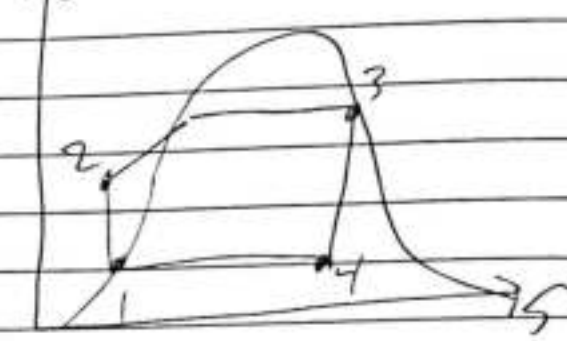
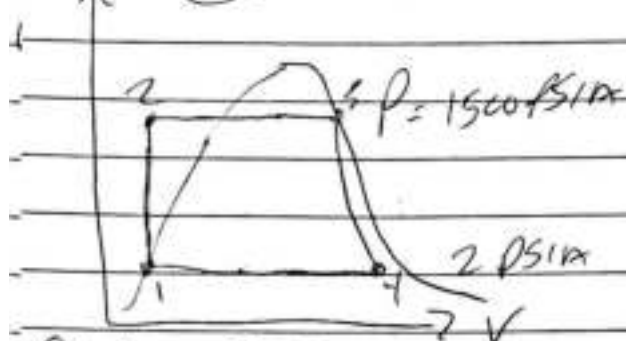


ROY SHEPARD HW 2.1 18, 25, 34, 48, 53

(18)



① $P_1 = 2 \text{ psia}$

$T_1 = 126.02^\circ\text{F}$

$U_1 = 0.01623 \text{ ft}^3/\text{lbm}$

$h_1 = 94.02 \text{ Btu/lbm}$

$S_1 = 1.75 \text{ Btu/lbm}\cdot\text{R}$

$h_2 = U_1(P_2 - P_1) + h_1$

$w_{\text{net}} = (h_3 - h_2) - (h_4 - h_1) = 913.8 \text{ Btu/lbm}$
 921.43 kJ/kg

$\dot{m} = \frac{P}{w_{\text{net}}} = \frac{2300 \text{ kW}}{921.43} = 2.496 \text{ kg/s}$

② $P_2 = 1500 \text{ psia}$

$S_2 = 1.775 \text{ Btu/lbm}\cdot\text{R}$

$h_2 = 118.33 \text{ Btu/lbm}$

$P_1 = \dot{m} (h_3 - h_4) = 5.47 (1553.1 - 925) = 2396.4 \text{ Btu/s}$
 $5.47 (1553.1 - 925) = 2396.4 \text{ Btu/s}$

③ $P_3 = 1500 \text{ psia}$

$T_3 = 820^\circ\text{F}$

$U_2 = 14388 \text{ ft}^3/\text{lbm}$

$h_3 = 1363.1 \text{ Btu/lbm}$

$S_3 = 1.5064 \text{ Btu/lbm}\cdot\text{R}$

$Q_B = \dot{m} \cdot w_B$

$5.47 \cdot 1244 = 6808.8$

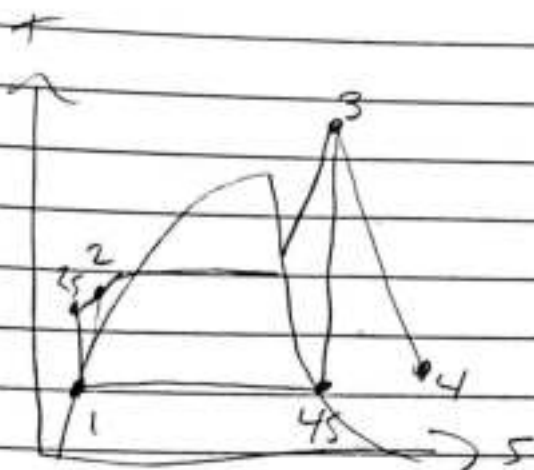
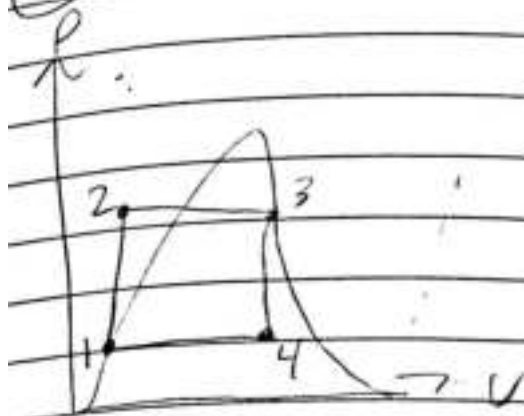
$\eta = \frac{P}{Q_B} = \frac{2500}{7183.8} = 0.348$

