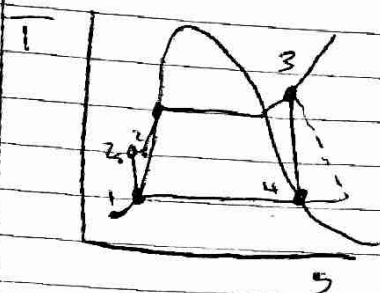
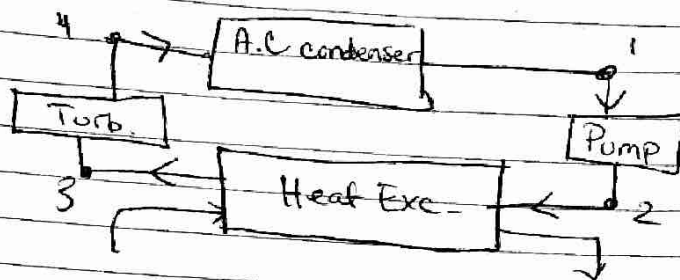


HW 10: 18,25

25



$P_1 = 410 \text{ kPa}$ $P_2 = 3250$ $T_3 = 147^\circ\text{C}$ $P_4 = 410 \text{ kPa}$
 $P_3 = 3250 \text{ kPa}$

① $T_3 = 147^\circ\text{C}$
 $h_3 = 761.54 \text{ kJ/kg}$
 $s_3 = 2.547 \text{ kJ/kg}\cdot\text{K}$

$h_{4f} = 689.74 \text{ kJ/kg}$
 $h_{4s} = 670.4 \text{ kJ/kg}$

$\eta_T = \frac{h_3 - h_4}{h_3 - h_{4s}} = 0.7877$
 $= 78.77\%$

② $P_1 = 410 \text{ kPa}$
 $h_1 = 273.01 \text{ kJ/kg}$
 $v_1 = 0.001842 \text{ m}^3/\text{kg}$
 $w_p = v_1(P_2 - P_1)/\eta_p$
 $= 5.81 \text{ kJ/kg}$
 $h_2 = h_1 + w_p$
 278.82 kJ/kg

③ $w_{T_{out}} = m(h_3 - h_{4f})$
 $305.6(761.54 - 689.74)$
 $= 21942.08 \text{ kW}$

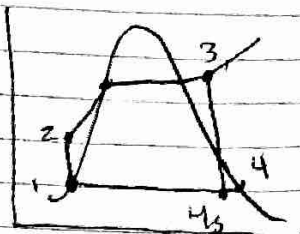
④ $w_{p_{in}} = 305.6$
 $\times 5.23$
 1798.5 kW

⑤ $w_{net} = w_{T_{out}} - w_{p_{in}}$
 $= 20166 \text{ kW}$

⑥ $Q_{in} = m c_p (T_1 - T_0)$
 $= 555.9(160 - 90)$
 162656 kW

⑦ $\eta_{th} = w_{net}/q_{in} = \frac{20166}{162656} = 0.123$
 12.3%

18



$$P_1 = 2 \text{ psi} \quad P_2 = 1500 \text{ psi} \quad P_3 = P_2 \quad P_4 = 2 \text{ psi}$$

$$T_3 = 800^\circ\text{F}$$

$$\textcircled{1} \quad w_{p1} = v_1 (P_2 - P_1)$$

$$= 0.016230 \text{ ft}^3/\text{lbm} (1500 - 2) \left(\frac{1}{5.404} \right)$$

$$= 4.50 \text{ Btu}$$

$$\textcircled{2} \quad h_2 = h_1 + w_{p1}$$

$$94.02 + 4.5$$

$$= 98.52$$

$$\textcircled{6} \quad \eta_T = \frac{h_3 - h_4}{h_3 - h_{4s}}$$

$$0.90 = \frac{1363.1 - h_4}{1363.1 - 873.86}$$

$$\textcircled{3} \quad T_3 = 800^\circ\text{F}$$

$$h_3 = 1361.1 \text{ Btu/lbm}$$

$$h_4 = 922.78 \text{ Btu/lbm}$$

$$\textcircled{4} \quad x_{4s} = \frac{s_{4s} - s_f}{s_{fg}}$$

$$= \frac{1.5064 - 0.175}{1.7444}$$

$$= 0.7633$$

$$\textcircled{7} \quad q_{in} = h_4 - h_1$$

$$922.78 - 94.02$$

$$= 828.76 \text{ Btu/lbm}$$

$$\textcircled{8} \quad w_{net} = q_{in} - q_{out}$$

$$1264.6 - 828.76$$

$$= 435.8 \text{ Btu/lbm}$$

$$\textcircled{5} \quad h_{4s} = h_f + x_{4s} \cdot h_{fg}$$

$$94.02 + 0.7633(1,021.7)$$

$$873.86 \text{ Btu/lbm}$$

$$\textcircled{9} \quad \dot{m} = \frac{\dot{w}_{net}}{w_{net}} = \frac{2500}{435.8} \left(\frac{0.94782 \text{ Btu}}{1 \text{ kJ}} \right)$$

$$= 5.437 \text{ lbm/s}$$

(10)

$$W_T = \dot{m} (h_3 - h_4)$$

$$5.437 (1363.1 - 922.78) \left(\frac{1}{1.94782} \right)$$

$$= 2525.8 \text{ kW}$$

$$\dot{Q}_{in} = \dot{m} q_{in}$$

$$= 5.434 (1264.6)$$

$$= 6,875.6 \text{ Btu/s}$$

$$\eta_{th} = \frac{2500 \text{ kJ/s}}{6,875.6 \text{ Btu/s}} \left(\frac{94782}{1 \text{ kJ}} \right) = 0.3446 \quad 34.46\%$$