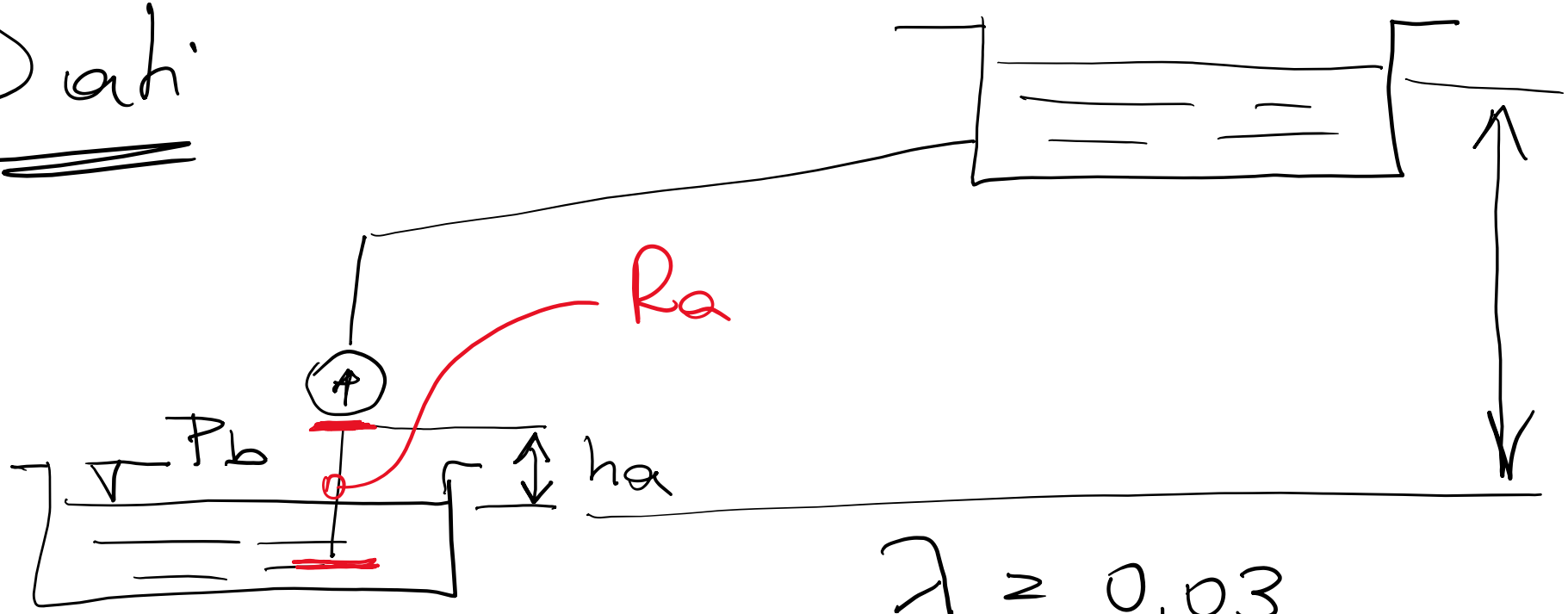
Es. 1

Dati



$h_g = 25\ m$

$l_{eq} = 100\ m$

$\lambda = 0{,}03$

$D = 1{,}5'' = 3{,}81\ cm =$

$= 0{,}0381\ m$

$P_b = 101320\ Pa$, $P_V = 1700\ Pa$ $(T_{H_2O} = 15°C)$

Determinare:

- Punto di funzionamento
- altezza massima di installazione $(h_a)_{max}$

$$H_{imp.} = h_g + \frac{R}{g} = h_g + \lambda \frac{l_{eq}}{\Delta g} \cdot \frac{Q^2}{2\left(\frac{\pi D^2}{4}\right)^2} =$$

$$= 25 + 0{,}03 \cdot \frac{100}{0{,}0381 \cdot 9{,}81} \cdot \frac{Q^2}{2\left(\frac{\pi \cdot 0{,}0381^2}{4}\right)^2} =$$

$$= 25 + 3'087'576\ Q^2$$

m^3/h	4	5	6	7
m^3/s	0,00111	0,00139	0,00167	0,00194
H_{imp} [m]	28,8	30,9	33,6	36,7

