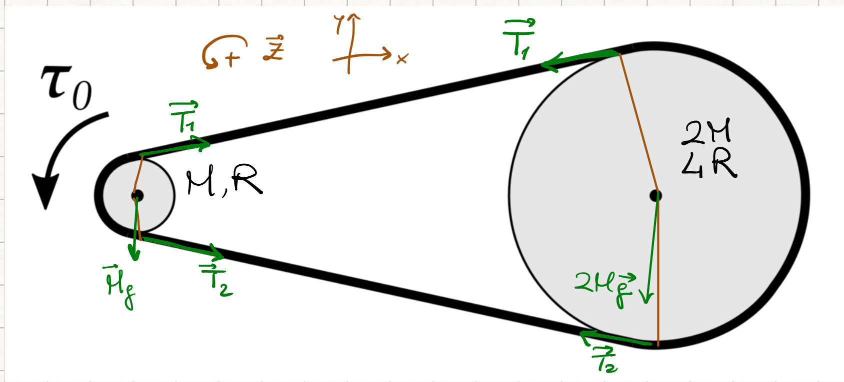
E26 - RIPASSO

1)



? α_v

? P_m (N giri)

m : $\vec{\tau}_0 + \vec{\tau}_1 + \vec{\tau}_2 = I_m \vec{\alpha}_m \Rightarrow \tau_0 - T_1 R + T_2 R = \frac{1}{2} M R^2 \alpha_m$

v : $\vec{\tau}_{T_1} + \vec{\tau}_{T_2} = I_v \vec{\alpha}_v \rightarrow T_1 \cancel{4}R - T_2 \cancel{4}R = \frac{1}{\cancel{2}} 2M \cancel{16}^{4} R^2 \alpha_v$

$a_{t,m} = a_{t,v} = \alpha_m R = \alpha_v 4R \Rightarrow \alpha_m = 4\alpha_v$

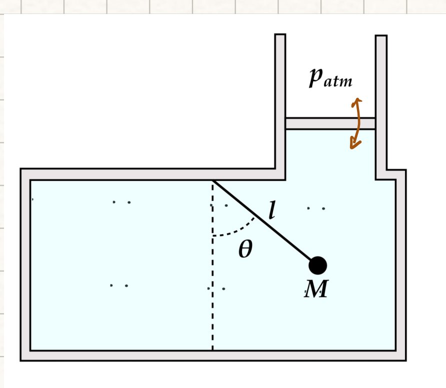
$$\Rightarrow \begin{cases} \tau_0 - RT_1 + RT_2 = \frac{1}{\cancel{2}} MR^2 \cancel{4}^{2} \alpha_v \Rightarrow RT_1 - RT_2 = \tau_0 - 2MR^2\alpha_v \\ RT_1 - RT_2 = 4MR^2\alpha_v \Rightarrow \tau_0 - 2MR^2\alpha_v = 4MR^2\alpha_v \Rightarrow \alpha_v = \frac{\tau_0}{6MR^2} \end{cases}$$

$P_m = \frac{L}{\Delta t}$; $L = \Delta E_m = \Delta E_K = \int_{\theta_i}^{\theta_f} \tau_0 \, d\theta = \tau_0 \Delta\theta = \tau_0 2\pi N$

$\Delta\theta = \cancel{\theta_0} + \cancel{\omega_0 t} + \frac{1}{2}\alpha_m t^2 \rightarrow 2\pi N = \frac{1}{2}\alpha_m \Delta t^2 \rightarrow \Delta t = \sqrt{\frac{4\pi N}{\alpha_M}} = \sqrt{\frac{\cancel{4}\pi N 6MR^2}{\cancel{4}\tau_0}} = \sqrt{\frac{6\pi MN}{\tau_0}} R$

$\rightarrow P_m = \frac{\tau_0 2\pi N}{R}\sqrt{\frac{\tau_0}{6\pi MN}} = \sqrt{\frac{\tau_0^3 \cancel{4}^{2} \cancel{\pi^2} N^{\cancel{2}}}{R^2 \cancel{6}_{3} \cancel{\pi} M \cancel{N}}} = \sqrt{\frac{2\tau_0^3 \pi N}{3MR^2}}$

