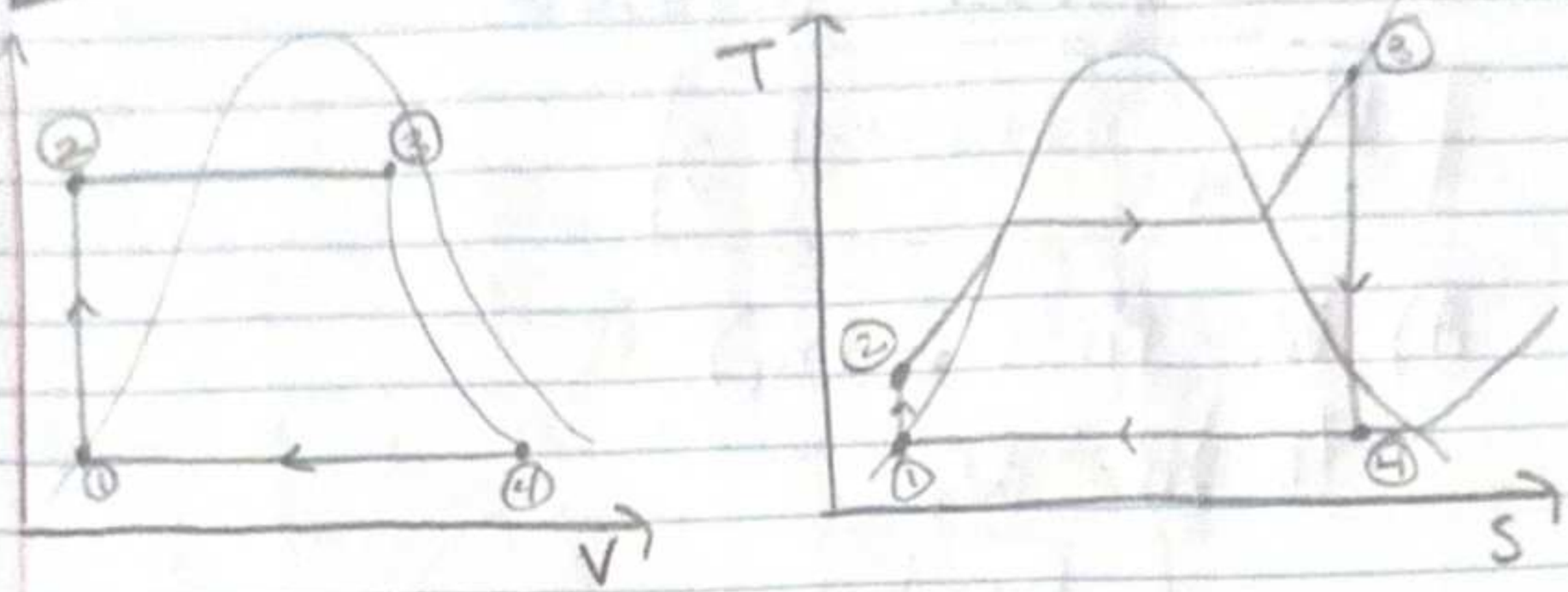
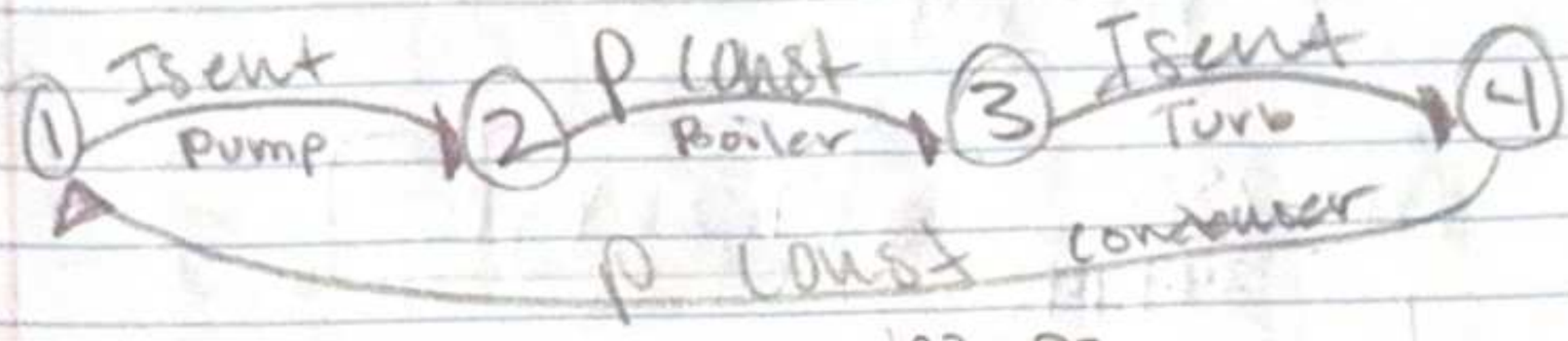
HW 2.1

