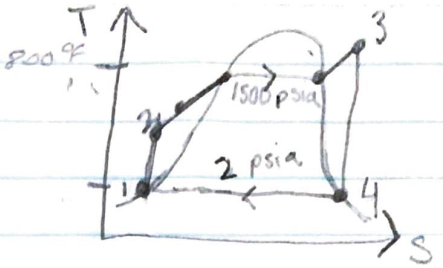
18. $T_3 = 800°F$

$P_1 = P_4 = 2$ psia

$P_3 = 1500$ psia

$h_T = h_4 = 0.9$

2500 KW of power



$h_3 = 1363.1$ Btu/lbm
$s_3 = 1.5064$ Btu/lbm
} Table A6E

$h_f = 94.02$ Btu/lbm
$h_{fg} = 1021.7$ Btu/lbm
} Table A-5E

$s_3 = s_2 = s_f$ at 2 psia + s_{fg} at 2 psia

$1.5064 = 0.17499 + x(1.7944)$

$x = 0.7632$

$h_4 = h_f + x(h_{fg})$

$= 94.02 + 0.7632(1021.2)$

$h_4 = 873.81$ Btu/lbm

$h_T = \frac{h_3 - h_4}{h_3 - h_4} \rightarrow 0.9 = \frac{1363.1 - h_4'}{1363.1 - 873.81}$

$h_4' = 922.74$ Btu/lbm

$h_1 = 94.02$ Btu/lbm

$w_{p,in} = 0.01623\,(1500 - 2) = 24.31$ Btu/lbm

$h_2 = 94.02 + 24.31 = 118.33$ Btu/lbm

$\eta_{th} = 1 - \frac{Q_R}{Q_S} \rightarrow 1 - \left(\frac{922.74 - 94.02}{1363.1 - 118.33}\right) = 33.14$

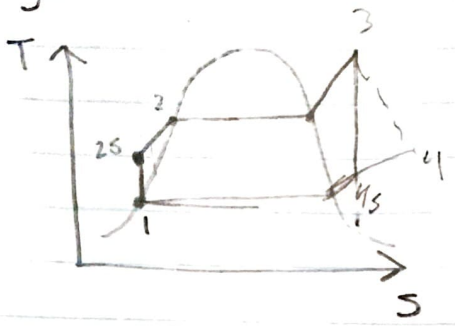
$w_{net} = 2500\text{ KW}\,(3412.14/60) = 142172.5$

$\dot{m} = \frac{142172.5}{(1363.1 - 922.74) - 118.33 - 94.02} = 341.72$ lbm/min

25. State 3

$P_3 = 3.25\ MPa$ ∧ $h_3 = 761.04\ kJ/kg$

$T_3 = 147°C$ – $s_3 = 2.543\ kJ/kg\,K$



State 4

$P_4 = 410\ kPa$ ∧ $h_{4S} = 688.79\ kJ/kg$

$T_4 = 79.5°C$ –

State 1

$P_1 = 410\ kPa$ ∧ $h_1 = h_f = 272.38\ kJ/kg$

Saturated liq. – $v_1 = v_{f1} = 0.001839\ m^3/kg$

State 2

$P_2 = P_3 = 3250\ kPa$

$w_{p/in} = v_1 (P_2 - P_1)$

$w_{p/in} = .001839\ (3250 - 410)$

$= 5.223\ kJ/kg$

$w_{p/in} = h_{2S} - h_1 = 5.223$

$h_{2S} = 272.38 + 5.223$

$= 277.6\ kJ/kg$

$\eta_p = \dfrac{h_{2S} - h_1}{h_2 - h_1}$ → $0.9 = \dfrac{278.6 - 272.38}{h_2 - 272.38}$

$h_2 = 279.29\ kJ/kg$

$\dot{m}s = 305.6$ Kg/s

$wp = \dot{m}s\,(h_2 - h_1)$

$= 305.6\,(279.29 - 272.38)$

$wp = 2111.7$ KW

$w_T = \dot{m}s\,(h_3 - h_4)$

$= 305.6\,(761.04 - 688.79)$

$w_T = 22079.6$ KW

$wnet = w_T - w_p = 19967.9$ KW

a) $\eta_{th} = \dfrac{h_3 - h_4}{h_3 - h_{45}} = \dfrac{761.04 - 688.79}{761.04 - 669.8}$

$\eta_{th} = 0.7919 = 79.19\%$

b) $wnet = 19967.9$ KW

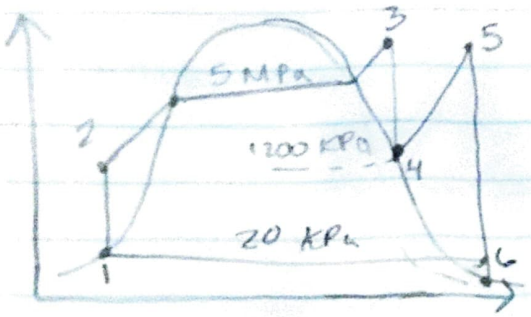
c) $Q_s = \dot{m}s\,(h_3 - h_2)$

$= 305.6\,(761.04 - 279.29)$

$= 147228.8$ KW

$\eta_t = wnet / Q_s = \dfrac{19967.9}{147228.8} = 0.1356 = 13.56\%$

3-1.



$P_1 = 20$ kPa

$h_1 = h_f = 251.42$ kJ/kg

$v_1 = v_f = .0010172$ m^3/kg

$w_{p,in} = v_1 (P_2 - P_1)$

$= .0010172\ (5.000 - 20)$ kPa $\left(\frac{1\ kJ}{1\ kPa \cdot m^3}\right)$

$w_{p,in} = 5.065$ kJ/kg

$h_2 = h_1 + w_{p,in}$

$= 251.42 + 5.065$

$= 256.49$ kJ/kg

$P_4 = 1{,}200$ kPa

$h_f = 798.33$ kJ/kg

$h_{fg} = 1985.4$ kJ/kg

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

$h_4 = 798.33$ kJ/kg $+ 0.961\ (1{,}985.4$ kJ/kg$)$

$2{,}704.3$ kJ/kg