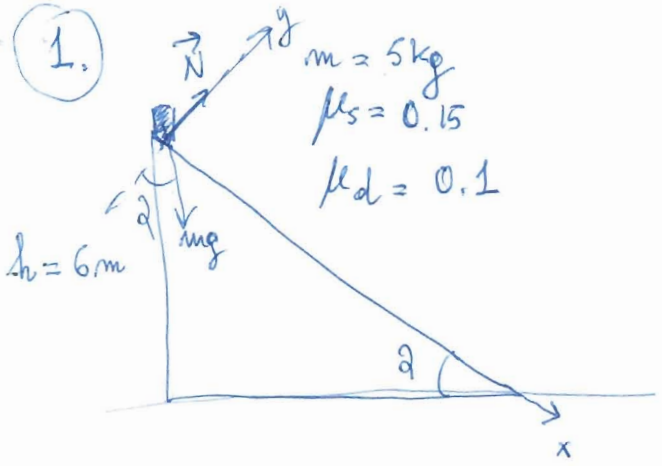
1.



i) $N = mg\cos\vartheta$

ii) $\Rightarrow$ lungo $\hat{x}$: $mg\sin\vartheta \leq \mu_s N = \mu_s mg\cos\vartheta \Rightarrow$

$$tg\vartheta \leq \mu_s \Rightarrow \vartheta_m = \text{arctg}(\mu_s) \simeq 0.15 \text{ rad} \simeq \boxed{8.6^\circ}$$

iii) lungo $\hat{x}$ $ma_x = F_x^{Tot} = mg\sin\vartheta - \mu_d N = mg\sin\vartheta - \mu_d mg\cos\vartheta$

$$\Rightarrow a_x = g\sin\vartheta - \mu_d g\cos\vartheta = 9.81 \times \sin 8.6 - 0.1 \times 9.81 \cos 8.6 \simeq \boxed{1.96 \ \frac{m}{s^2}}$$

iv) $x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2 \rightarrow t = \sqrt{\frac{2x}{a_x}} = \sqrt{\frac{2h}{\sin\vartheta\, a_x}} = \sqrt{\frac{2 \times 6}{\sin 8.6 \cdot 1.96}} \simeq \boxed{4.555}$

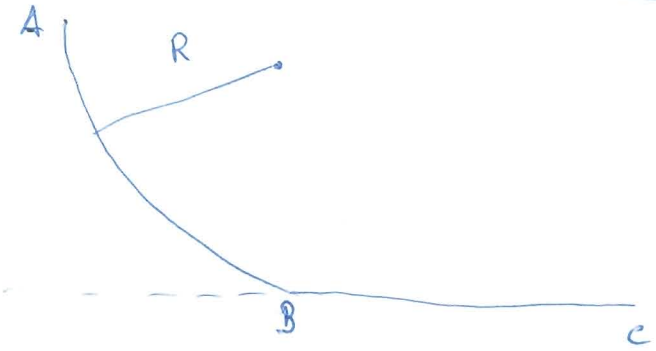
($x_0 = 0$, $v_{0x} = 0$)

$x \cdot \sin\vartheta = h$

$x \simeq 20.3 \text{ m}$

(2)

$\omega = 2 \frac{rad}{s}$



$v = \omega R$

i) $\omega = 6 \Rightarrow v = 15 \frac{m}{s} \rightarrow K_B = \frac{1}{2} m v_B^2 = \frac{1}{2} \times 7 \left(\frac{15}{6}\right)^2 J = 126 J$

ii) $\vec{N}$ sempre $\perp$ allo spostamento

iii) Conservazione energia:

$K_B - K_A = mgz_A - mgz_B = mgh$

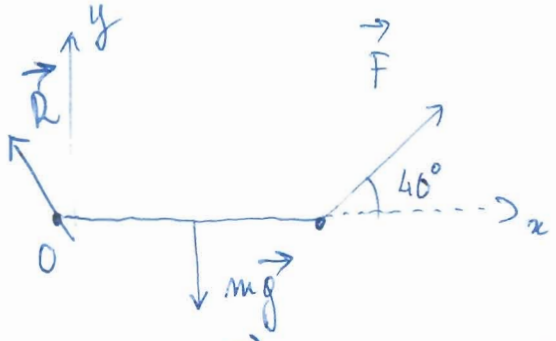
$h = \frac{K_B - K_A}{mg} = \frac{\frac{1}{2} m v_B^2}{mg} = \frac{\frac{1}{2} v_B^2}{g} = \frac{\frac{1}{2}\left(\frac{6}{1}\right)^2}{9.81} m \simeq 1.8 m$

iv) $L_{2A} = \frac{1}{2} m v_B^2 + \frac{1}{2} m v_f^2 = K_B = 126 J$

($v_f = 0$)

