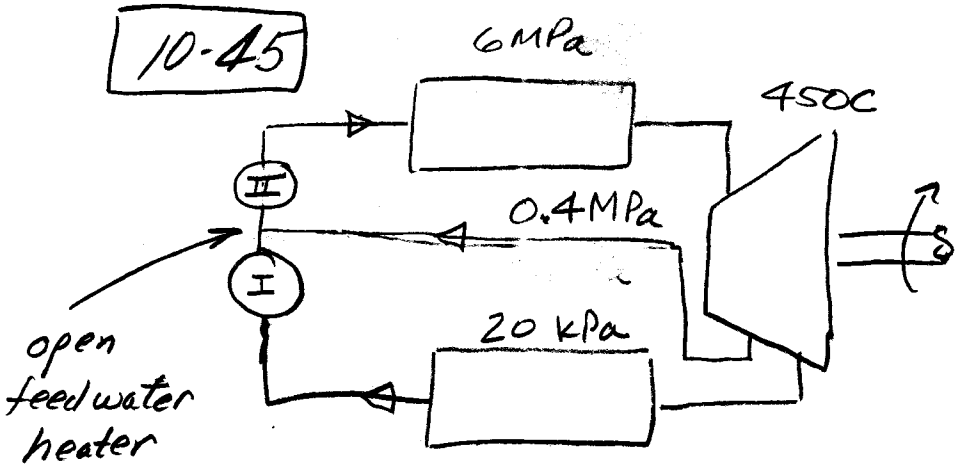
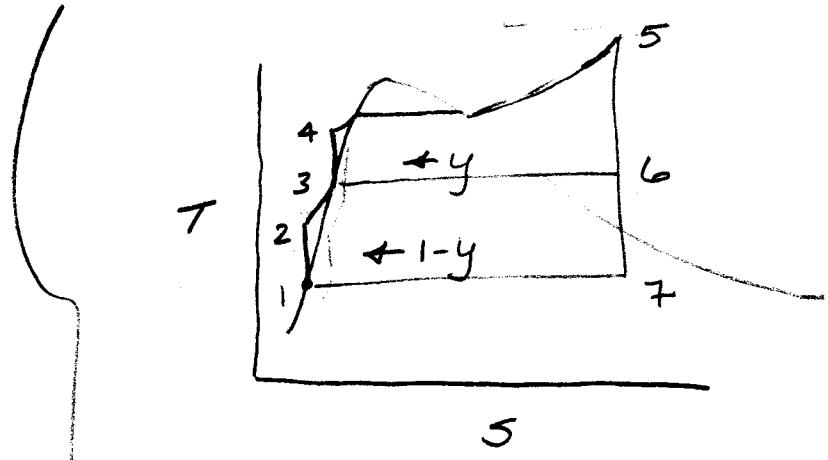
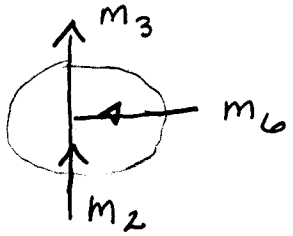
10-45





solution:

1. obtain h values at pts ① ② ③ ④ ⑤ ⑥ and ⑦



2. apply energy balance around feedwater heater

$$\dot{E}_{in} = \dot{E}_{out}$$

$$\dot{m}_6 h_6 + \dot{m}_2 h_2 = \dot{m}_3 h_3$$

$$y h_6 + (1-y) h_2 = (1) h_3$$

where $y = \frac{\dot{m}_6}{\dot{m}_3}$

$$y = \frac{h_3 - h_2}{h_6 - h_2} = 0.1462$$

10-45 cont.