④ $P_4 = 2 \text{ psia}$

$S_4 = 1.5061 \text{ Btu/lbm}\cdot\text{R}$

$h_4 = 925 \text{ Btu/lbm}$

85



① $T_1 = 160^\circ\text{C}$

$h_1 = 273 \text{ kJ/kg}$

$v_1 = 0.00184 \text{ m}^3/\text{kg}$

$h = \frac{5.2313}{19} + 273$

② $T_2 = 90^\circ\text{C}$

$h_2 = 278.8 \text{ kJ/kg}$

$\eta_T = \frac{h_3 - h_4}{h_3 - h_4} = 0.79$

③ $T_3 = 147^\circ\text{C}$

$P_3 = 3.25 \text{ MPa}$

$h_3 = 761 \text{ kJ/kg}$

$P_{\text{net}} = m_3(h_3 - h_4)(h_2 - h_1) =$

22.7 MW

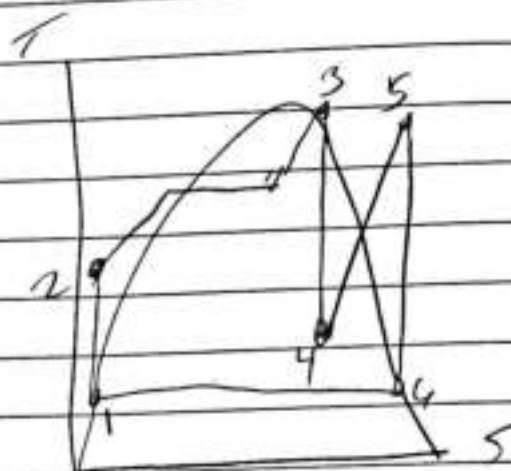
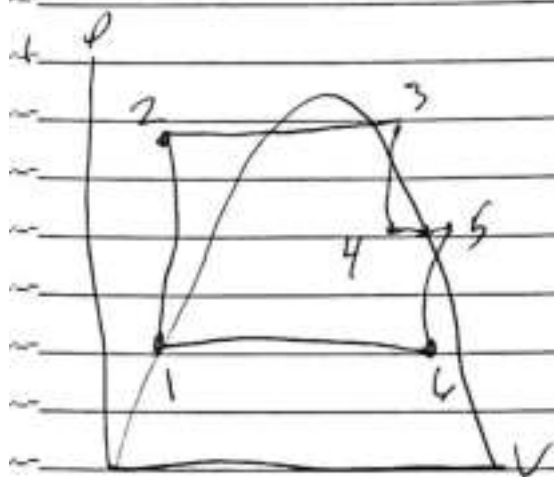
④ $T_4 = 75.5^\circ\text{C}$