10-18

$\eta_T = 90\%$ $W_{net} = 2500kW$

M. Zell
Smalls





Sat water Table

$p_1 = 13.78kpa$	$p_2 = 10,342kpa$	$p_3 = 10342kpa$	$p_4 = 13.78kpa$
$T_1 = 326.15k$	$T_2 = 329.15k$	$T_3 = 699.82k$	$T_4 = 326.15k$
$v_1 = 0.001013$	Table A-7	Sat Vap Tables	$S_4 = S_3$
$h_1 = 219.84$	$h_2 = 231.29$	$h_3 = 1423.2$	$S_4 = 3.37$
$S_1 = .7371$	$S_2 = .7371$	$v_3 = 0.001465$	$h_4 = 1079.06$
Interopolated	$S_1 = S_2$	$S_3 = 3.37$ ↑ interpolate	

$p_3 = p_2$

$2(6.89) = 13.78kpa$

$1500(6.89) = 10342.14$

$\frac{(900°F - 32) \times 5}{9} + 273.15 = 699.82K$

$538° \rightarrow 326.15K$

$566° \rightarrow 329.15K$

$S_4 = S_{F_4} + x_4 S_{Fg_4}$

$S_{F_4} = 0.71$

$S_{Fg_4} = 7.34$

$x_4 = \frac{S_4 - S_{F_4}}{S_{Fg}}$

$x_4 = 0.362$

$h_4 = h_F + h_{Fg} x_4$

$h_{F_4} = 217.61$

$h_{Fg4} = 2379.7$

B) $W_T = W_{out_{3-4}} = h_3 - h_4$

$1423.2 - 1079.06$

$\boxed{W_{out_{3-4}} = 344.14 \text{ kJ/kg}}$

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

↳ $\dot{m} = \frac{W_T}{h_3 - h_4}$

$\dot{m} = \frac{2500}{344.14} \rightarrow \boxed{7.26 \text{ kg/s}}$

