Soluzioni

1. 

$t_{tot} = t_{caduta} + t_{suono}$

$t_{caduta} \overset{vds}{=} t^*$

$t_{suono} = h / v_{suono}$ (cost)

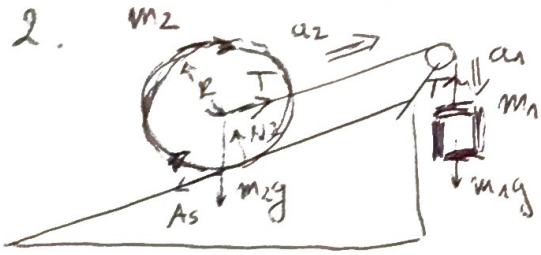
$\Rightarrow t^* = t_{tot} - \frac{h}{v_{suono}} = 1.2\,s - 0.25 = 1\,s$

Legge oraria (lancio verso il fondo):

$y(t) = h - v_0 t - g\frac{t^2}{2} \Rightarrow y(t^*) = 0 = h - v_0 t^* - g\frac{t^{*2}}{2}$

$\Rightarrow v_0 = \frac{1}{t^*}\left(h - g\frac{t^{*2}}{2}\right) = (68-5)\frac{m}{s} = 63\ \frac{m}{s}$

$\boxed{v_0 = 63\ \frac{m}{s}}$

2. 

Traslazione:

① $m_1 a_1 = m_1 g - T$

② $m_2 a_2 = T - m_2 g \sin\theta - A_S$

Rotazione:

$m_2 \frac{R^2}{2} \cdot \alpha = A_S \cdot R$

Puro rotolamento: $\alpha = \frac{a_2}{R}$

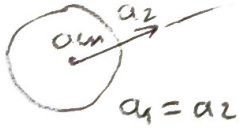
$m_2 \frac{R^2}{2} \cdot \frac{a_2}{R} = A_S \cdot R \Rightarrow A_S = m_2 \frac{a_2}{2}$

① $m_1 a_1 = m_1 g - T$

③ $m_2 a_2 = T - m_2 g \sin\theta - m_2 \frac{a_2}{2}$

$\Downarrow$

$\frac{3}{2} m_2 a_2 = T - m_2 g \sin\theta$



$a_1 = a_2 = a_{cm}$

$\Rightarrow$ ① $m_1 a = m_1 g - T$

② $\frac{3}{2} m_2 a = T - m_2 g \sin\theta$ ⊕

① + ② $\Rightarrow a\left(m_1 + \frac{3}{2} m_2\right) = m_1 g - m_2 g \sin\theta \overset{m_2 = \frac{2}{3} m_1}{\Longrightarrow}$

$\boxed{a = \frac{g}{2}\left(1 - \frac{2}{3}\sin\theta\right)}$

$[a] = [g] = m/s^2$ OK

$\sin\theta < 1 \Rightarrow a > 0$ direzione OK

$\Rightarrow \alpha = \frac{a_2}{R} = \frac{a}{R} \Rightarrow \boxed{\alpha = \frac{g}{2R}\left(1 - \frac{2}{3}\sin\theta\right)}$

$E_K = m_1 \frac{v_1^2}{2} + m_2 \frac{v_2^2}{2} + I\frac{\omega^2}{2}$, $a = cost$, $\alpha = cost$ $\Rightarrow$ $v_1 = a \cdot t$, $v_2 = a \cdot t$, $\omega = \alpha \cdot t = \frac{a}{R} \cdot t$

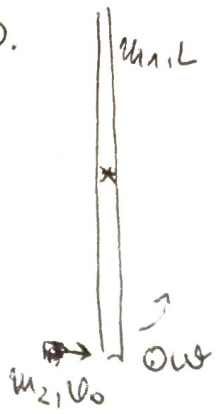
$E_K = \frac{m_1}{2} a^2 t^2 + \frac{2}{3}\frac{m_1}{2} a^2 t^2 + m_2 \frac{R^2}{2} \cdot \frac{1}{2} \cdot \frac{a^2 t^2}{R^2} =$

$= \frac{m_1}{2} a^2 t^2 \left(1 + \frac{2}{3} + \frac{1}{3}\right) = m_1 a^2 t^2 \Rightarrow$

