TEQ 2020/2021 2º TESTE 21/1/2021

1.

1.1 $\dot{m} = 10\ kg/min = 0.17\ kg/s$

$P_i = 1\ bar \quad T_i = 30°C$

$P_f = 700\ bar$

3 andares

$\gamma = \frac{7/2}{5/2} = 1.4$

$\frac{P_{ie}}{P_i} = \left(\frac{P_f}{P_i}\right)^{1/3} = 8.879$

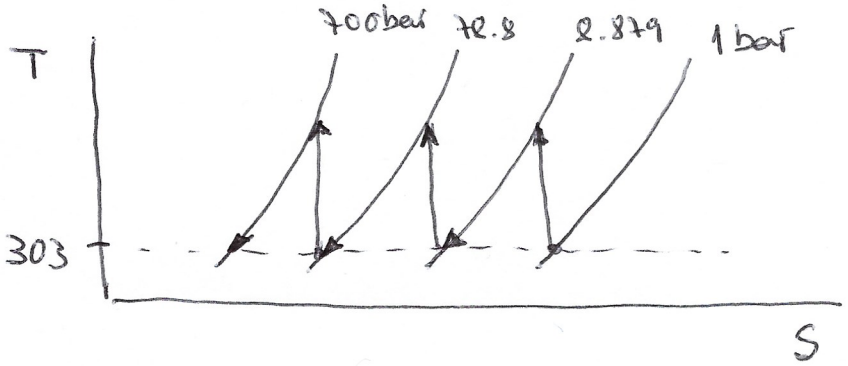
$$\dot{W}_s = 3\,\dot{m}\,R\,T_i\,\frac{\gamma}{\gamma-1}\left[\left(\frac{P_{ie}}{P_i}\right)^{\frac{\gamma-1}{\gamma}} - 1\right]$$

$$\dot{W}_s = 3 \times 0.17 \times \frac{8.314}{32\times10^{-3}} \times 303 \times \frac{1.4}{0.4}\left(8.879^{0.2857} - 1\right)$$

$$\dot{W}_s = 1.22 \times 10^5\ W$$

1.2 $$\dot{Q} = \frac{-\dot{W}_s}{n.º\ andares} = \frac{-1.22\times10^5}{3} = 40.67\times10^3\ J/s$$

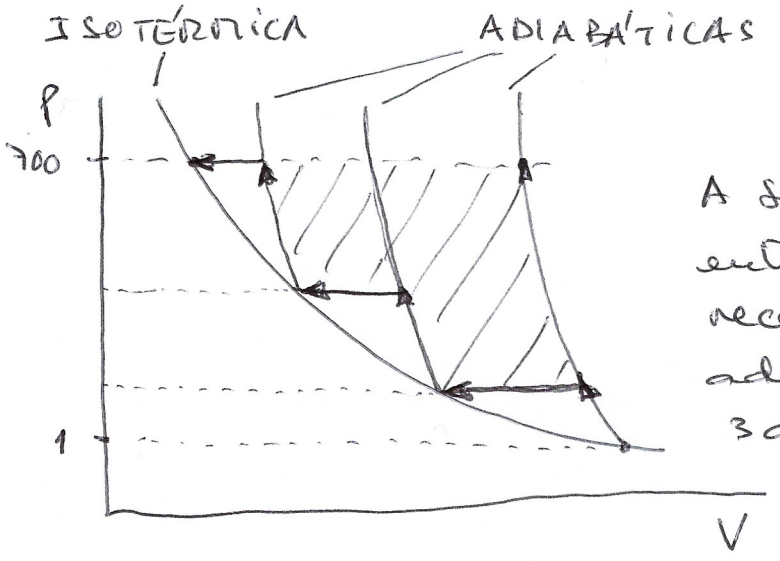
1.3



1.4

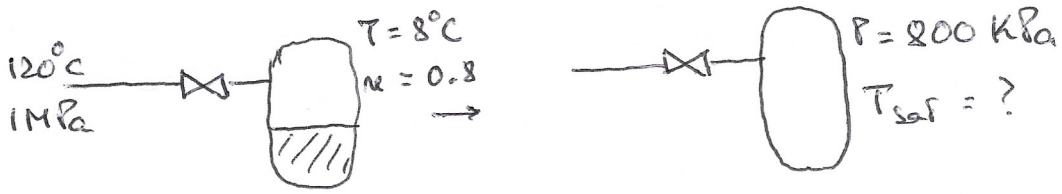
$$\dot{W}_s = 0.17 \times \frac{8.314}{32\times10^{-3}} \times 303 \times \frac{1.4}{0.4}\left[\left(\frac{700}{1}\right)^{0.4/1.4} - 1\right]$$

$$\dot{W}_s = 2.58\times10^5\ W$$



A sombreado a diferença entre o trabalho necessário na compressão adiabática 1 ander e 3 anderes c/arrefecimento.