$H^* = 33\ m$

$Q^* = 5,7\ m^3/h = 0,00158\ m^3/s$

$NPSH_r = 2\ m$

$$P_{idt} = \rho Q^* g H^* =$$

$$= 1000 \left[\frac{kg}{m^3}\right] \cdot 0{,}00158 \left[\frac{m^3}{s}\right] \cdot$$

$$\cdot 9{,}81 \left[\frac{m}{s^2}\right] \cdot 33 \, [m] =$$

$$= 511 \, W = 0{,}511 \, kW$$

Condizione affinché la pompa non cavita:

$$NPSH_r \leq NPSH_a = \frac{p_b - p_v}{\rho g} - h_a - |R_a| \underline{v}$$

$$\underline{v} \frac{p_b - p_v}{\rho g} - h_a - \lambda \frac{h_a}{D g} \frac{Q^2}{2\left(\frac{\pi D^2}{4}\right)^2} =$$

$$= \frac{p_b - p_v}{\rho g} - h_a \left[1 + \frac{\lambda}{D g} \frac{Q^2}{2\left(\frac{\pi D^2}{4}\right)^2} \right]$$

$$h_a \leq \left[\frac{p_b - p_v}{\rho g} - NPSH_e\right] \Big/ \left[1 \pm \frac{\lambda}{\Delta g} \frac{Q^2}{2\left(\frac{\pi \Delta^2}{4}\right)^2}\right]$$

$$= \left[\frac{101320 - 1700}{1000 \cdot 9{,}81} - 2\right] \Big/ \left[1 \pm \frac{0{,}03}{0{,}0381 \cdot 9{,}81} \cdot \frac{0{,}00158^2}{2\left(\frac{\pi \cdot 0{,}0381^2}{4}\right)^2}\right]$$

$$= \frac{8.155}{1 + \frac{0{,}03}{0{,}0381 \cdot 9{,}81} \cdot \frac{0{,}00158^2}{2\left(\frac{\pi \cdot 0{,}0381^2}{4}\right)^2}} = 7{,}6 \text{ m}$$

Es 5.2

$N_A = 1800$ giri/min

$Q_A = 0,19 \frac{m^3}{s}$

$H_A = 60$ m

$\Big\}$ $P_{idr_A} = 112$ kW

Determinare la potenza, la portata e la prevalenza della pompa quando questa funziona in condizioni di similitudine cinematica a $N_B = 1200$ giri/min

$$\phi_A = \frac{Q_A}{N_A D_A^3} = \frac{Q_B}{N_B D_B^3} = \phi_B, \; D_A = D_B$$

$$Q_B = Q_A \frac{N_B}{N_A} = 0,19 \cdot \frac{1200}{1800} =$$

$$= 0,127 \frac{м^3}{с}$$

$$\psi_A = \frac{g H_A}{n_A^2 D_A^2} = \psi_B = \frac{g H_B}{n_B^2 D_B^2}$$

$$D_A = D_B \Rightarrow H_B = H_A \left(\frac{n_B}{n_A}\right)^2 =$$

$$= 60 \cdot \left(\frac{1200}{1800}\right)^2 =$$

$$= 26{,}7 \text{ м}$$

$$P_B = \rho Q_B g H_B \approx 33 \text{ kW}$$

$$\hat{P}_A = \frac{P_A}{\rho_A N_A^3 D_A^5} = \frac{P_B}{\rho_B N_B^3 D_B^5} = \hat{P}_B$$

$$\rho_A = \rho_B, \quad D_A = D_B$$

$$P_B = P_A \left(\frac{N_B}{N_A}\right)^3 = 112 \cdot \left(\frac{1200}{1800}\right)^3 \approx 33 \text{ kW}$$