$L_{2A} = -\mu_d N \cdot s \Rightarrow \mu_d = \frac{-L_{2A}}{Ns} = \frac{-L_{2A}}{mg \cdot 3} = \frac{126}{7 \cdot 9.81 \cdot 10} \simeq 0.18$

3.



i) equilibrio $\vec{\tau}^{tot}_{est} = 0 \rightarrow mg\frac{L}{2} = F \cdot L \cdot \sin 40°$

$$F = \frac{mg}{2\sin 40°} = \frac{10 \times 9.81}{2 \sin 40°} \simeq 76.3\,N.$$

ii) equilibrio $\vec{F}^{tot}_{est} = 0 \Rightarrow$

lungo y: $R_y + F\sin 40° = mg$

$49.05\,N \simeq R_y = mg - \frac{mg}{2} = \frac{mg}{2} \equiv F_y \Rightarrow$

$58.4\,N \simeq R_x = F\cos 40° = F_x$

$$R = \sqrt{R_x^2 + R_y^2}$$

$$\sqrt{(49.05)^2 + (58.4)^2}\,N$$

$$\simeq 76.3\,N \equiv F$$

due infatti:

iii) $I\alpha = \tau^{tot}_{est} \rightarrow \alpha = \frac{mg\frac{L}{2}}{I} = \frac{10 \times 9.81 \times 0.4}{0.53}\,\frac{rad}{s^2} \simeq 74\,\frac{rad}{s^2}$

$I = \frac{1}{12} ML^2 = \frac{1}{12} \times 10 \times (0.8)^2 \simeq 0.53\,kg\,m^2$

4)

i) $Q_V = 6 \frac{\text{litri}}{\text{minuto}} = \frac{6 \cdot 10^{-3} m^3}{60\ s} = 10^{-4} \frac{m^3}{s}$

$Q_V = v_i A_i = v_i \pi \left(\frac{d_i}{2}\right)^2 \Rightarrow v_i = \frac{Q_V}{\pi \left(\frac{d_i}{2}\right)^2} = \frac{10^{-4}}{\pi \left(\frac{1.5 \cdot 10^{-2}}{2}\right)^2} = \frac{4}{\pi (15)^2} \frac{m}{s} \simeq 5.6 \times 10^{-3} \frac{m}{s}$

$Q_V = v_f A_f$

$\Rightarrow v_f = v_i \frac{A_i}{A_f} = v_i \left(\frac{d_i}{d_f}\right)^2 = v_i \left(\frac{15}{2}\right)^2 \simeq 0.32 \frac{m}{s}$

ii) Eq. di Bernoulli:

$p_i + \frac{1}{2}\rho v_i^2 + \rho g h_i + p_f + \frac{1}{2}\rho v_f^2 + \rho g h_f$

$h_i = 0$, $p_f = p_{atm}$, $h_f = 20\ m$

$p_i = p_{atm} + \frac{1}{2}\rho (v_f^2 - v_i^2) + \rho g h_f$

$= 101.3 \times 10^3\ Pa + 0.5 \times 10^3 \left[(0.32)^2 - (5.6 \times 10^{-3})^2\right] + 10^3 \times 9.81 \times 20$

$\simeq 2.97 \times 10^5\ Pa$

iii)

$Q_V = v \cdot A \Rightarrow A = \frac{Q_V}{v} = \frac{10^{-4} \frac{m^3}{s}}{0.5 \frac{m}{s}} = 2 \times 10^{-4} m^2 = 2\ cm^2$

$A = \pi r^2 \Rightarrow r = \sqrt{\frac{A}{\pi}} = \sqrt{\frac{2}{\pi}} \cdot 10^{-2} m \simeq 0.8 \cdot 10^{-2} m = 0.8\ cm$