$P_4 = 4/0 \text{ MPa}$

$h_4 = 689.7 \text{ kJ/kg}$

$\eta_{\text{th}} = \frac{P_{\text{net}}}{m_3(h_3 - h_2)} = 0.137$

(34)



$$① P_1 = 20 \text{ kPa}$$

$$T_1 = 60.1^\circ\text{C}$$

$$U_1 = 0.00102 \text{ m}^3/\text{kg}$$

$$h_1 = 251.42 \text{ kJ/kg}$$

$$s_1 = 1.832 \text{ kJ/kg}\cdot\text{K}$$

$$② P_2 = 5000 \text{ kPa}$$

$$s_2 = 1.832 \text{ kJ/kg}\cdot\text{K}$$

$$h_2 = 256.45 \text{ kJ/kg}$$

$$h_2 = U_1(P_2 - P_1) + h_1$$

$$s_4 = s_{f4} + x_4 s_{fg4}$$

$$h_4 = h_{f4} + x_4 h_{fg4}$$

$$s_6 = s_{f6} + x_6 s_{fg6}$$

$$h_6 = h_{f6} + x_6 h_{fg6}$$

$$③ P_3 = 5000 \text{ kPa}$$

$$s_3 = 6.33 \text{ kJ/kg}\cdot\text{K}$$

$$T_3 = 324.72^\circ\text{C}$$

$$h_3 = 2916.69 \text{ kJ/kg}$$

$$\eta_{th} = \frac{w_{net}}{q_{in}} = \frac{(h_3 - h_4) + (h_5 - h_6) - (h_2 - h_1)}{(h_3 - h_2) + (h_5 - h_4)}$$

$$④ P_4 = 1200 \text{ kPa}$$

$$T_4 = 187.95^\circ\text{C}$$

$$s_4 = 6.35 \text{ kJ/kg}\cdot\text{K}$$

$$h_4 = 2704.3 \text{ kJ/kg}$$

$$\frac{1250 \text{ kJ/kg}}{3313.2 \text{ kJ/kg}}$$

$$0.355$$

$$⑤ P_5 = 1200 \text{ kPa}$$

$$s_5 = 7.62 \text{ kJ/kg}\cdot\text{K}$$

$$T_5 = 500^\circ\text{C}$$

$$h_5 = 3477 \text{ kJ/kg}$$

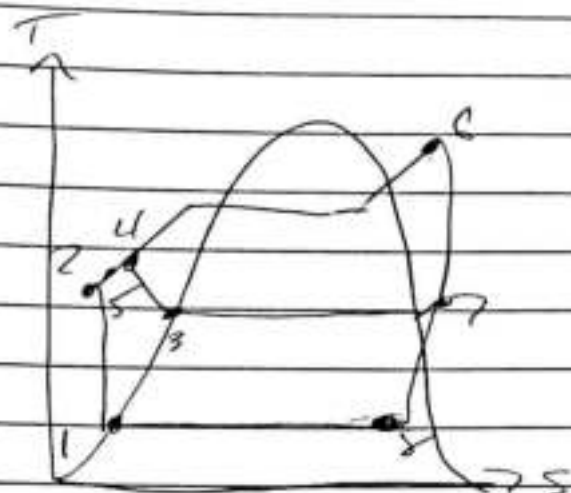
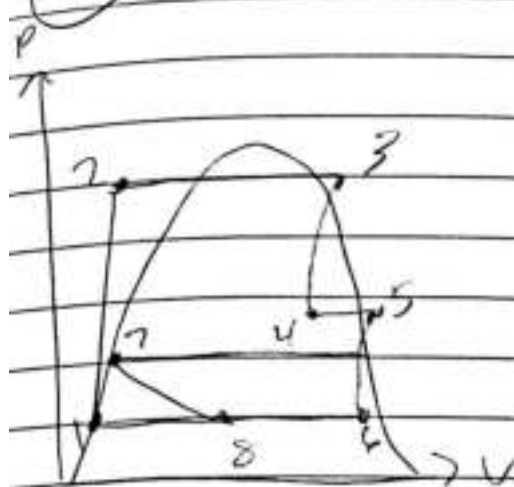
$$⑥ P_6 = 20 \text{ kPa}$$