3. calculate q_{in}, q_{out}, w_{net}

$$q_{in} = h_5 - h_4$$

$$q_{out} = (1-y)(h_7 - h_1)$$

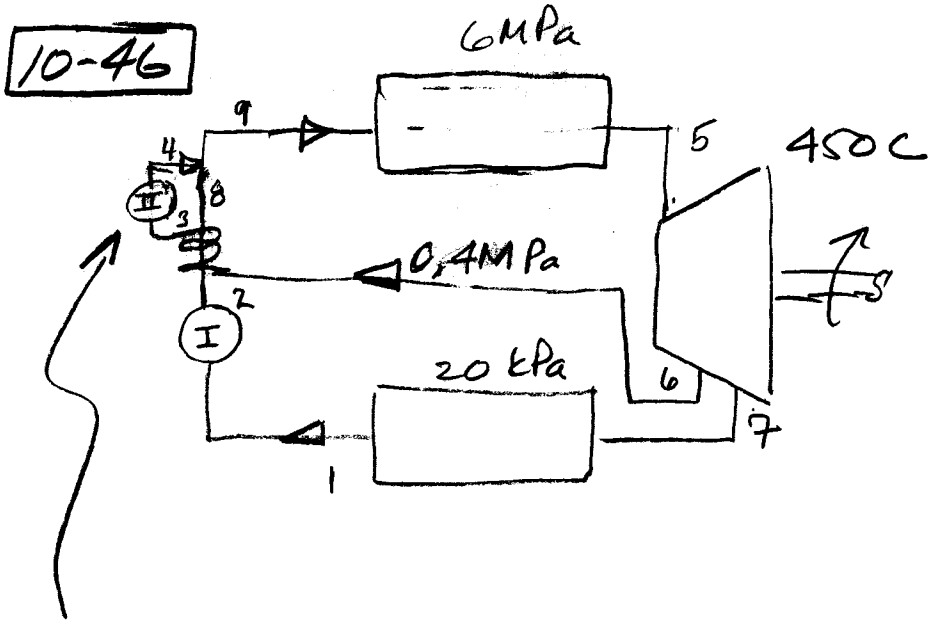
then

$$w_{net} = q_{out} - q_{in}$$

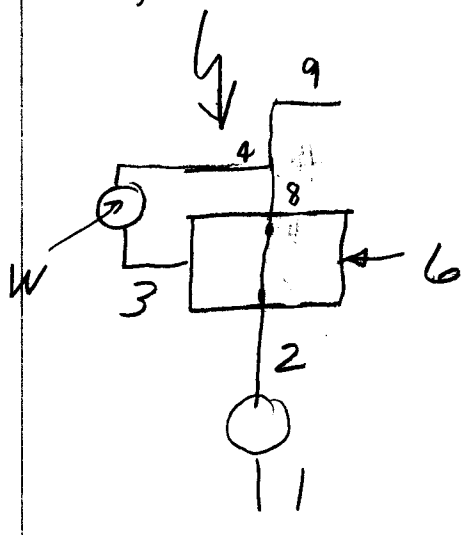
and

$$\eta = 1 - \frac{q_{out}}{q_{in}} = \underline{\underline{37.8\%}}$$

10-46



closed feedwater heater with extracted steam returned to boiler pressure



solution:

Same as problem 10-45 except for energy balance around feedwater heater

$h_1 = 251$ kJ/kg

$h_2 = 258$ "

$h_3 = 605$ "

$h_8 = 611$ "

$h_5 = 3303$ "

$s_5 = s_6$ then $x_6 = 0.966$

and $h_6 = 2666$ $\frac{kJ}{kg}$

$s_7 = s_5$ then $x_7 = 0.8325$

and $h_7 = 2214$ $\frac{kJ}{kg}$

now - energy balance around feedwater heater to determine y

(see diagram previous page)

$$m_2(h_8 - h_2) = m_6(h_6 - h_3)$$

Let $y = m_6$ then $1-y = m_2$

since $m_6 + m_2 = m_5 = m_{total} = 1$

$$(1-y)(h_8 - h_2) = y(h_6 - h_3)$$

or

$$y = \frac{h_8 - h_2}{(h_6 - h_3) + (h_8 - h_2)}$$

$$= 0.1463$$

$$q_{in} = 2692 \ \frac{kJ}{kg}$$

$$q_{out} = (1-y)(h_7 - h_1) = 1675 \ \frac{kJ}{kg}$$

then $w_{net} = q_{in} - q_{out}$

and $\eta = 1 - \frac{q_{out}}{q_{in}} = 37.8\%$