C) $q_{boiler} = q_{in} = q_{in_{2-3}} = h_3 - h_2$

$q_{in_{2-3}} = 1423.2 - 231.29$

$\boxed{= 1191.91 \text{ kJ/kg}}$

D) $\eta_{th} = \frac{W_{net}}{q_{in}}$

$= \frac{332.69}{1191.91}$

$\boxed{= .279 \text{ or } 28\%}$

$(344.14 - 11.45) = 332.69$

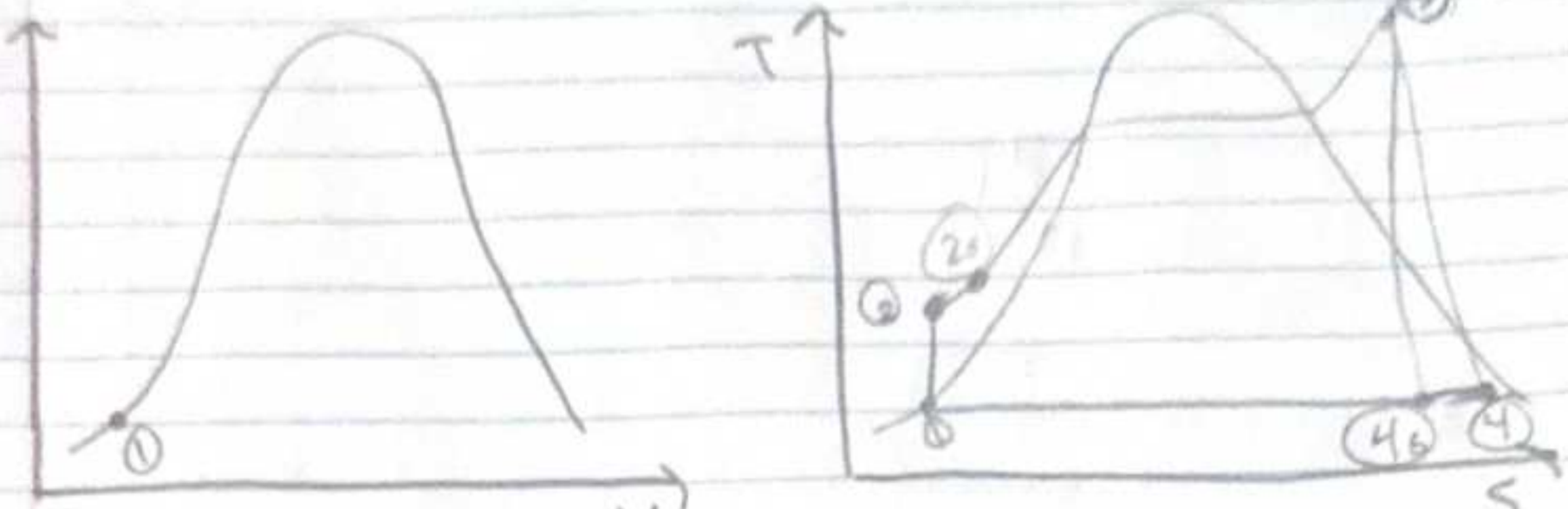
$W_{net} = W_{out} - W_{in}$

$W_{in} = h_2 - h_1$

$231.29 - 219.84$

$W_{in} = 11.45$

10-25| $\dot{m} = 555.9 kg/s$ $\eta_p = 90\%$



1 → pump → 2 → heat exchang → 3 → Turb → 4

$T_1 = 160°C$

Sat liquid Table

$p_1 = 618.23$

$h_1 = 273.91$

$v_1 = 0.001842$

$p_2 = 3250$

$h_2 = 278.82$

$h_3 = 761.54$

$p_3 = 3.25 mpa$

$T_3 = 147°C$

$\dot{m} = 305.6$

$S_3 = 2.54$

$p_4 = 410 kpa$

$T_4 = 179.5°C$

$S_4 = S_3$

$h_{4s} = 670.40$

$h_4 = 689.74$

$W_T = \dot{m}(h_3 - h_4)$
$= 21,941$

$W_p = \dot{m}(h_2 - h_1)$
$= 1777$

$W_{net} = W_{T_o} - W_{p,in}$
$= 20,165$

$\eta_{th} = \frac{h_3 - h_4}{h_3 - h_{4s}} = \frac{761.54 - 689.74}{761.54 - 670.40} = 0.788$

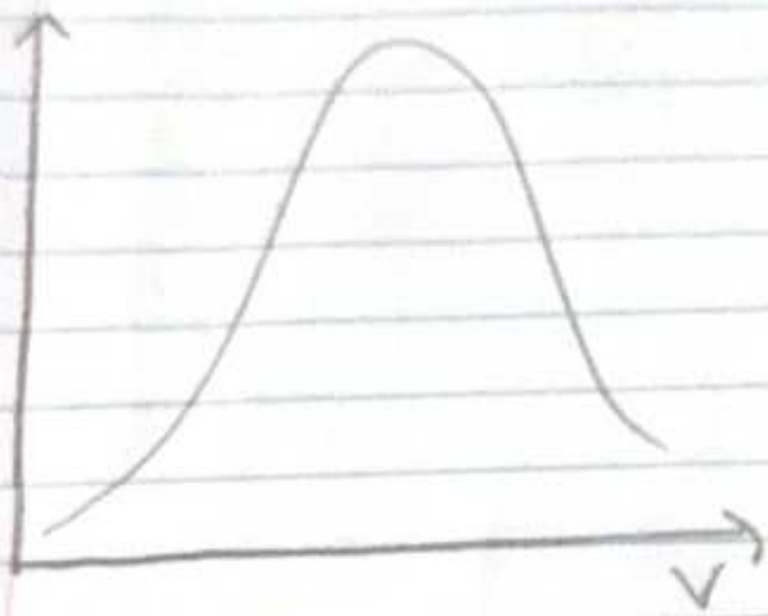
$w_{p,in} = v_1(p_2 - p_1)/\eta_p$
$= 5.81 kJ/kg$

