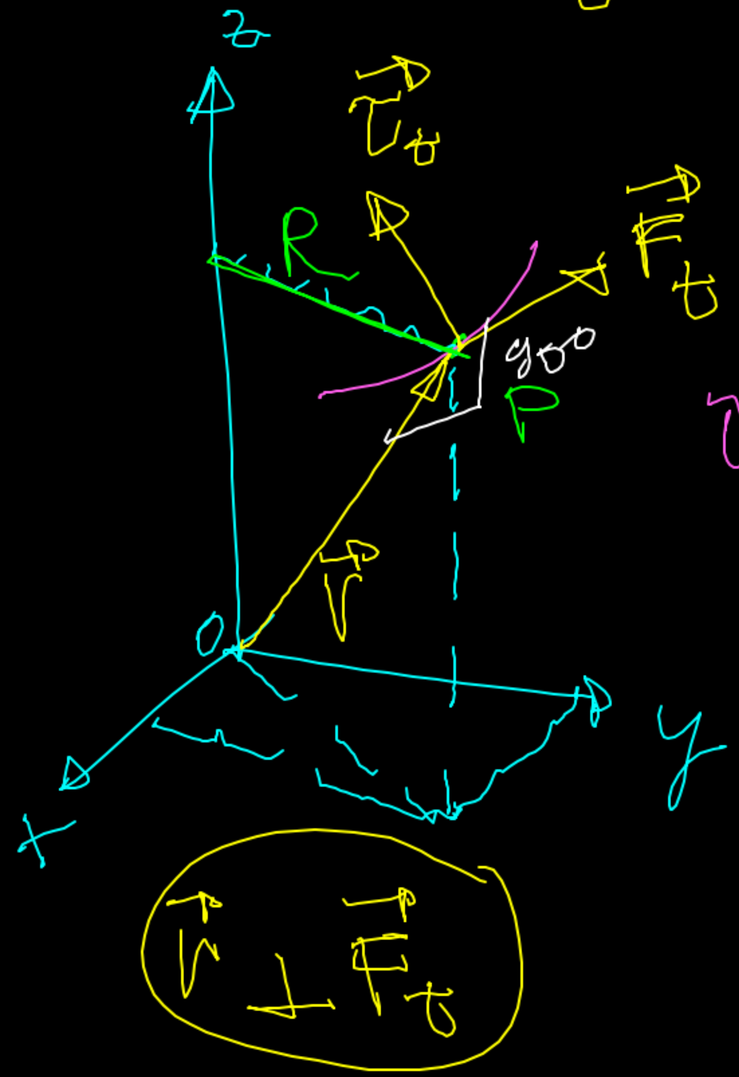
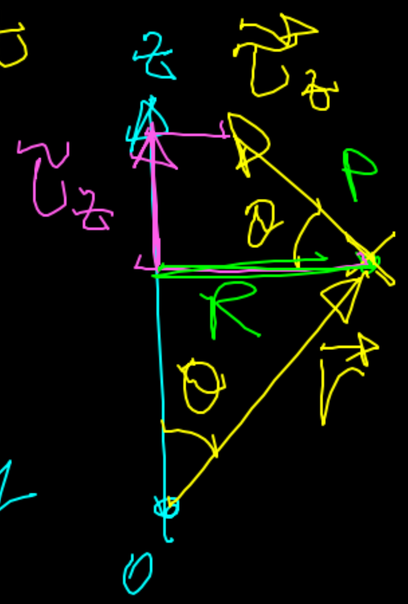
$$\tau_z = \underbrace{(\vec{r} \times \vec{F}_t)}_{\vec{\tau}_t}{}_z \qquad |\vec{\tau}_t| = |\vec{r} \times \vec{F}_t| = r F_t (\sin 90^\circ)$$

