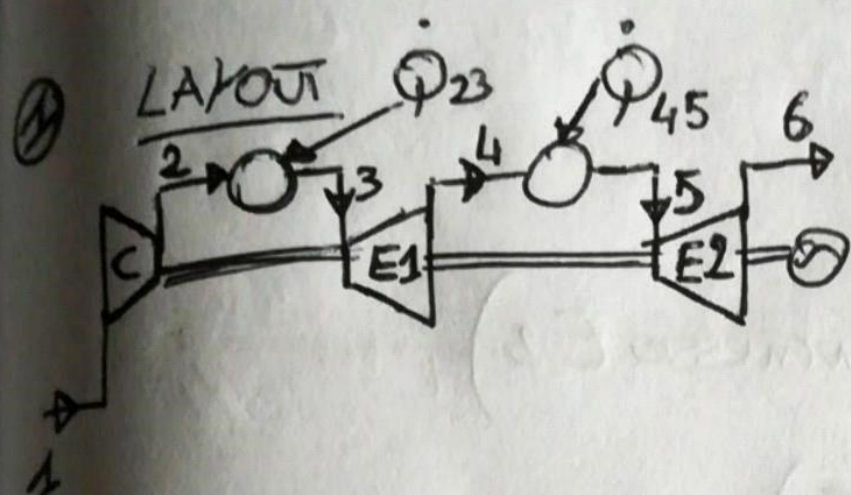ESAME 19/06/2020
" SISTEMI ENERGETICI PER INGEGNERIA FISICA "

① LAYOUT

a) POTENZA COMPRESSORE C

$$T_{2,is} = T_1 \beta^{\sigma} = T_1 \beta^{\frac{\gamma-1}{\gamma}} = 658,4 \, K$$

$$T_2 = T_1 + \frac{(T_{2,is} - T_1)}{\eta_{is,c}} = 698,4 \, K$$

$$\dot{W}_C = \dot{m}_1 \, c_p \, (T_2 - T_1) = 4030,5 \, kW$$

b) POTENZA TERMICA $\dot{Q}_{23}$

$$\dot{Q}_{23} = \dot{m}_1 \, c_p \, (T_3 - T_2) = 6794,8 \, kW$$

c) POTENZA E1 (ESPANSIONE ISOENTROPICA)

$$\dot{W}_{E1} = \dot{m}_3 \, c_p \, (T_3 - T_4) = 5097,07 \, kW$$

$$T_4 = T_3 \, \beta_{E1}^{-\sigma} = 866,99 \, K$$

$$\dot{W}_{E1} = 5097,07 \, kW$$

①

— PROBLEMA E_2

$$\dot{W}_{NET} = \dot{W}_{E1} + \dot{W}_{E2} - \dot{W}_c$$

$$\downarrow$$

$$\dot{W}_{E2} = 3933,4 \ kW$$

d) $\underline{T_5}$ (TEMPERATURA INGRESSO E_2)

$$\dot{W}_{E2} = \dot{m}_1 \, c_p \left(T_5 - T_6 \right)$$

$$\dot{W}_{E2} = \dot{m}_1 \, c_p \left(T_5 - T_5 \, \beta_{E2}^{-\alpha} \right)$$

$$\beta_{E2} = \beta_c / \beta_{E1} = 3,2$$

$$T_5 = \frac{\dot{W}_{E2}}{\dot{m}_1 \, c_p \left(1 - \beta_{E2}^{-\alpha} \right)} = \frac{\textcolor{red}{1381\,K}}{\cancel{3933,4 \ kW}}$$

e) RENDIMENTO SISTEMA

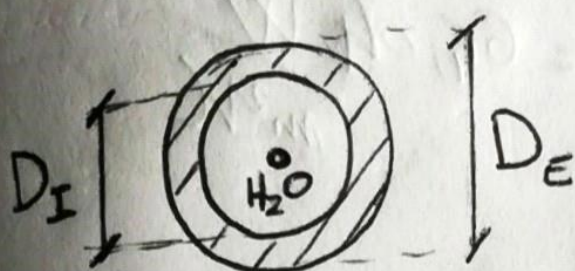$$\dot{Q}_{45} = \dot{m}_1 \, c_p \left(T_5 - T_4 \right) = 5180,7 \ kW$$

