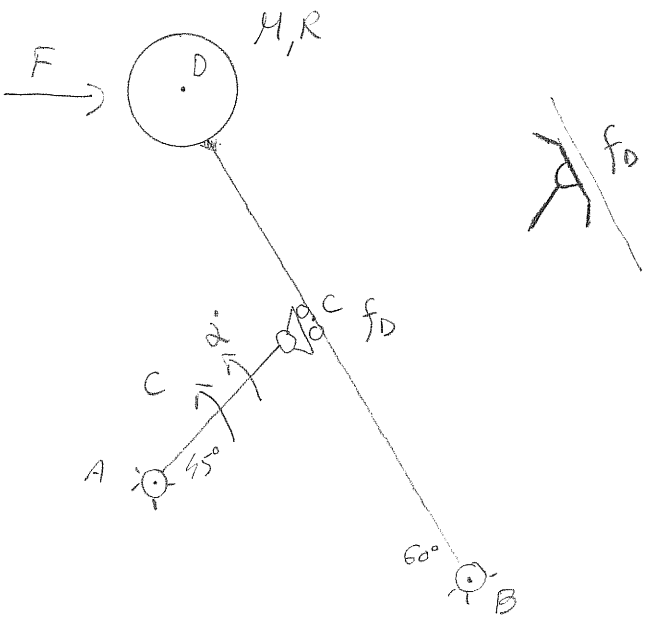


SISTEMA NEL PIANO VERTICALE

NOTI

$M = 10\ kg$ (DISCO OMOGENEO)

$R = 0.1\ m$

$AC = 0.3\ m$

$BD = 0.76\ m$

$CB = 0.4\ m$

$F = 100\ N$

$\dot{\alpha} = 10\ rad/s$ COSTANTE

$f_D = 0.2$

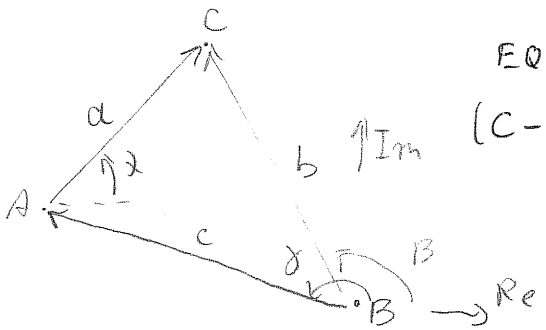
CALCOLARE

- $\vec{v}_D$, $\vec{a}_D$
- C PER GARANTIRE IL MOTO
- REAZIONI VINCOLARI IN A

ANALISI CINEMATICA:

Il punto D si muove su traiettoria circolare di centro B

Devo trovare il legame tra $\dot{\alpha}$ e velocità / accelerazione angolare di BD



EQ. CHIUSURA

$$(C-B) = (C-A) + (A-B) \qquad b e^{i\beta} = a e^{i\alpha} + c e^{i\gamma}$$

COST	a c, γ
VAR	b, β α

$$\begin{cases} b\cos\beta = a\cos\alpha + c\cos\gamma \\ b\sin\beta = a\sin\alpha + c\sin\gamma \end{cases}$$

$$b^2\cos^2\beta + b^2\sin^2\beta = a^2\cos^2\alpha + c^2\cos^2\gamma + 2ac\cos\alpha\cos\gamma + a^2\sin^2\alpha + c^2\sin^2\gamma + 2ac\sin\alpha\sin\gamma$$

$$b^2 = a^2 + c^2 + 2ac\cos\alpha\cos\gamma + 2ac\sin\alpha\sin\gamma$$

NON NECESSARIO POSIZIONE ASSEGNATA

$\Rightarrow b =$ $\beta =$

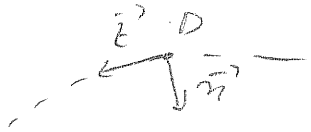
$$\begin{cases} \dot{b}\cos\beta - b\dot{\beta}\sin\beta = -a\dot{\alpha}\sin\alpha \\ \dot{b}\sin\beta + b\dot{\beta}\cos\beta = a\dot{\alpha}\cos\alpha \end{cases} \qquad \begin{bmatrix} \cos\beta & -b\sin\beta \\ \sin\beta & b\cos\beta \end{bmatrix} \begin{Bmatrix} \dot{b} \\ \dot{\beta} \end{Bmatrix} = \begin{Bmatrix} -a\dot{\alpha}\sin\alpha \\ a\dot{\alpha}\cos\alpha \end{Bmatrix}$$

$\Rightarrow \dot{b} = 2.90\ m/s \qquad \dot{\beta} = 1.94\ rad/s$

$$\begin{cases} \ddot{b}\cos\beta - 2\dot{b}\dot{\beta}\sin\beta - b\ddot{\beta}\sin\beta - b\dot{\beta}^2\cos\beta = -a\ddot{\alpha}\sin\alpha - a\dot{\alpha}^2\cos\alpha \\ \ddot{b}\sin\beta + 2\dot{b}\dot{\beta}\cos\beta + b\ddot{\beta}\cos\beta - b\dot{\beta}^2\sin\beta = a\ddot{\alpha}\cos\alpha - a\dot{\alpha}^2\sin\alpha \end{cases}$$

$$\begin{bmatrix} \cos\beta & -b\sin\beta \\ \sin\beta & b\cos\beta \end{bmatrix} \begin{Bmatrix} \ddot{b} \\ \ddot{\beta} \end{Bmatrix} = \begin{Bmatrix} 2\dot{b}\dot{\beta}\sin\beta + b\dot{\beta}^2\cos\beta - a\dot{\alpha}^2\cos\alpha \\ -2\dot{b}\dot{\beta}\cos\beta + b\dot{\beta}^2\sin\beta - a\dot{\alpha}^2\sin\alpha \end{Bmatrix}$$

