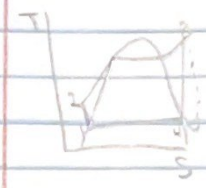
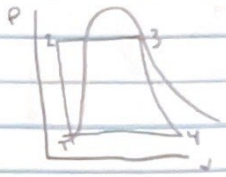
HW 2.1 - KAYLA DAVIES - MET350

10-18E



$\eta_T = 90\%$

$\dot{W}_{net} = 2500$ kW



① $P_1 = 4$ psia, $h_1 = 120.9$ btu/lbm, $v_1 = 0.016$ ft³/lbm

② $h_2 = 125.43$

③ $P_3 = 1500$ psia, $T_3 = 700$ F, $h_3 = 1363.1$, $s_3 = 1.5064$

④ $P_{4s} = 4$ psia, $s_{4s} = 1.5064$

$W_{p,in} = v_1(P_2 - P_1) = (0.016)(1500-4)\left(\frac{1}{5.404}\right) = 4.53$ btu/lbm

$h_2 = h_1 + w_{p,in} = 120.9 + 4.53 = 125.43$ btu/lbm

$x_{4s} = \frac{1.5064 - 0.21955}{1.46225} = 0.783$

$h_{4s} = 120.9 + 0.783(1006) = 909.01$ btu/lbm $\rightarrow h_4 = 1363.1 - 0.9(1363.1 - 909.01) = 954.42$

$q_{in} = h_3 - h_2 = 1363.1 - 125.43 = 1237.67$

$w_{net} = 404.15$ btu/lbm

$q_{out} = h_4 - h_1 = 954.42 - 120.9 = 833.52$

a) $\dot{m} = \frac{2500}{404.15} \left| \frac{0.947821}{1} \right| = \boxed{5.863 \text{ lbm/s}}$

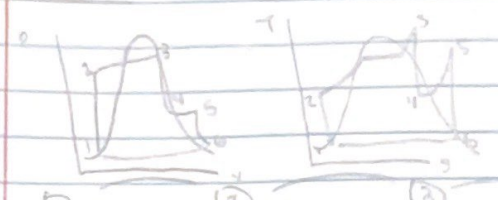
b) $\dot{W}_{T,out} = \dot{m}(h_3 - h_4) = 5.863\,(1363.1 - 954.42) = \boxed{2528.02 \text{ kW}}$

c) $\dot{Q}_{in} = \dot{m} q_{in} = 5.863 \times 1237.367 = \boxed{7256.52 \text{ btu/s}}$

d) $\eta_{TH} = \frac{W_{in}}{Q_{in}} = \frac{2500}{7256.52} \left| \frac{0.947821}{1} \right| = 0.33 = \boxed{33\%}$

HW 7.1 v3

10-25



$\eta_p = 91\%$

$\dot{m} = 595.9$ kg/s

① ② ③ ④

$T_1 = 433.15$ | $T_2 = 363.15$ | $T_3 = 420.15$ | $T_4 = 352.65$

$h_1 = 273.01$ | $h_3 = 761.54$ | $m_4 = 689.74$

$v_1 = 0.001$ m³/kg

$h_2 = \frac{h_{2s} - h_1}{\eta_p} + h_1 = \frac{5.23}{0.9} + 273.01 = 278.82$ kJ/kg

$mC_p(T_3 - T_2) = \dot{m}(h_3 - h_2) \quad \therefore (595.9)(4.258)(420-90) = \dot{m}(761.54 - 278.62)$

$\dot{m} = 343.24$ kg/s

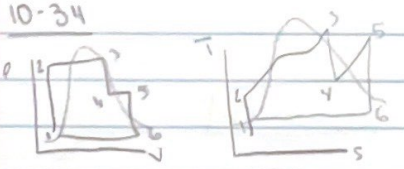
a) $\eta_T = \frac{h_3 - h_4}{h_3 - h_{4s}} = \frac{761.54 - 689.74}{761.54 - 670.40} = 0.79 = \boxed{79\%}$

b) $W_{net} = \dot{m}(h_3 - h_4) - (h_2 - h_1) \therefore 343.24(761.54 - 689.74) - (278.82 - 273.01)$

$= \boxed{22650.4 \text{ kW}}$

c) $\eta_T = \frac{W_{net}}{\dot{m}(h_3 - h_2)} = \frac{22650.4}{343.24(761.54 - 278.82)} = 0.137 = \boxed{13.7\%}$

10-34



① ② ③ isentrop ④ ⑤ ⑥

$P_1 = 20$ kPa | $h_2 = 256.26$ | $P_3 = 5000$ kPa | $P_4 = 1700$ kPa | $P_5 = 1700$ | $P_6 = 10$ kPa

$h_1 = 251.2$ | $s_3 = 6.549 = s_4$ | $x_4 = 0.86$ | $s_5 = 7.624$ | $x_6 = 0.96$

$h_4 = 2704.31$ kJ/kg | $s_6 = 7.62$

$H_6 = 2514.6$

$T_3 = 350 - \frac{300}{6.4516} - 6.2118 \times (6.594 - 6.21) = 328.765\,C = \boxed{602\ K}$

$H_3 = 3069.3 - \frac{2925.7}{350} \cdot 300 \times (328.765 - 300) = 3008.3$ kJ/kg

$T_5 = 500 - \frac{400}{7.4079} - 7.3793 \times (7.624 - 7.379) = 481.96\,C = \boxed{755\ K}$

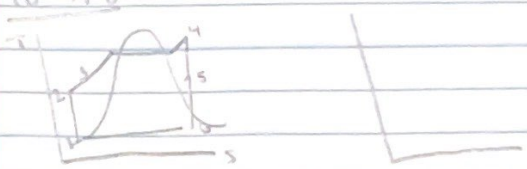
$W_{T_1} = 3008.31 - 2704.31 = 303.99$ kJ/kg

$W_{T_2} = 3438.1 - 2514.6 = 923.5$ kJ/kg

$Q_{in} = (3008.31 - 256.26) + (3438.13 - 9704.31) = 3485.86$ kJ/kg

$\eta_{TH} = 303.99 + 923.5 - \frac{5.0646}{3485.86} = 0.38 \quad \boxed{38\%}$

10-48



①	②	③	④	⑤	⑥	⑦	⑧
$h_1 = 251.42$	↑	$P = 3$ mpa	$P_4 = 5000$ kPa	$P_5 = 1000$ kPa	$P = 20$ kPa	$h_7 = 762.5$	$= h_8$
$h_2 = 0.001(353-20) + 251$		$T_3 = 209.9$	$T_4 = 623$ K	$s_5 = s_4$	$s_6 = 6.74$	$T_7 = 209.9$	
$h_2 = 254.45$		$h_3 = 763.53$	~~$h_4 = 3116.1$~~	$h_5 = 2852.8$	$h_6 = 251.4 + 0.836(2357)$		
			$s_4 = 6.745$		~~$h_6 = 2221.58$~~		

$w_{pump} = h_2 - h_1 = 254.45 - 251.42 = \boxed{3.03 \text{ kJ/kg}}$

$y = \frac{763.53 - 254.45}{2852.86 - 762} = 0.2435$

$w_{turb.} = (h_4 - h_5) + (1-y)(h_5 - h_6) = (3116.1 - 2852.8) + (1-0.2435)(2852.8 - 2221.58)$

$w_{turb} = \boxed{741.56 \text{ kJ/kg}}$

$Q_{supply} = 3116.1 - 763.57 = \boxed{2352.57 \text{ kJ/kg}}$

10-53