$$\eta = \frac{\dot{W}_{NET}}{\dot{Q}_{23} + \dot{Q}_{45}} = 0,42$$
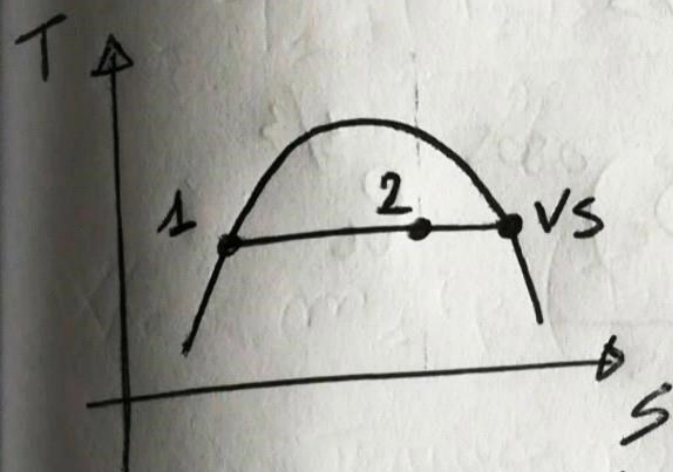
②

f) DIAGRAMMA T-S
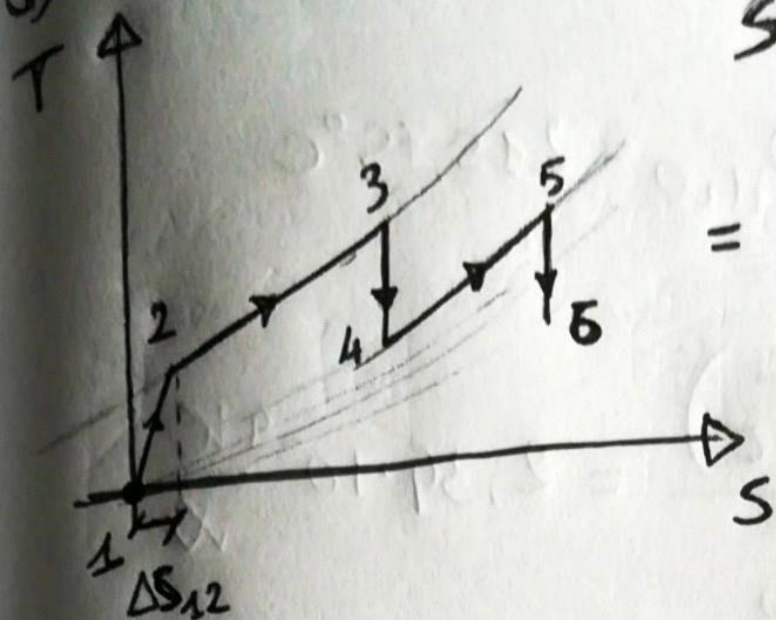
$$S_2 = S_1 + c_p \ln \frac{T_2}{T_1} - \frac{R}{MM} \ln \beta_c =$$

