10-18E

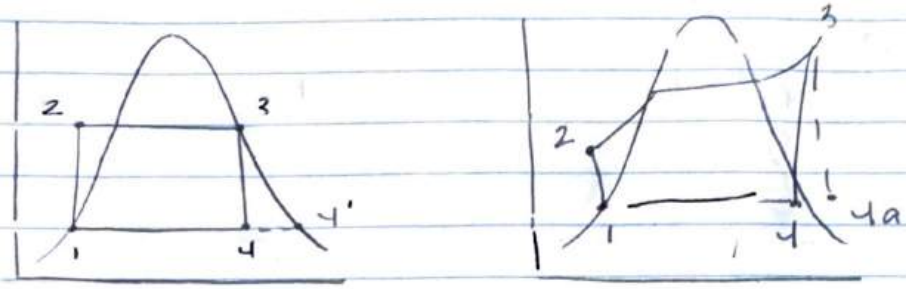
$P_{BOIL} = 1500$ psia $\rightarrow$ 10,342.14 kPa

$P_{COND} = 2$ psia $\rightarrow$ 13.7895 kPa

$T_{IN} = 800°F \rightarrow 700K$

$\eta_T = 0.9$

$P_{NET} = 2500$ kW



1	2	3	4
$P_1 = 2$ psia	$P_2 = P_3$	$P_3 = 1500$ psia	4a
$h_1 = 94.02 = 218.69 \frac{kJ}{kg}$		$T_3 = 800°F$	$P_4 = P_1$
$v_1 = 0.01623 = 0.00101 \frac{m^3}{kg}$		$h_3 = 1363.1 = 3170.33$	$s_4 = s_3$
		$v_3 = 0.43550$	
		$s_3 = 1.5064 = 4.819 \frac{kJ}{kg\text{-}K}$	

$W_p = h_2 - h_1$

$h_2 = W_p + h_1$

$v_1 (P_2 - P_1) + h_1$

$h_2 = 229.12 \frac{kJ}{kg}$

$h_{4a} = 876 \frac{Btu}{lb} = 2027.58 \frac{kJ}{kg}$

$h_4 = h_3 - \eta_T (h_3 - h_{4a})$

$= 925 \frac{Btu}{lb} = 2151.55 \frac{kJ}{kg}$

$W_B = h_3 - h_2 = 2941.21 \frac{kJ}{kg}$

$W_C = h_4 - h_1 = 1932.86 \frac{kJ}{kg}$

$W_{NET} = W_B - W_C = 1008.35 \frac{kJ}{kg}$

$\dot{m} = \frac{\dot{P}}{W_{NET}} = \frac{2500 \frac{kJ}{s}}{1008.35 \frac{kJ}{kg}} \rightarrow \boxed{2.479 \frac{kg}{s}}$

$P_T = m(h_3 - h_4)$

$= 2525.55 \text{ kW}$

$q_B = \dot{m}(w_B) = 7291.25 \text{ kW}$

$\eta_{TH} = \frac{P}{q_B} = \frac{2500}{7291.25} = 0.34 \rightarrow 34\%$

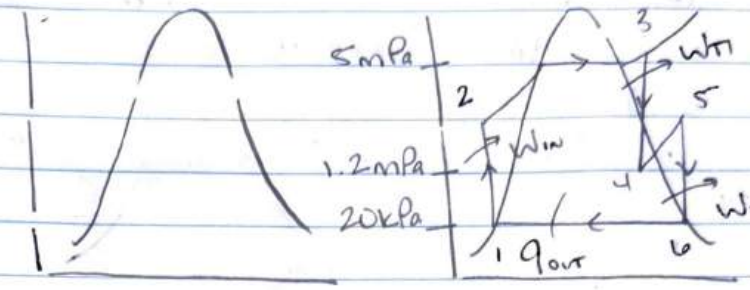
10-34

$P_c = 20\,kPa$

$P_b = 5000\,kPa \rightarrow 5\,mPa$

$P_r = 1200\,kPa \rightarrow 1.2\,mPa$

$x_4 = x_6 = 0.96$



1200kPa
$h_f = 798.33$
$h_{fg} = 1985.4$
$S_f = 2.2159$
$S_{fg} = 4.3058$

1	2	3	4	5	6
$P_1 = 20\,kPa$		$P_3 = 5000\,kPa$	$x_4 = 0.96$	$P_5 = 1200\,kPa$	$P_6 = P_1$
$h_f = 251.42$		$S_3 = S_4$	$h_4 = h_f + x_4 h_{fg}$	$S_5 = S_6$	$x_6 = 0.96$
$h_{fg} = 2357.5$		STEAM TABLES	$= 2704.31$	STEAM TABLES	
$S_f = 0.8320$		$h_3 = 3008.3$	$S_4 = S_f + x_4 S_{fg}$	$h_5 = 3438.21$	$h_6 = h_f + x_6 h_{fg}$
$S_{fg} = 7.0752$		$T_3 = 328.76$	$= 6.3494$	$T_5 = 482.02$	$= 2574.62$
$V_f = 0.001017$					$S_6 = S_f + x_6 S_{fg}$
					$= 7.6242$

