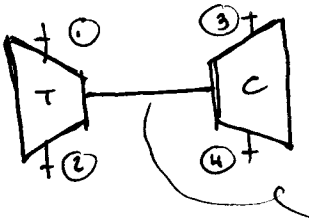
OCT. 16/18



$\dot{m}_3 = 0.1$ kg/s

$T_3 = 20°C$, $P_3 = 100$ kPa

$P_4 = 500$ kPa

$W_T = -W_C$

$\dot{m}_2 = 0.5$ kg/s

$P_2 = 200$ kPa

Sat. vapor

$$\frac{T_4}{T_3} = \left(\frac{P_4}{P_3}\right)^{\frac{k-1}{k}} \Rightarrow T_4$$

↳ $W_c = C_p(T_3 - T_4)$

$W_t = h_1 - h_2$ → Find h_1

Find s_1

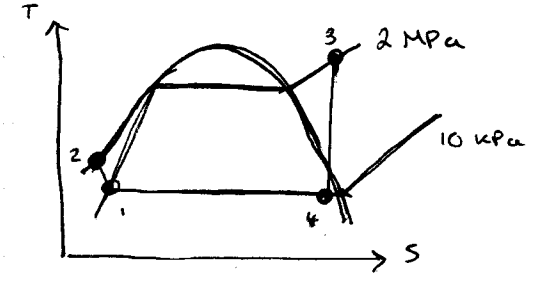
$$\dot{Q} + \dot{m}_1\left(h_1 + v_1^2/2 + z_1 g\right) = \dot{W} + \dot{m}_1\left(h_2 + v_2^2/2 + z_2 g\right)$$

$$q + m_1\left(h_1 + v_1^2/2 + z_1 g\right) = w + m\left(u_2 + v_2^2/2 + z_2 g\right)$$

Question 1 From exam :

Oct. 18/18

Example :



TABLE

$P_3 = 3.5\ MPa$, $T_3 = 350\ °C$ } $h_3 = 3104.9\ kJ/kg$, $s_3 = 6.6601\ kJ/kg$

$h_1 = 191.81\ kJ/kg$

$s_1 =$

$v_1 = 0.001010\ m^3/kg$

$w_p = v_1(P_2 - P_1) = 3.52\ kJ/kg$

$w_p = h_1 - h_2 \Rightarrow h_2 = h_1 - w_p$

$h_2 = 195.33\ kJ/kg$

Part A

Boiler: $q_H = h_3 - h_2 \Rightarrow 3104.9 - 195.33 \Rightarrow$ **$q_H = 2909.57\ kJ/kg$**

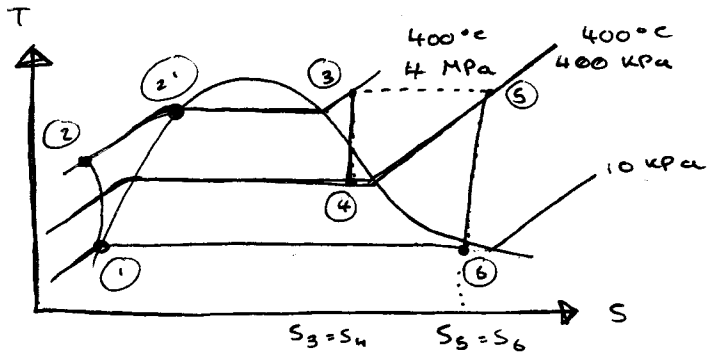
$s_3 = s_4 = 6.6601\ kJ/kg.K$, $P_4 = 10\ kPa$ } $s_f|_{10kPa}$, $s_{fg}|_{10kPa}$ → $s_4 = s_f + x\, s_{fg}$

→ then $x_4 = 0.801$ or **80.1 %** → PART B

$\eta = \frac{w_{net}}{q_H} \rightarrow 1 - q_H/q_L = \left(\frac{q_H - q_L}{q_H}\right) \rightarrow$ **34.1 %**

The reheat cycle :

Example : Consider a reheat cycle utilizing steam. Steam leaves the boiler and enters the turbine at 4 MPa, 400 °C. After expansion in the turbine to 400 kPa, the steam is reheated to 400 °C and then expanded in the low-pressure turbine to 10 kPa. Determine the cycle efficiency.



$$\eta_{th} = \frac{w_{net}}{q_h} \Rightarrow 1 - \frac{q_L}{q_h} \Rightarrow \boxed{35.9\ \%}$$

Pump $w_p = v_1 (P_1 - P_2)$

$\Rightarrow w_p = (0.001010)(10 - 4000) \Rightarrow w_p = -4\ kJ/kg$

$w_p = h_1 - h_2 \Rightarrow h_2 = h_1 - w_p$

$h_2 = 191.8 - (-4) = 195.8\ kJ/kg$

Boiler : $q_h = (h_3 - h_2) + (h_5 - h_4)$

$s_3 = s_4 = 6.769$, $P_4 = 400\ kPa$ $\Rightarrow h_4 = h_f|_{400\ kPa} + x_4 h_{fg}|_{400\ kPa}$

$\hookrightarrow h_4 = 2685.6\ kJ/kg$

$s_4 = s_f|_{400\ kPa} + x_4 s_{fg}|_{400\ kPa} \longrightarrow x_4 = 0.9752$

$q_h = 3605.6\ kJ/kg$

$q_L = h_1 - h_6$

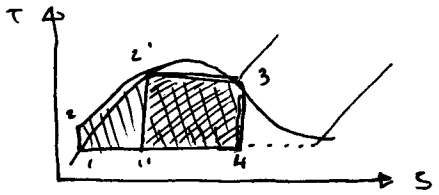
$P_6 = 10\ kPa$

$s_6 = s_5 = 7.8985 = s_f|_{10\ kPa} + x_6 s_{fg}|_{10\ kPa} \Rightarrow x_6 = 0.9664$

$h_6 = 191.8 + 0.9664(2392.8) = 2504.3\ kJ/kg$

$q_L = -2312.5\ kJ/kg$

Regenerative Cycle:



Feedwater Cycle: