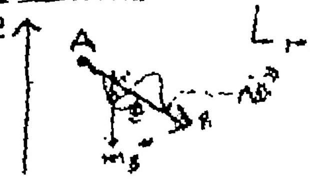
$dW = F_T\, ds = m \frac{dv}{dt} ds = m v\, dv$

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



$L = mg(z_A - z_B) = E_{pA} - E_{pB}$

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

L forza attrito: $L = \int_A^B \vec{f} \cdot d\vec{s} = \int_A^B \mu_d N \hat{u}_v \cdot d\vec{s} = - \mu_d N$

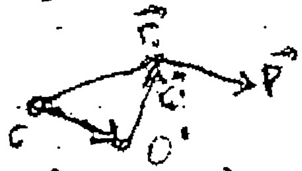
$dW = \vec{F} \cdot d\vec{s} = F_x\, dx + F_y\, dy + F_z\, dz = -dE_p$

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

$\vec{F} = -\nabla E_p \longrightarrow F = mg \Rightarrow \frac{dE_p}{dz} = F = mg$, $E_p = \int mg\, dz$

$\longrightarrow F = -kx \Rightarrow \frac{dE_p}{dx} = -kx$, $E_p = \int -kx\, dx$

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



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

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

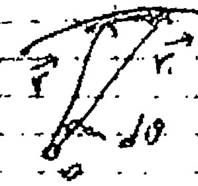
$\vec{M}_O = \vec{r}_O \times \vec{F}$ $\quad \vec{M}_{O'} = \vec{M}_O + \vec{O'O} \times \vec{F}$ $\quad \vec{M} = \sum \vec{r}_i \times \vec{F}_i = \vec{r} \times \sum \vec{F}_i$

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

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

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

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



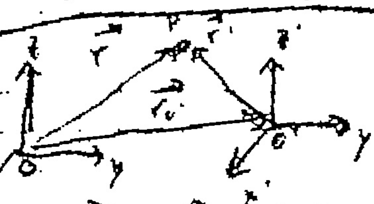
$dA = \frac{1}{2} r\, r\, d\theta$ $\quad \frac{dA}{dt} = \text{cost.}$ $\quad \frac{dA}{dt} = \frac{L}{2m}$ $\quad \int dA = \int_0^T \frac{L}{2m} dt$

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

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

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

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



$\vec{r} = \vec{r}_{O'} + \vec{r}'$ $\quad \vec{\omega} \times \hat{x}'$

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

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