$$T_6 = 60.06^\circ\text{C}$$

$$s_6 = 7.62 \text{ kJ/kg}\cdot\text{K}$$

$$h_6 = 251.42 \text{ kJ/kg}$$

48



① $P_1 = 200 \text{ kPa}$

$T_1 = 60.6^\circ\text{C}$

$h_1 = 251.42 \text{ kJ/kg}$

$s_1 = 1.832 \text{ kJ/kg}\cdot\text{K}$

$u_1 = 1010.17 \text{ kJ/kg}$

$h_2 = u_1(P_2 - P_1) + h_1$

② $P_2 = 300 \text{ kPa}$

$s_2 = 1.832 \text{ kJ/kg}\cdot\text{K}$

$h_2 = 254.45 \text{ kJ/kg}$

③ $P_3 = 1000 \text{ kPa}$

$T_3 = 171.6^\circ\text{C}$

$h_3 = 814.9 \text{ kJ/kg}$

$s_3 = 2.25 \text{ kJ/kg}\cdot\text{K}$

$u_3 = 1011 \text{ kJ/kg}$

$h_4 = u_3(P_4 - P_3) + h_3$

④ $s_4 = 2.25 \text{ kJ/kg}\cdot\text{K}$

$h_4 = 817.87 \text{ kJ/kg}$

$P_4 = 3000 \text{ kPa}$

$T_4 = 180^\circ\text{C}$

⑤ $P_6 = 3000 \text{ kPa}$

$T_6 = 358^\circ\text{C}$

$h_6 = 3116.1 \text{ kJ/kg}$

$s_6 = 6.7450 \text{ kJ/kg}\cdot\text{K}$

⑥ $P_5 = 3000 \text{ kPa}$

$h_5 = 816.4 \text{ kJ/kg}$

$$\textcircled{7} P_7 = 1000 \text{ kPa}$$

$$S_7 = 6.7450 \text{ kJ/kg} \cdot \text{K}$$

$$T_7 = 210.69^\circ\text{C}$$

$$h_7 = 2852.86 \text{ kJ/kg}$$

$$X = \frac{S - S_7}{S_{fg}} \quad X = .84$$

$$\textcircled{8} P_8 = 20 \text{ kPa}$$

$$S_8 = 6.7450 \text{ kJ/kg} \cdot \text{K}$$

$$T_8 = 650^\circ\text{C}$$

$$h_8 = 2231.7 \text{ kJ/kg}$$

$$\textcircled{a} y(h_7 - h_3) = (1 - y)(h_5 - h_2) = y \cdot 197$$

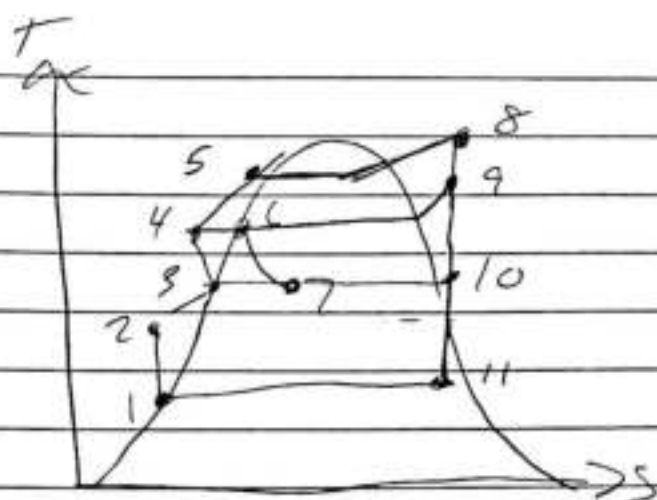
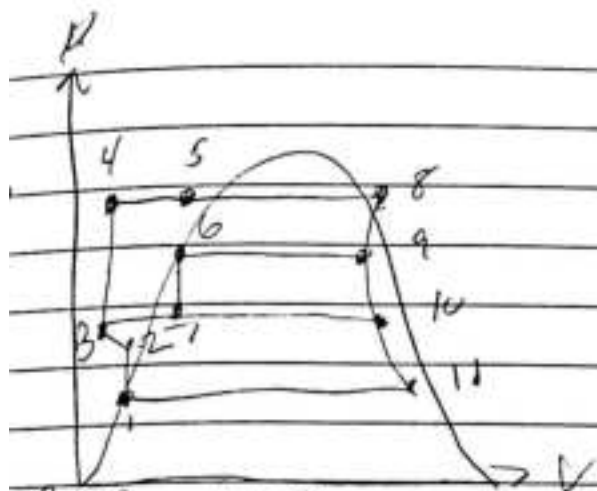
$$w_T = (h_6 - h_7) + (1 - y)(h_5 - h_8)$$