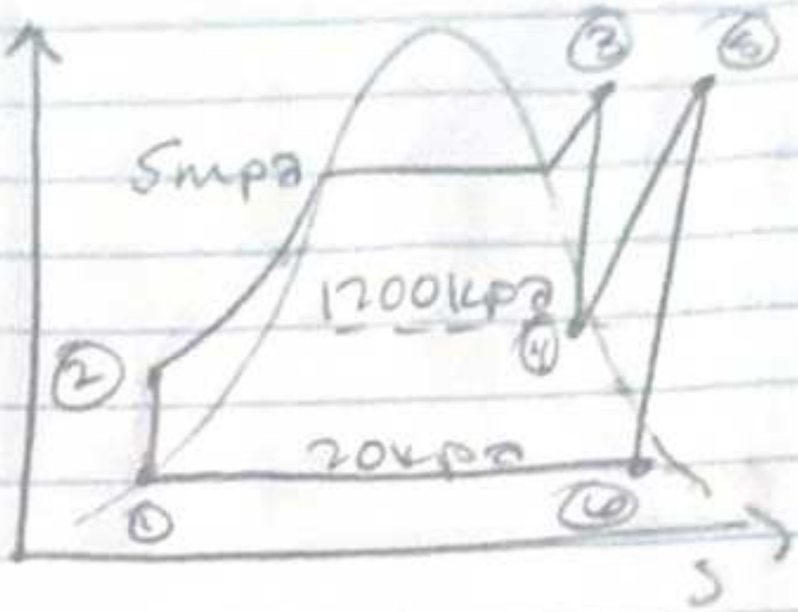
$h_2 = h_1 + w_{p,in} = 278.82$

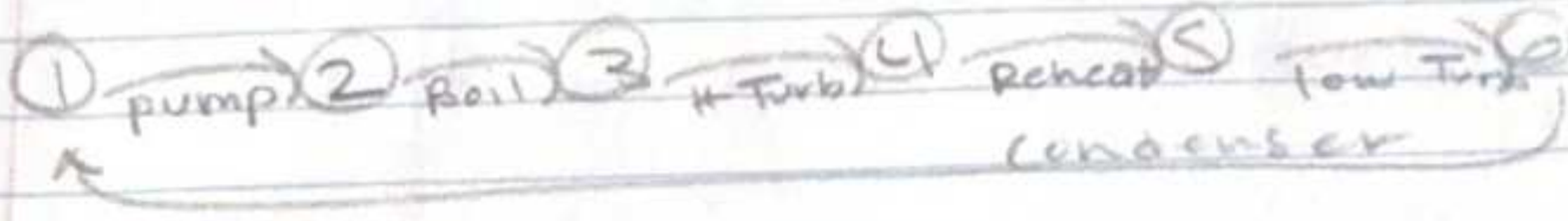
$Q_{in} = \dot{m}_g c_g (T_{in} - T_{out})$
$= 162,656$