3)



$M = 20$ kg

$l = 1,5$ m

ADIAB $\Rightarrow Q = 0$

$n = 3$ mol (BIAT)

$T_0 = 300$ K

EQUILIBRIO $p = P_{atm}$

$\theta = 60°$

a) ? ΔT

b) ? ΔS_g ($\vec{a} = 0$)

$\Delta U = Q - L$

$n c_v \Delta T = -P_{atm}\Delta V + Mgl(1-\cos\theta) \rightarrow n c_v \Delta T = -nR\Delta T + Mgl(1-\cos\theta)$

$P_{atm} V_0 = nRT_0$

$P_{atm} V_1 = nRT_1$

$\Rightarrow P_{atm}\Delta V = nR\Delta T$

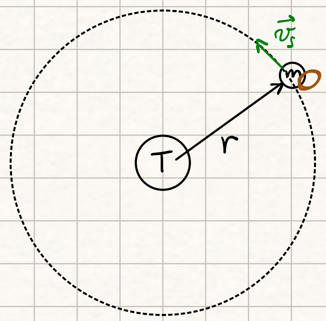
$\Rightarrow \Delta V = \frac{nR\Delta T}{P_{atm}}$

$\rightarrow \Delta T = \frac{Mgl(1-\cos\theta)}{n c_p} = 1,68$ K

$$\Delta S_g = \int_i^f \frac{(dQ)_{rev}}{T} = n c_v \ln\frac{T_f}{T_i} + nR\ln\left(\overset{\frac{nRT_f}{nRT_i}}{\frac{V_f}{V_i}}\right) = n c_v \ln\frac{T_f}{T_i} + nR\ln\frac{T_f}{T_i} = nR\ln\frac{T_f}{T_i}\left(\frac{5}{2}+1\right)$$

$$= \boxed{0{,}45\ J/K}$$

2)



$r = 2R_T$

$m_m = \frac{m}{3}$

$v_s = v_m$

URTO PERFETTAMENTE ANAELASTICO $\rightarrow$ $\Delta E_k \neq 0$, $\Delta \vec{Q} = 0$, $\Delta \vec{L} = 0$, $\Delta E_m = 0$

? $\vec{v}_f$? orbita

$$m v \vec{u}_t - \frac{m}{3} v \vec{u}_t = \left(m + \frac{m}{3}\right) v_f \vec{u}_t$$

$$\rightarrow v_f = \left(\frac{2}{\cancel{3}}\cancel{m} v\right)\left(\frac{\cancel{3}}{\cancel{4}_2}\frac{1}{\cancel{m}}\right) = \frac{v}{2}$$

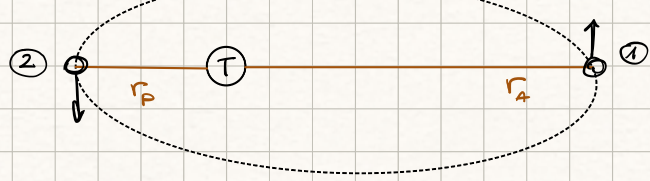
PRE-URTO: $F_G = \gamma\frac{Mm}{r^2} = m a_c = m\frac{v^2}{r} = m\frac{v^2}{2R_T}$

$$\Rightarrow \gamma\frac{M\cancel{m}}{{}_2\cancel{4}R_T^2} = \cancel{m}\frac{v^2}{\cancel{2R_T}} \Rightarrow v = \sqrt{\frac{\gamma M}{2R_T}}$$

$$\Rightarrow \boxed{\vec{v}_f = \frac{1}{2}\sqrt{\frac{\gamma M}{2R_T}}\,\vec{u}_t}$$

$$E_k = \frac{1}{2}\left(m + \frac{m}{3}\right)v_f^2 = \frac{1}{2}\,\frac{\cancel{4}m}{3}\,\frac{1}{\cancel{4}}\,\frac{\gamma M}{2R_T} = \frac{\gamma M m}{12 R_T}$$

$$E_m = E_k + E_p = \gamma\frac{Mm}{12R_T} - \gamma\frac{M\frac{4}{3}m}{2R_T} = \frac{\gamma M m}{R_T}\left(-\frac{7}{12}\right) < 0$$ $\Rightarrow$ orbita ellittica