2.



2.1 $T_{sat}\,(800\,KPa) = 31.33^{\circ}C$

2.2 $m_i = \dfrac{V}{v^l + 0.8\,\Delta V}$ $\qquad m_f = \dfrac{V}{V^g}$

$m_{entra} = m_f - m_i$

$m_i = \dfrac{0.2}{0.2 \times 0.0007884 + 0.8 \times 0.0525} = 4.7438\ Kg$

$m_f = \dfrac{0.2}{0.02547} = 7.8524\ Kg$

$m_{entra} = 7.8524 - 4.7438 = 3.1086\ Kg$

2.3 $$m_2 u_2 - m_1 u_1 = m_{entra} h_{entra} + Q$$

8°C $u_1 = 0.2 \times 60.43 + 0.8 \times 231.46 = 197.25$ kJ/kg

0.8 MPa $u_2 = 243.78$ kJ/kg

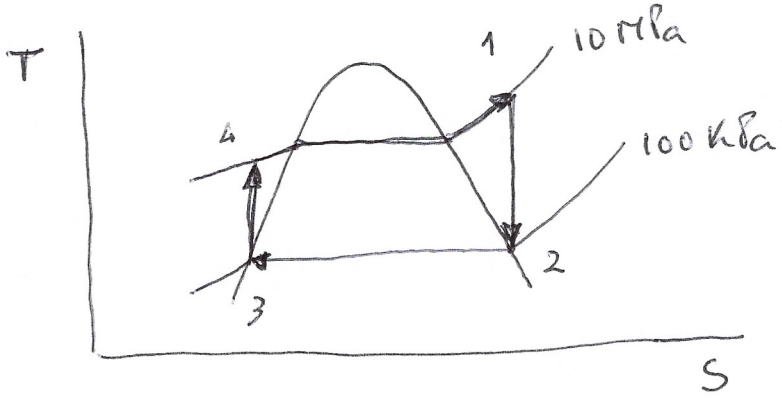
1 MPa $h_2 = 356.52$ kJ/kg
120°C

$$7.8524 \times 243.78 - 4.7438 \times 197.25 = 3.1086 \times 356.52 + Q$$

$$Q = -129.7 \text{ kJ}$$

3.

3.1



3.2 $$\dot{W}_{útil} = \dot{W}_{s\ turbina} + \dot{W}_{s\ bomba}$$

$$\dot{W}_{útil} = -100 \times 10^3 = \dot{m}\left[(h_2 - h_1) + (h_4 - h_3)\right]$$

$h_1 = 3375.1$ kJ/kg

$s_1 = 6.5995$ kJ/kg.K

$$S_1 = S_2 = 6.5995 = 1.3028 + 6.0561\ x_{e^V}$$

$$x_{eV} = 0.87$$

$$h_3 = 417.5 \text{ KJ/Kg}$$

$$V_3 = 0.001043 \text{ m}^3/\text{Kg}$$

$$h_4 = h_3 + V_3 \Delta P$$

$$= 417.5 + 0.001043 (10^7 - 10^5) \times 10^{-3} = 427.8$$

$$\dot{m} (2381.48 - 3375.1) + \dot{m} (427.8 - 417.8) = -100 \times 10^3$$

$$\dot{m} = 101.7 \text{ Kg/s}$$

3.3

$$\eta_T = \frac{-\dot{W}_{real}}{\dot{m} (h_1 - h_4)} = 0.33 \quad 33\%.$$

3.4 3 Factores:

- aumento da pressão do vaporizador.
- diminuição da pressão do condensador.
- sobreaquecimento do vapor entre o vaporizador e a Turbina.

4.

$$\frac{dS}{dt} = \dot{S}_{entra} - \dot{S}_{sai} + \frac{\dot{Q}}{T} + \dot{S}_G$$

$\frac{dS}{dt} = 0$ estacionário

adiabático: $\dot{Q} = 0$

$\dot{S}_{entra} - \dot{S}_{sai} = 0 \Rightarrow \Delta S = 0$ isentrópico

$\dot{S}_G = 0$ Reversível