$\eta_{th} = \frac{W_{net}}{q_{in}} = 12.4\%$

10 - 34







$p_1 = p_6$ $h_2 = 756.49$

$p_1 = 20kpa$ $p_2 = 5000kpa$

$x_2 = 96\%$

Steam Table

$h_1 = 251.62$

$V_1 = 0.001017$

$p_4 = 1200kpa$

$x_4 = 96\%$ A-4

$h_4 = h_F + x_4 h_{FS}$

$h_4 = 2704.3$

$S_4 = 6.3495$

$p_6 = 20kpa$

$x_6 = 0.76$

$S_6 = 7.6242$

$h_6 = 2514.6$

$p_3 = 5000kpa$

$S_3 = S_4$

$S_4 = 6.3495$

$T_3 = 327.2$

$h_3 = 3006.9$

$p_5 = 1200$

A-4 $S_5 = S_6$

$T_5 = 491.1$

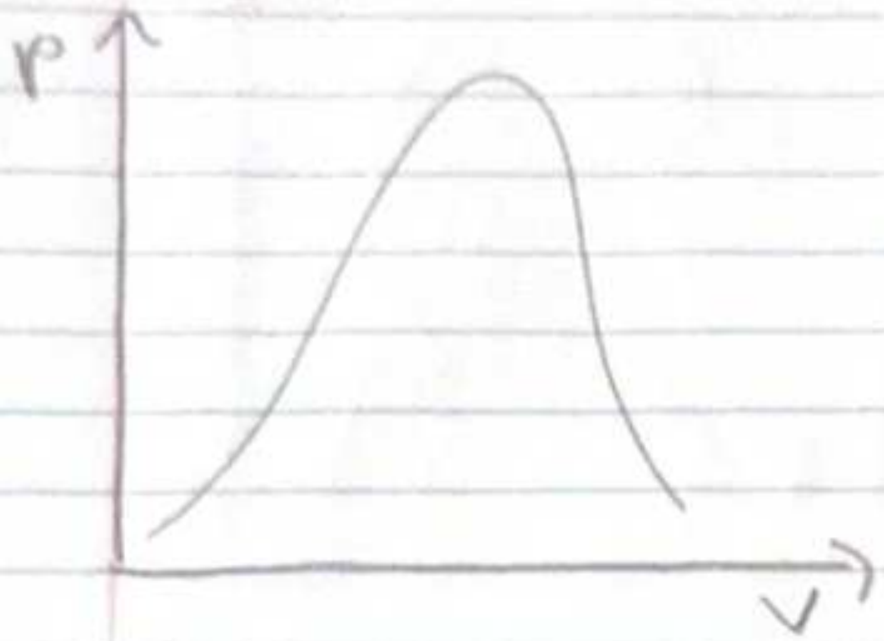
$h_5 = 3436$

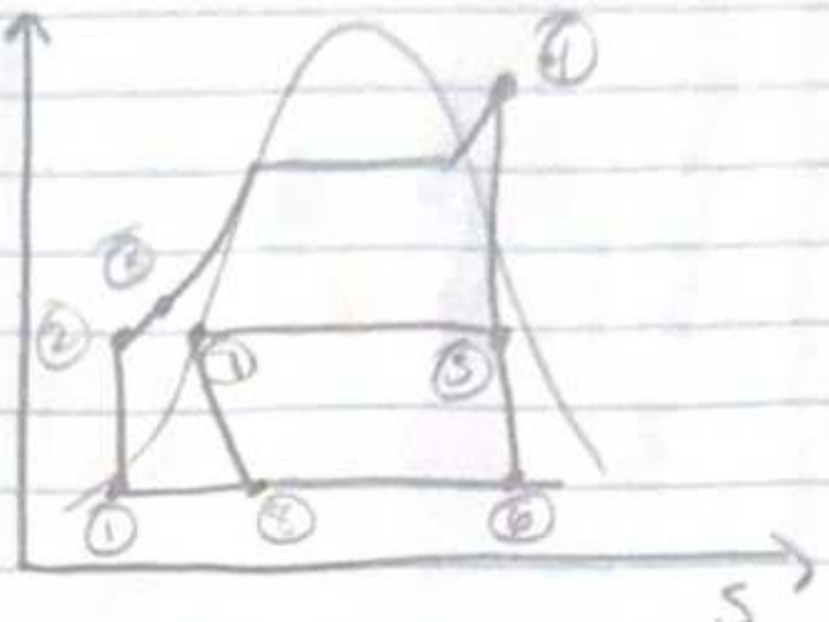
$q_{in} = 3482.0 \rightarrow (h_3 - h_2) + (h_5 - h_4)$