$$\tau_z = |\vec{\tau}_t| \sin\theta = r F_t \sin\theta$$

$$= (r \sin\theta) F_t$$

$$= R F_t$$





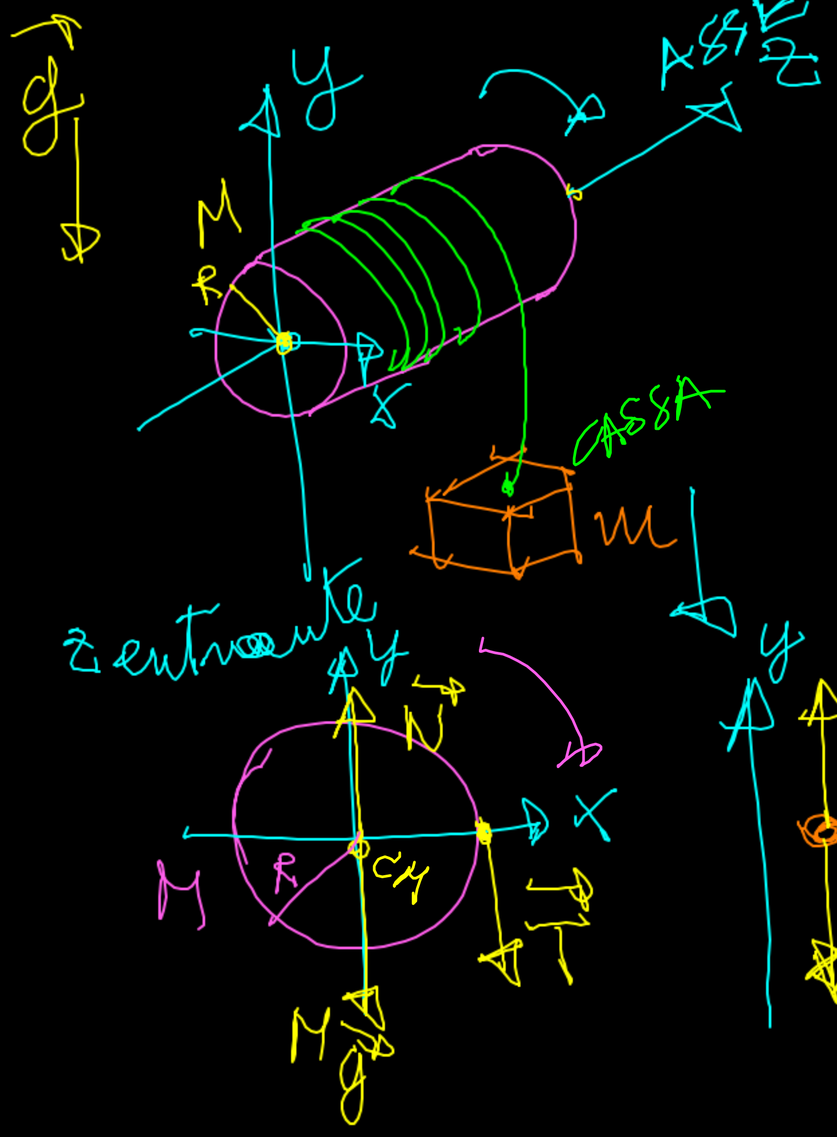
$\vec{F}_t$ è entrante

$\vec{r} \perp \vec{F}_t$

$$\tau_z = R F_t = I_z \alpha_z$$

momento angolare

ESEMPIO



$a_y > 0$ corre

a_z cilindro

T fune

CASSA $\quad T - mg = -m a_y$

CILINDRO

I E.c. $\frac{d\vec{P}}{dt} = \sum \vec{F}_{est} = M\vec{a}_{cm}$ $\quad N - Mg - T = 0$