$$w_T = 878.1 \text{ kJ/kg}$$

$$\textcircled{b} w_P(1 - y)(h_2 - h_1) + y(h_4 - h_3) = 3.77 \text{ kJ/kg}$$

$$\textcircled{c} h_5 = y h_4 + (1 - y) h_8 = 816.4 \text{ kJ/kg}$$

$$q_B = h_6 - h_5 = 2514.04 \text{ kJ/kg}$$



① $P_1 = 10 \text{ mpa}$

$h_1 = 191.81 \text{ kJ/kg}$

$v_1 = 0.001$

$T_1 = 45.81^\circ\text{C}$

$s_1 = 0.6492 \text{ kJ/kg}\cdot\text{K}$

$w_{P_1} = v(P_2 - P_1)$

$h_2 = h_1 + w_{P_1}$

② $h_2 = 192.4 \text{ kJ/kg}$

$s_2 = 0.6492 \text{ kJ/kg}\cdot\text{K}$

$w_{P_2} = v_3(P_4 - P_2)$

③ $P_2 = 6 \text{ mpa}$

$h_3 = 670.38 \text{ kJ/kg}$

$v_3 = 0.001 \text{ m}^3/\text{kg}$

$h_4 = h_3 + v_{42}$

④ $h_4 = 680.73 \text{ kJ/kg}$

$P_4 = 1.2 \text{ mpa}$

⑧ $P_8 = 10 \text{ mpa}$

$T_8 = 600^\circ\text{C}$

$h_8 = 3625.8 \text{ kJ/kg}$

$s_8 = 6.9045 \text{ kJ/kg}\cdot\text{K}$

⑤ $h_5 = 798.33 \text{ kJ/kg}$

$P_5 = 1.2 \text{ mpa}$

⑨ $P_9 = 1.2 \text{ mpa}$

$s_9 = 6.9045 \text{ kJ/kg}\cdot\text{K}$

⑥ $h_6 = 798.33 \text{ kJ/kg}$

$P_6 = 1.2 \text{ mpa}$

$h_9 = 2974.5 \text{ kJ/kg}$

⑦ $h_7 = 798.33 \text{ kJ/kg}$

$P_7 = 6 \text{ mpa}$

⑩ $P_{11} = 10 \text{ mpa}$

$s_{11} = 6.9045 \text{ kJ/kg}\cdot\text{K}$

$h_{11} = 2820.9 \text{ kJ/kg}$

$h_{11} = 2187 \text{ kJ/kg}$

⑪ $P_{11} = 10 \text{ mpa}$

$s_{11} = 6.9045 \text{ kJ/kg}\cdot\text{K}$

$$q_{in} = h_6 - h_5 = 2827,5 \text{ kJ/kg}$$

$$y(h_5 - h_6) = h_5 - h_4 = 10540$$

$$q_{out} = (1 - y - z)(h_{11} - h_1) = 1349 \text{ kJ/kg}$$

$$zh_{10} + yh_7 + (1 - y - z)h_2 = h_2 = 1694$$

$$w_{net} = (2827,3 - 1549) \text{ kJ/kg} = 1278 \text{ kJ/kg}$$

$$\eta_H = 1 - \frac{1549}{2827} = \boxed{1.452} \quad (b)$$

$$\dot{M} = \frac{400 \cdot 1000}{1278} = \boxed{313 \text{ kg/s}} \quad (a)$$