$\Rightarrow \ddot{b} = 0.73\ m/s^2 \quad \ddot{\beta} = -20.9\ rad/s^2$



$\vec{v}_D = \vec{\omega}_{BD} \wedge (D-B) = \dot{\beta}\, DB\, \vec{t}$ (1.47)

$\vec{a}_D = \dot{\vec{\omega}}_{BD} \wedge (D-B) - \omega_{BD}^2 (D-B) = \ddot{\beta}\, DB\, \vec{t} + \dot{\beta}^2\, DB\, \vec{n}$ (−15.88 2.86)

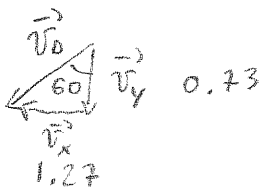
$\ddot{\beta} < 0$

[DB = f]

In componenti cartesiane

$$\begin{cases} x_D = f\cos\beta \\ y_D = f\sin\beta \end{cases} \qquad \begin{cases} \dot{x}_D = -f\dot{\beta}\sin\beta = -1.28 \\ \dot{y}_D = f\dot{\beta}\cos\beta = -0.73 \end{cases} \qquad \begin{cases} \ddot{x}_D = -f\ddot{\beta}\sin\beta - f\dot{\beta}^2\cos\beta = -27.7 \\ \ddot{y}_D = f\ddot{\beta}\cos\beta - f\dot{\beta}^2\sin\beta = -19.32 \end{cases}$$

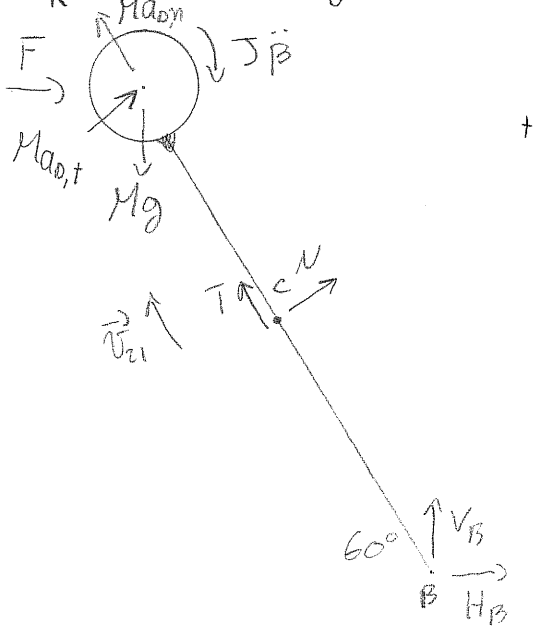
APPLICO IL BILANCIO DI POTENZE



$\sum W_k = \frac{d E_c}{dt}$

$E_c = \frac{1}{2} M V_D^2 + \frac{1}{2} J \omega_{BD}^2 \qquad J = \frac{M R^2}{2} \qquad E_c = \frac{1}{2} M f^2 \dot{\beta}^2 + \frac{1}{2} \frac{M R^2}{2} \dot{\beta}^2$

$W_k = \vec{C} \times \vec{\dot{\alpha}} + M\vec{g} \times \vec{v}_D + \vec{F} \times \vec{v}_D - |\vec{T}| \cdot |\vec{v}_r| = C\dot{\alpha} - Mg\dot{y}_D + F\dot{x}_D - T\dot{b}$



$+\circlearrowleft \quad M_B^{x(BD)} = +Mg\, BD\cos 60 - F\, BD\sin 60 - N\, BC - M a_{D,t}\, BD +$

$- J\ddot{\beta} = 0$

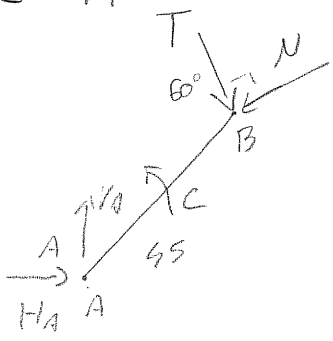
$\Rightarrow N = -716.9\ N$

$T = f_D |N| = 143.3\ N$

! ATTENZIONE AL VERSO DI $\vec{T}$

$$C\ddot{\alpha} - Mg\dot{y}_D + F\dot{x}_D - T\dot{b} = \left(Mf^2 + M\frac{R^2}{2}\right)\dot{\beta}\dot{\beta}$$

$$\Rightarrow C = 97.2 \ Nm$$



$$F_x^{\circ(AB)} = H_A + T\cos 60 - N\,\text{sen}\,60 = 0$$

$$F_y^{\circ(AB)} = V_A - T\,\text{sen}\,60 - N\cos 60 = 0$$

$$H_A = -692.5 \ N$$

$$V_A = -236.3 \ N$$

VERIFICO 1 VAL. KI CON UN EQ $M_B^{*(AB)} = 0$ ✓