II E.c. $\sum \tau_z = I_z \alpha_z$ $\quad TR = \frac{1}{2} MR^2 a_z$

i) $T - mg = -m a_y$

ii) $N - Mg - T = 0$

iii) $TR = \frac{1}{2} M R^2 \alpha_z$

iv) $a_y = \alpha_z R$

$\Rightarrow$

(iii) $\oplus$ (iv) $T = \frac{1}{2} M R \frac{a_y}{R} = \frac{1}{2} M a_y$

↳ i) $\frac{1}{2} M a_y - mg = -m a_y$

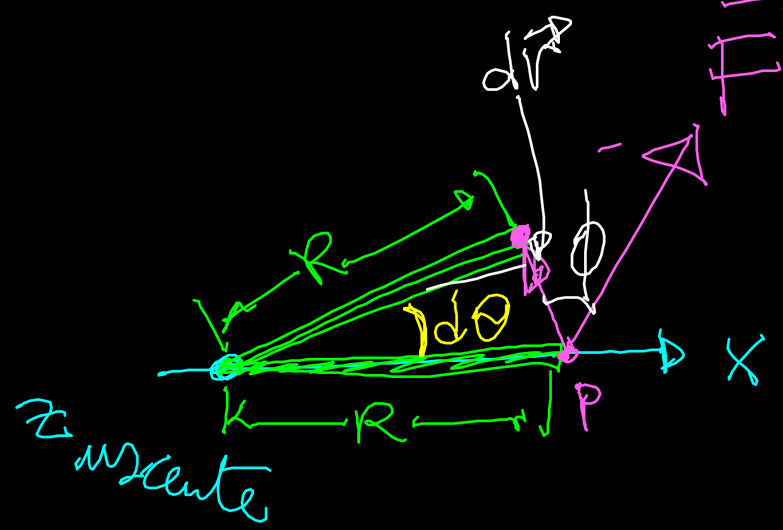
$\left(\frac{1}{2} M + m\right) a_y = mg$

$a_y = \frac{mg}{\left(\frac{1}{2} M + m\right)} = \frac{2mg}{(M+2m)}$

$T = \frac{Mmg}{M+2m}$

$\alpha_z = \frac{2mg}{R(M+2m)}$

LAVORO E ENERGIA (ROTAZIONI ASSIALI)



$$|d\vec{r}| = R\,d\theta$$

$$dW = \vec{F}\cdot d\vec{r} = (F\cos\phi)\,dr = F_t R\,d\theta = \tau_z\,d\theta$$

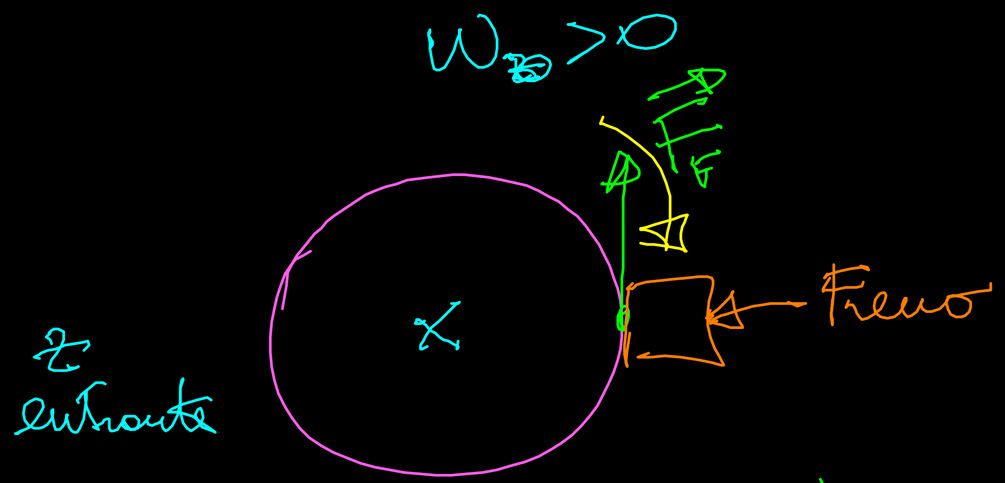
$$W_{\theta_i \to \theta_f} = \int_{\theta_i}^{\theta_f} \tau_z\,d\theta$$

ESEMPIO PREC.

$\tau_z = TR > 0$

$\Delta\theta = \pi/2 > 0$

$W_{0 \to \pi/2} = TR\Delta\theta > 0$



$$\tau_{\vec{z}}(\vec{F}_F) = -F_F \cdot R$$

$$\Delta\theta = \omega_0 \Delta t > 0$$

$$d\theta = \omega_0 dt$$

$$dW = \tau \cdot d\theta = -F_F R \omega_0 dt < 0$$