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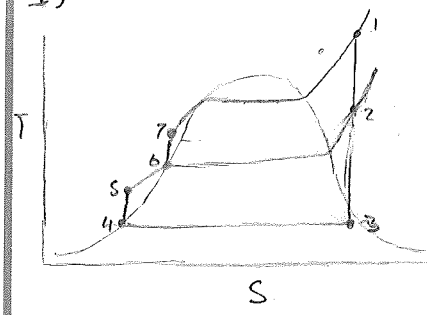
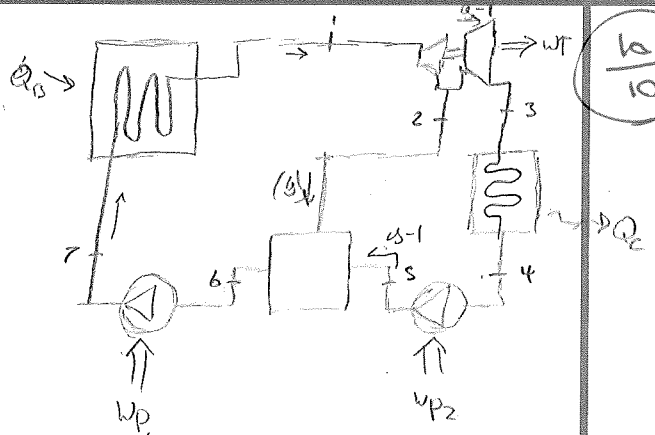
Dylan Wood

Assignment #5
Thermo 2

1)



W=20MW



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	T	P	V	h	S	Cond
1	600°C	15MPa		3582.3	6.6776	super
2		1.2MPa		2859.54	6.6776	super
3		.01MPa		2114.92	6.6776	
4		.01MPa	0.00101	191.83	0.6493	
5		1.2MPa		193.03		
6		1.2MPa		798.65		
7		15MPa		814.37		

$y = \frac{798.65 - 193.03}{2859.54 - 193.03} = .2271$ ✓

$\frac{6.8294 - 6.6776}{6.8294 - 6.5898} = \frac{2935 - h_2}{2935 - 2815.9}$ $h_2 = 2859.54$ kJ/kg $s_{g_2} = 6.5273 < 6.6776$ so pt 2 is superheated

$x_3 = \frac{s_3 - s_f}{s_g - s_f} = \frac{6.6776 - 0.6493}{8.1502 - 0.6493} = .80367$

$x_3 = \frac{h_3 - h_f}{h_g - h_f} = .80367(2584.7 - 191.83) + 191.83 = 2114.92$

$h_5 = h_4 + v\Delta P = 191.83 + 0.00101(1.2 - .01)\times 10^3 = 193.03$ kJ/kg

$h_7 = h_6 + v\Delta P = 798.65 + 0.001139(15 - 1.2)\times 10^3 = 814.37$ kJ/kg

a) $\eta_{therm} = \frac{work}{cost} = \frac{[(h_1 - h_2) + (1-y)(h_2 - h_3)] - [(h_7 - h_6) + (1-y)(h_5 - h_4)]}{(h_1 - h_7)}$ ✓

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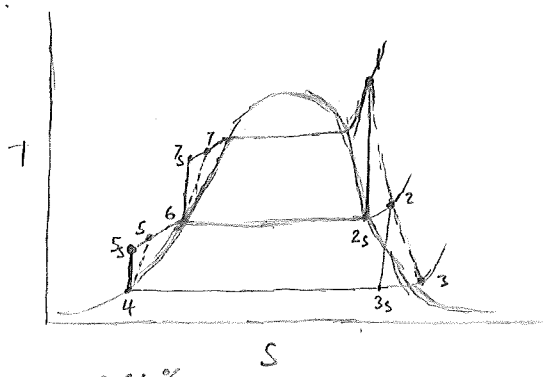
$= \frac{[(3582.3 - 2859.54) + (1 - .2271)(2859.54 - 2114.92)] - [(814.37 - 798.65) + (1 - .2271)(193.03 - 191.83)]}{[(3582.3 - 814.37)]}$

$= 46.3\%$ eff ✓

b) $\dot{m} = \frac{20\times 10^3}{(3582.3 - 2859.54) + (1 - .2271)(2859.54 - 2114.92)}$ $\frac{W}{\dot{m}} = (h_1 - h_2) + (1-y)(h_2 - h_3)$

$= 15.605$ kg/s

2)



	T	P	v	h	s	cond
1	600°C	15MPa		3582.3	6.6776	super
2s		1.2MPa		2859.54	6.6776	super
2		1.2MPa		2935.0	6.8294	super
3s		.01MPa		2163.35	6.8294	
3		.01MPa		2225.08		
4		.01MPa	0.001001	191.83	0.6493	
5s		1.2MPa		193.03		
5		1.2MPa		193.33		
6		1.2MPa	0.001139	798.65		
7s		15MPa		814.37		
7		15MPa		818.3		

$\eta_H = 89.56\%$

$\eta_{Ht} = 92\%$ $\eta_p = 80\%$

$s_{g_2} = 6.5233 < 6.6776$ so pt 2s is in superheated

$h_2 = h_1 - \eta_{ht}(h_1 - h_{2s}) = 3582.3 - .8956(3582.3 - 2859.54) = 2935.00$ kJ/kg

$x_{3s} = \frac{6.8294 - 0.6493}{8.1502 - 0.6493} = .8239$ $\quad .8239 = \frac{h_{3s} - 191.83}{2584.7 - 191.83}$ $\quad h_{3s} = 2163.35$ kJ/kg

$h_3 = h_2 - \eta_{Ht}(h_2 - h_{3s}) = 2935.0 - .92(2935.0 - 2163.35) = 2225.08$ kJ/kg

$h_5 = h_4 + \frac{(h_{5s} - h_4)}{\eta_{P_1}} = 191.834 + \frac{(193.03 - 191.83)}{.8} = 193.33$ kJ/kg

$h_7 = h_6 + \frac{(h_{7s} - h_6)}{\eta_{P_2}} = 798.65 + \frac{(814.37 - 798.65)}{.8} = 818.3$ kJ/kg

a) $\eta_{therm} = \frac{Wt}{cost} = \frac{[(h_1 - h_2) + (1-y)(h_2 - h_3)] - [(h_7 - h_6) + (1-y)(h_5 - h_4)]}{[(h_1 - h_7)]}$ $\quad y = \frac{798.65 - 193.33}{2935 - 193.33} = .2207$

$= \frac{[(3582.3 - 2935.0) + (1 - .2207)(2935.0 - 2225.08)] - [(818.3 - 798.65) + (1 - .2207)(193.33 - 191.83)}{[(3582.3 - 818.3)]}$

$= 42.7\%$ ✓

b) $\dot{m} = \frac{20 \times 10^3}{[(3582.3 - 2935.0) + (1 - .2207)(2935.0 - 2225.08)] - [(818.3 - 798.65 + (1 - .2207)(193.33 - 191.83)]}$

$= 16.95$ kg/s ✓

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