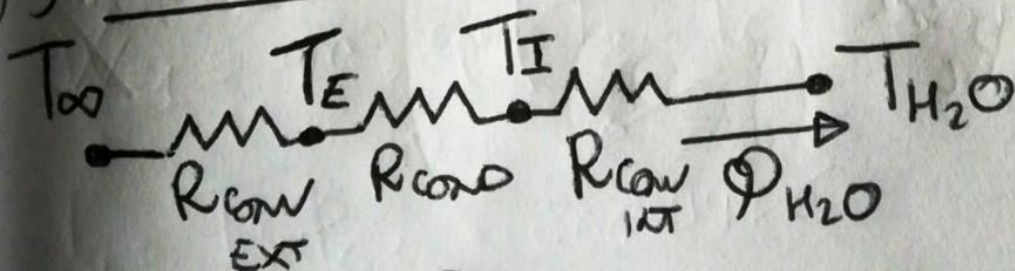$$= 59,52 \frac{J}{kg \cdot K}$$

②

$$D_E = D_I + 2S = 0,106 \, m$$

$$h_1 = h_{LS}$$

$$h_2 = h_1 + (h_{VS} - h_{LS}) \cdot X_2$$

a) POTENZA TERMICA ASSORBITA

$$\dot{Q}_{H_2O} = \dot{m}(h_2 - h_1) = 1925,66 \, kW$$

c/b) TEMPERATURA INTERNA ED ESTERNA TUBO $(T_E ; T_I)$

$$R_{COND} = \frac{\ln \frac{D_E}{D_I}}{2\pi K L} = 3,55 \cdot 10^{-7} \frac{K}{W}$$

1,55·10⁻⁶ (handwritten in red)

$$R_{CONV\,INT} = \frac{1}{h_{INT} A_{INT}} = 7,96 \cdot 10^{-6} \frac{K}{W}$$

3,95·10⁻⁶ (handwritten in red)

③

$$T_I = T_\infty + R_{conv} \cdot \Phi_{H_2O} = {\color{red}205,67}\,°C$$

$$T_E = T_I + R_{cond} \cdot \Phi_{H_2O} = {\color{red}207,87}\,°C$$

$$R_{conv} = \frac{\cancel{1}(T_\infty - T_E)}{\Phi_{H_2O}} = 2,39 \cdot 10^{-4}\,\frac{K}{W}$$

$$h_{EXT} = \frac{1}{R_{conv} \cdot A_{EXT}} = {\color{red}62,57}\;\;\cancel{66,04}\,\frac{W}{m^2 K}$$

d) VELOCITÀ CORRENTE GAS

$$Nu = 0,027\,Re^{0,805}\,Pr^{1/3}$$

$$\frac{h_{EXT}\,D_E}{K_f} = 0,027 \left(\frac{\rho_f\,v_f\,D_E}{\mu_f^{0,805}} \right)^{0,805} \cdot Pr^{1/3}$$

$$Pr = \left(\frac{c_p\,\mu_f}{K_f} \right) = 0,72$$

$$v_f = \left(\frac{Nu}{0,027\,Pr^{1/3}} \cdot \frac{\mu_f^{0,805}}{(\rho_f\,D_E)^{0,805}} \right)^{1/0,805} = {\color{red}26,6}\,\frac{m}{s}$$

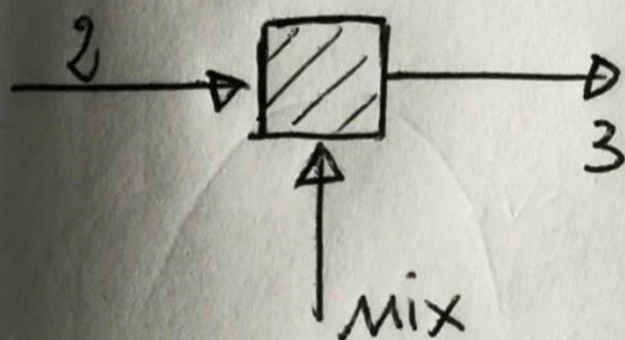$$\text{l)} \quad R_{TOT} \cdot (T'_{\infty 2} - T_{H_2O}) = \dot{Q}'_{H_2O} =$$

$$\Delta \dot{Q}'_{H_2O} = \frac{\dot{Q}'_{H_2O}}{\dot{m}} =$$

$$\Delta \dot{m}' = \frac{\Delta h'_{H_2O}}{\Delta h_{EVA}} =$$

② PORTATA DI H_2O DA MISCELARE PER AVERE
TITOLO $X = 0,6$

MIXER

$$\begin{cases} \dot{m}_2 h_2 + \dot{m}_{mix} h_{mix} = \dot{m}_3 h_3 \quad \text{BIL. ENERGIA} \\[2mm] \dot{m}_2 + \dot{m}_{mix} = \dot{m}_3 \quad \text{BIL. MASSA} \end{cases}$$

$$\dot{m}_{mix} = \frac{\dot{m}_2 (h_3 - h_2)}{h_{mix} - h_3} = 0,1305 \; \frac{kg}{s}$$