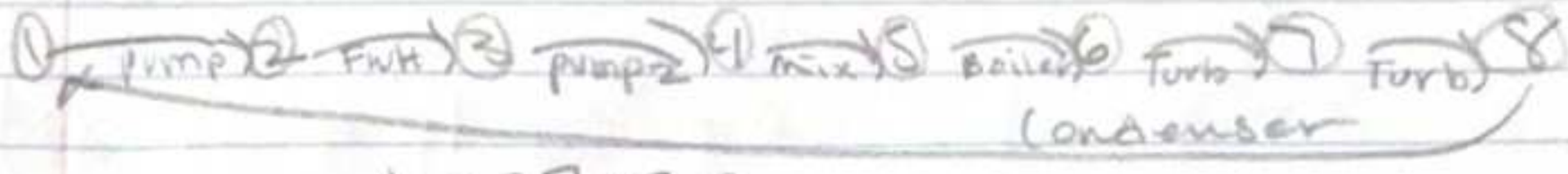
$q_{out} = 2263.2 \rightarrow h_6 - h_1$

$\eta_{th} = 1 - \frac{q_{out}}{q_{in}} = 35.0\%$

10-417







$h_3 = 763.5$

$p_1 = 20 kpa$
$h_1 = 251.4$
$v_1 = 0.001017$

$W_p = v_1(p_2 - p_1)$
$= 3.03$

$p_2 = 3000 kpa$
$h_2 = 254.45$

$p_3 = 3000 kpa$
$T_3 = T_7 = 209.9$

$p_4 = 3000$
$h_4 = 3116$
$s_4 = 6.745$
$T_4 = 350°C$

$p_5 = 1000 kpa$
$s_5 = s_4$
$h_5 = 2851.9$

$p_6 = 20 kpa$
$T_6 = 350°C$
$s_6 = s_4$
$x_6 = 0.83357$
$h_6 = 2221.7$

p_8
$h_8 = h_7$
$h_8 = 762.5$

$p_7 = 1000 kpa$
$x_7 = 0$
$h_7 = 762.51$
$T_7 = 179.9$

$y = \frac{h_3 - h_2}{h_5 - h_7} = 0.2437$

$W_{To} = h_4 - h_5 + (1-y)(h_5 - h_6) = 740.9$

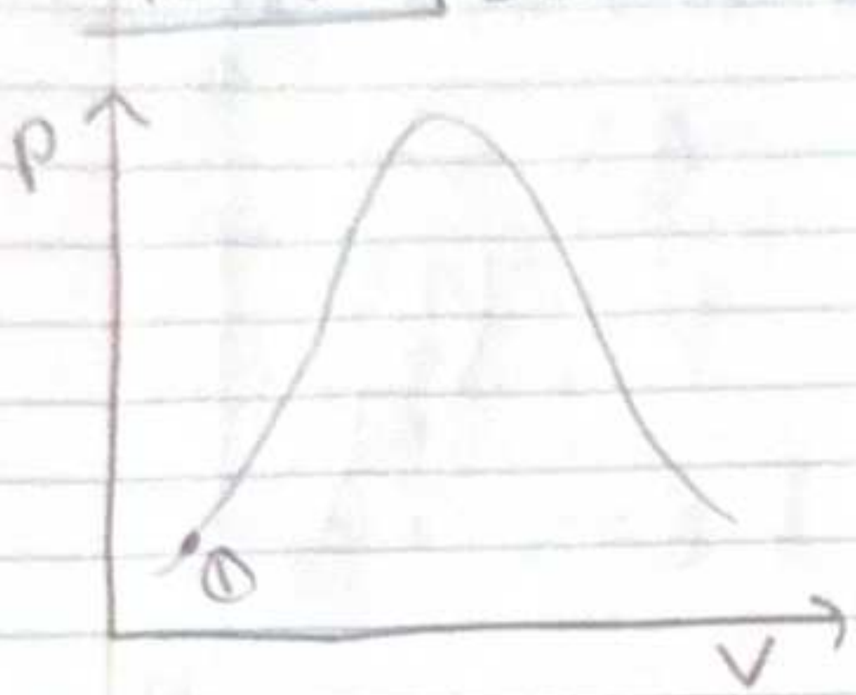
$W_p = 3.03$

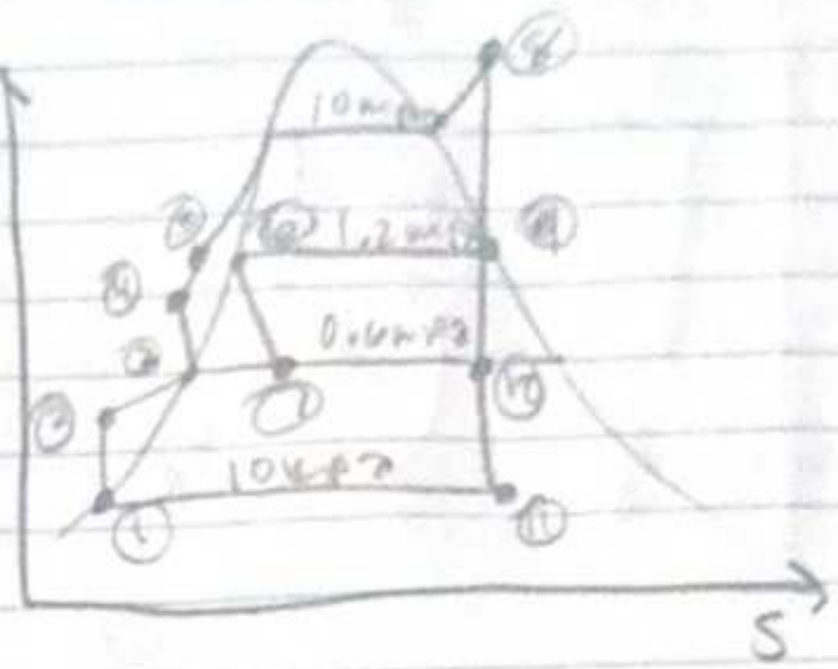
$W_{net} = W_t - W_p = 737.8$

$q_{in} = h_4 - h_3 = 2353$

$\eta_{th} = \frac{W_{net}}{q_{in}} = 0.3136$

10-83] Ideal Steam Regen Rankine