$$W_{pump,IN} = V_f (P_b - P_c)$$

$$h_2 - h_1 = V_f (P_b - P_c)$$

$$h_2 = V_f (P_b - P_c) + h_1$$

$$= 256.48\ kJ/kg$$

$$W_{NET} = W_{T1} + W_{T11} - W_P$$

$$= (h_3 - h_4) + (h_5 - h_6) - (h_2 - h_1)$$

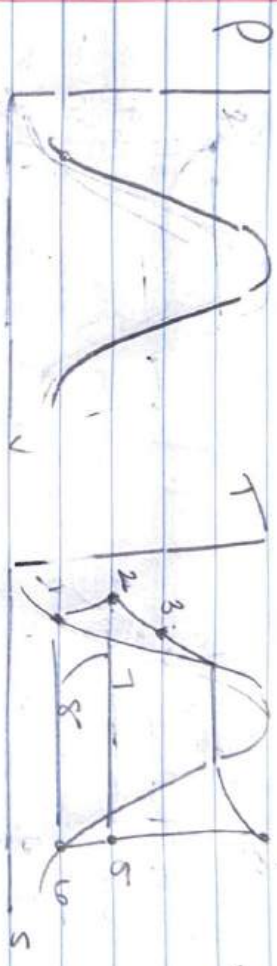
$$= 1219\ kJ/kg$$

$$q_{IN} = (h_3 - h_2) + (h_5 - h_4)$$

$$= 3482.21 \text{ kJ/kg}$$

$$\eta_{TH} = \frac{W_{NET}}{q_{IN}} = \frac{1219}{3482.21} = 0.35 \rightarrow 35\%$$

10-48 $P_{IN} = 3000\,kPa$ $T_{IN} = 350°C$
$P_C = 20\,kPa$
$P_{TWH} = 1000\,kPa$



1 2 3 4 5 6 7 8

$P_1 = 20kPa$ $P_2 = 3mPa$ $P_3 = 3mPa$ $P_5 = 1mPa$ $P_6 = 20kPa$ $P_7 = 1mPa$ $P_8 = P_7$

$h_1 = 251.42$ $T_3 = T_7$ $T_4 = 350°C$ $S_5 = S_4$ $S_6 = S_4$ $h_7 = 762.51$ $h_8 = h_7$

$V_1 = 0.001017$ $h_3 = 763.53$ SUPERHEATED SUPERHEATED $T_7 = 209.9$

$h_2 = h_1 + V_1(P_2 - P_1)$ TABLES TABLES

$= 254.45$ $h_4 = 3116.1$ $h_5 = 2852.89$

$S_4 = 6.7450$ $X_6 = \frac{S_6 - S_{f6}}{S_{fg6}}$

$= 0.8857$

$y = \frac{h_3 - h_2}{h_5 - h_7} = 0.2435$ $h_6 = h_{f6} + X_6 h_{fg6}$

$= 2221.58$

$W_{PUMP} = h_2 - h_1 = \boxed{3.030\ \frac{kJ}{kg}}$

$W_{TURB} = (h_4 - h_5) + (1-y)(h_5 - h_6)$

$= \boxed{741.558\ \frac{kJ}{kg}}$

$\dot{Q}_B = Q_{IN} = h_4 - h_3 = \boxed{2352.57\ \frac{kJ}{kg}}$

10-83

$P_{TW} = 10\,MPa$ $T_T = 600°C$

$P_C = 10\,kPa$

$P_{TOW} = 1.2\,MPa$

$P_{CONN} = 0.6\,MPa$

1	2	3	4	5	6	7
$P_1 = 10\,kPa$	$P_2 = 0.6\,MPa$	$P_3 = P_2$	$P_4 = 10\,MPa$	$P_5 = 10\,MPa$	$P_6 = 1.2\,MPa$	$P_7 = 0.6\,MPa$
$h_1 = 191.81$		$h_3 = 670.38$		$T_5 = T_6$	$h_6 = 798.33 = h_5$	
$V_1 = 0.00101$		$V_3 = 0.001101$			$T_6 = 188$	
	$h_2 = h_1 + V_1(P_2 - P_1)$		$h_4 = h_3 + V_3(P_4 - P_3)$			
	$= 192.51$		$= 680.73$			

8	9	10	11
$P_8 = 10\,MPa$	$P_9 = 10\,MPa$	$P_{10} = 0.6\,MPa$	$P_{11} = 10\,kPa$
$T_8 = 600°C$	$S_9 = S_8$	$S_{10} = S_8$	$S_{11} = S_8$
$h_8 = 3625.8$	$h_9 = 2974.5$	$h_{10} = 2820$	$X_{11} = \frac{S_{11} - S_{f11}}{S_{fg11}}$
$S_8 = 6.9045$			$= 0.8341$
			$h_{11} = h_{f11} + X_{11} h_{fg11}$
			$= 2187$

$$y = \frac{(h_5 - h_4)}{(h_9 - h_6)} = 0.0544$$

$$y h_7 + (1 - y - z) h_2 + z h_{10} = h_3$$

$$z = \frac{(h_3 - h_2) - y(h_7 - h_2)}{(h_{10} - h_2)} = 0.1694$$

$q_{IN} = (h_8 - h_5) = 2827$

$q_{OUT} = (1 - y - z)(h_{11} - h_1) = 1549.38$

$W_{NET} = q_{OUT} - q_{IN} = 1278$

$$\dot{m} = \frac{400000}{1278} \left[\frac{kg}{s}\right] = 313 \left[\frac{kg}{s}\right]$$

$$\eta = 1 - \frac{q_{OUT}}{q_{IN}} = 1 - 0.452 = 45.2\%$$