• $\Delta E_m = 0 \rightarrow E_{m_1} = E_{m_2}$

$$-\frac{7}{{}_4\cancel{12}}\gamma\frac{M\cancel{m}}{R_T} = \frac{1}{\cancel{2}}\,\frac{\overset{2}{\cancel{4}}\cancel{m}}{\cancel{3}}v_1^2 - \gamma\frac{M\frac{4}{3}m}{r_1}$$

• $\vec{L}_1 = \vec{L}_2$:

$$\frac{\cancel{4}\cancel{m}}{\cancel{3}}v_2 r_2 \vec{u}_z = \frac{\cancel{4}\cancel{m}}{\cancel{3}}v_1 r_1 \vec{u}_z \rightarrow \frac{1}{2}\sqrt{\frac{\gamma M}{2R_T}}\,2R_T = v_1 r_1$$

$$\rightarrow \sqrt{\frac{\gamma M R_T}{2}} = v_1 r_1 \rightarrow v_1 = \frac{1}{r_1}\sqrt{\frac{\gamma M R_T}{2}}$$

$$\Rightarrow -\frac{7}{4}\cancel{\gamma}\frac{\cancel{M}}{R_T} = \frac{\cancel{2}}{r_1^2}\,\frac{\cancel{\gamma M}R_T}{\cancel{2}} - \frac{4\cancel{\gamma M}}{r_1} \Rightarrow \frac{7}{\cancel{4}}\frac{r_1^2}{\cancel{R_T}} - \overset{16R_T}{\cancel{4}}r_1 + {}^{4}R_T^2 = 0 \Rightarrow r_1 = \frac{8R_T \pm \sqrt{64R_T^2 - 28R_T^2}}{7}$$

$$= \frac{8 \pm 6}{7}R_T$$

$$r = 2R_T = r_A$$
$$= \frac{2}{7}R_T = r_P$$ $< R_T$ (si schianta)

5) $M = 3\,Kg$

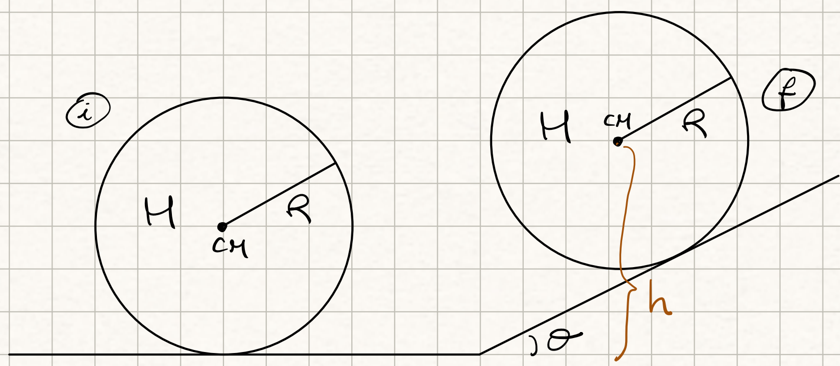
MOTO DI PURO ROT

$\omega_0 = 10\,rad/s$

$\theta = 30°$

$h = 3\,m$

?R



$$v_{CM} = \omega_0 R \quad ; \quad a = \alpha R = \omega^2 R$$

$\Delta E_m = 0$:

$$\frac{1}{2}Mv_{CM}^2 + \frac{1}{2}I_0\omega_0^2 = Mg(h-R)$$

$$\frac{1}{2}M\omega_0^2R^2 + \frac{1}{2}\left(\frac{1}{2}MR^2\right)\omega_0^2 = Mg(h-R)$$

$$\frac{1}{2}\cancel{M}R^2\omega_0^2\left(1+\frac{1}{2}\right) = \cancel{M}g(h-R) \Rightarrow \frac{3}{4}\omega_0^2R^2 + gR - gh = 0 \Rightarrow$$

$$3\omega_0^2R^2 + 4gR - 4gh = 0$$

$$\Rightarrow R = \frac{-2g \pm \sqrt{4g^2 + 12\omega_0^2 gh}}{3\omega_0^2} = 0{,}56\,m$$