→ (1) pump (2) FWH (3) pump II (4) FWH (5) FWH (6)

$h_1 = 191.81$ $p_2 = 600kpa$ $p_4 = 10000kPa$

$v_1 = 0.00101$ $h_2 = h_1 + W_{p,in}$ → 192.4 $h_4 = h_3 + W_{p,II}$ → 680.73

$p_1 = 10kpa$ $W_{p,in} = v_1(p_2 - p_1)$

$= 0.60$

$p_6 = 1.2mpa$ $p_5 = 10.mpa$

$p_3 = 0.6$ $W_{p,II} = v_3(p_3 - p_4)$ $h_6 = h_7 = 798.33$ $h_5 = 795.33$

$h_3 = 670.38$ $= 10.39$ $T_6 = 188.0$ $T_5 = 188$

$v_3 = 0.00101$ $T_6 = T_5$

→ (7) (8) Turb (9) Turb (10) Turb (11) condenser

$\dot{m} = \frac{\dot{W}_{net}}{w_{net}}$ $p_7 = 10mpa$ $p_9 = 1.2mpa$ $p_{11} = 10kpa$

$= 313$ $T_8 = 600°C$ $s_9 = s_8$ $s_{11} = s_8$

$h_8 = 3625.8$ $h_9 = 2974.5$ $x_{11} = 0.8341$

$\eta_{th} = 1 - \frac{q_{out}}{q_{in}}$ $s_8 = 6.9045$ $h_{11} = 2187$

$= 45.2\%$

$p_{10} = 0.6mpa$

$s_{10} = s_8$

$h_{10} = 2820.9$

$y = \frac{h_5 - h_4}{h_9 - h_4} = 0.05404$

$2 = \frac{(h_3 - h_2) - y(h_7 - h_2)}{h_{10} - h_2} = 0.16941$

$q_{in} = 2827$ $W_{net} = 1278$

$q_{out} = 1549$