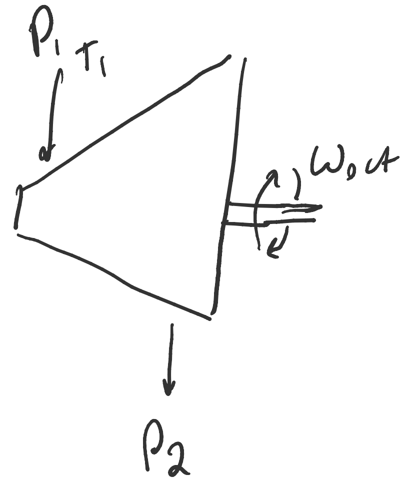
# PBC4

November 13, 2022 2:17 PM

STEAM




a) $T_1 = 400°C$, $P_1 = 5MPa$

$h_1 = 3231.7$

$s_1 = 6.9235$

$P_2 = 100kPa$

$$S_1 = S_2 = S_g x + S_f (1-x)$$

$$x_{2s} = \frac{S_2 - S_f}{S_g - S_f}$$

$S_{f@100kPa} = 1.3028$

$S_{g@100kPa} = 7.3589$

$$x_{2s} = \frac{6.9235 - 1.3028}{7.3589 - 1.3028}$$

$$x_{2s} = 0.9281$$

$$h_{2s} = h_g x + h_f (1-x)$$

$$h_{2s} = 2675.0(0.9281) + 417.51(1 - 0.9281)$$

$$h_{2s} = 2512.65 \text{ kJ/kg}$$

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$\eta_T = \underline{w}_{out} / (\underline{w}_{out})_s$

$\underline{w}_{out} = \eta_T (h_1 - h_{2s})$

$\underline{w}_{out} = 0.8(3231.7 - 2512.65)$

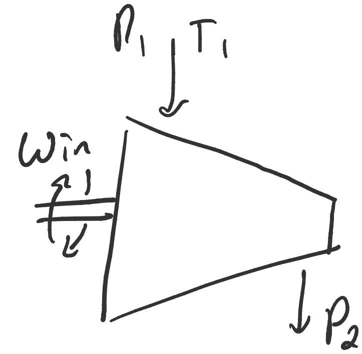
$\underline{w}_{out} = 575.24$

$(\underline{w}_{in})_c = (\underline{w}_{out})_T$

Air

$T_1 = 300 K$ $\quad P_1 = 100 \text{ kPa}$

$T_2 = ?$ $\quad P_2 = 800 \text{ kPa}$




$h_1 = 300.19 \text{ kJ/kg}$ $\quad P_{r1} = 1.3860$

$$(P_{r2})_s = \left(\frac{P_2}{P_1}\right) P_{r1}$$

$$(P_{r2})_s = \left(\frac{800}{100}\right)(1.386) = 11.088$$

from table A21

$$\frac{h_{2s} - 533.98}{11.088 - 10.37} = \frac{544.35 - 533.98}{11.10 - 10.37}$$

$$\frac{}{11.088-10.37} = \frac{}{11.10-10.37}$$

$$h_{2s} = 544.18 \text{ kJ/kg}$$

$$\eta_c = \frac{(\underline{W}_{in})_s}{\underline{W}_{in}} = \frac{h_{2s} - h_1}{(\underline{W}_{out})_{Turbine}}$$

$$\eta_c = \frac{544.18 - 300.19}{575.24}$$

$$\boxed{\eta_c = 0.424}$$

b) $575.24 = h_2 - h_1$

$$h_2 = 575.24 + 300.19$$

$$h_2 = 875.43 \text{ kJ/kg}$$

from table A21

$$\frac{860-840}{888.27-866.08} = \frac{T_2 - 840}{875.43-866.08}$$

$$\boxed{T_2 = 848.43}$$

c) $\Delta s = C_p \ln(T_2/T_1) + R \ln(P_2/P_1)$

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$$\Delta S = (1.005) \ln\left(\frac{848.43}{300}\right) + (0.287) \ln\left(\frac{800}{100}\right)$$

$$\boxed{S_{gen} = 1.641 \text{ kJ/kg}\cdot\text{K}}$$