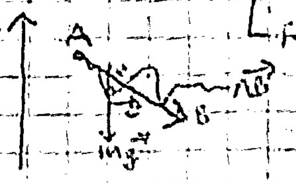
$$dW = F_t\, ds = m \frac{dv}{dt} ds = m v\, dv \qquad \int_A^B dW = \int_{v_A}^{v_B} m v\, dv = m\frac{v^2}{2}\Big|_{v_A}^{v_B} = \Delta E_k$$



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

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

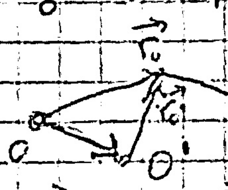
$$dW = \vec{F} \cdot d\vec{s} = F_x dx + F_y dy + F_z dz = -dE_p \text{ se } F \text{ è cons.}$$

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

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

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

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



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

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

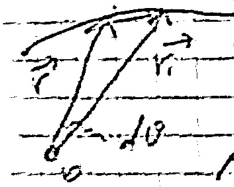
$$\vec{M}_o = \vec{r}_o \times \vec{F} \qquad \vec{M}_{o'} = \vec{M}_o + \vec{o'o} \times \vec{F} \qquad \vec{M} = \sum \vec{r}_i \times \vec{F}_i = \vec{r} \times \sum \vec{F}_i = \vec{r} \times \vec{R}$$

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

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

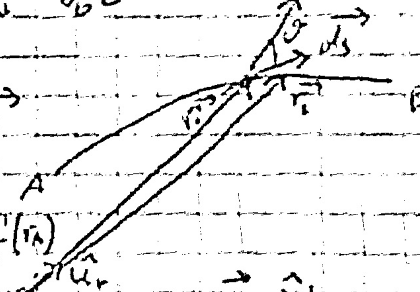
Se O sta nel piano del moto, $\vec{r} \perp \hat{u}_\theta \Rightarrow L = mr^2\frac{d\theta}{dt}$

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



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

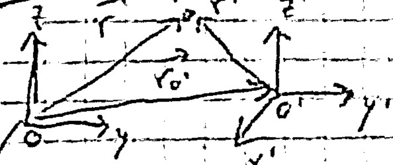
$$A = \frac{L}{2m} T \qquad \text{periodo: } T = \frac{2mA}{L}$$



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

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

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



$$\vec{r} = \vec{r}_{o'} + \vec{r}'$$

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

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