$\boxed{E_K = m_1 t^2 \frac{g^2}{4}\left(1 - \frac{2}{3}\sin\theta\right)^2}$

$[E_K] = J$ OK

3.



a) $L_{prima} = L_{dopo}$

$$m_2 \cdot v_0 \cdot \frac{L}{2} = I_{tot} \cdot \omega$$

$$I_{tot} = m_1 \frac{L^2}{12} + m_2 \frac{L^2}{4} = m_1 \frac{L^2}{3}$$

$$\Rightarrow \omega = \frac{m_2 \cdot v_0 \cdot L}{2 \cdot m_1 \cdot L^2} \cdot 3 = \frac{3 v_0}{2L} \Rightarrow \boxed{\omega = 45 \frac{rad}{s}}$$

$1 - \frac{3}{4}$

b)

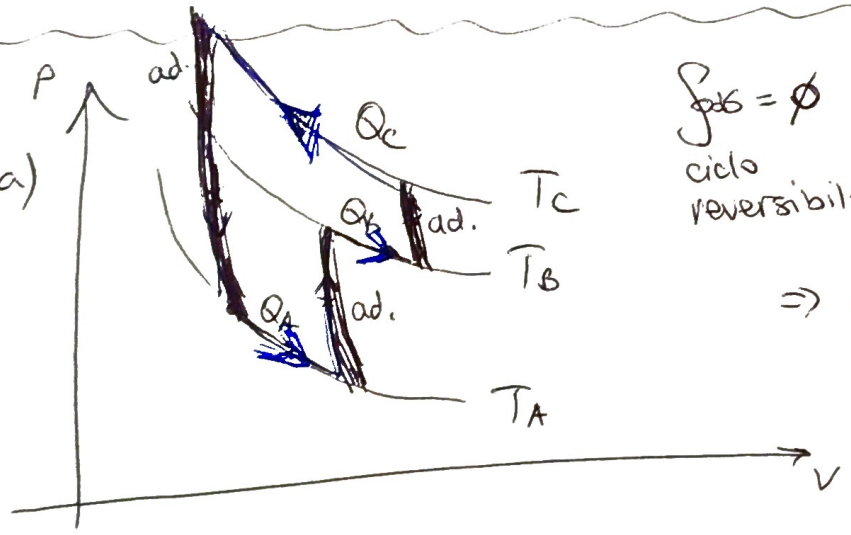
$$|\Delta E| = E_{prima} - E_{dopo} = m_2 \frac{v_0^2}{2} - I_{tot} \frac{\omega^2}{2} = m \frac{v_0^2}{2} - \frac{1}{2} \cdot m_1 \frac{L}{3} \cdot \frac{9 v_0^2}{4L} = m_1 \frac{v_0^2}{2} \cdot \frac{1}{4}$$

$$\frac{|\Delta E|}{E_{prima}} \cdot 100\% = \frac{m_1 \frac{v_0^2}{2} \cdot \frac{1}{4}}{m_1 \frac{v_0^2}{2}} \cdot 100\% = \boxed{25\%}$$

c) $m_2 c \Delta T = \frac{1}{4} m_2 \cdot \frac{v_0^2}{2} \Rightarrow \boxed{\Delta T = \frac{v_0^2}{8 \cdot c} = 0.25\,^\circ C}$

4.

a)



$\oint_{ciclo\ reversibile} = \emptyset \Rightarrow \frac{Q_A}{T_A} + \frac{Q_B}{T_B} + \frac{Q_C}{T_C} = \emptyset$

$$\Rightarrow Q_C = -T_C \left(\frac{Q_A}{T_A} + \frac{Q_B}{T_B} \right) =$$

$$= -500 \left(\frac{600}{300} + \frac{400}{400} \right) J = -1500\,J$$

$\Rightarrow Q_{ass} = Q_A + Q_B = 1000\,J$

$Q_{ced} = Q_C = -1500\,J$

b) $|W| = Q_{ass} + Q_{ced} = -500\,J < 0$ (ok, frigorifero)

c) $COP = \frac{Q_{ass}}{|W|} = \frac{1000}{500} = 2$