

10-57

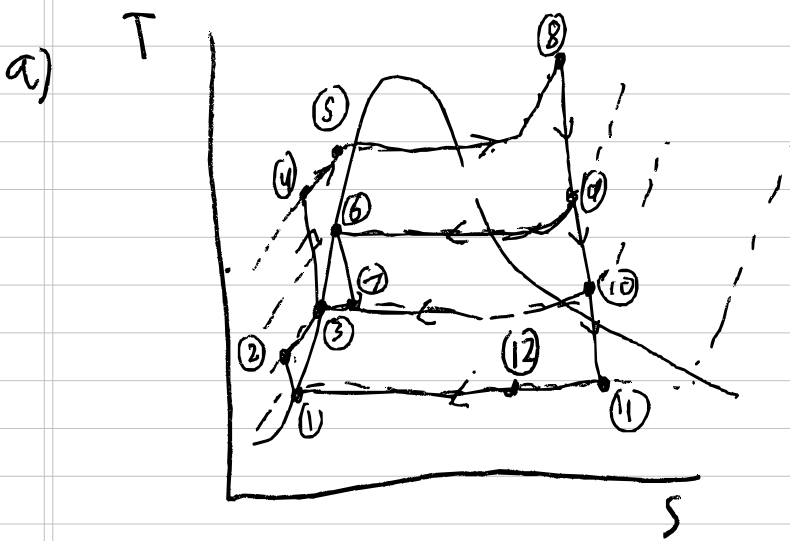
$$\dot{m} = 75 \text{ kg/s}$$

$$y = 0.1448$$

$$p = 1460 \text{ kPa}$$

$$p = 245 \text{ kPa} \text{ from } z$$

$$c_p = 4.18 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} \quad \Delta T = 10^\circ \text{C}$$



b)

$$1 - y - z$$

$$z(h_7 - h_{245}) = (1 - y - z)(h_{7245} - h_{f1400})$$

$$z(2385) = (0.8554 - z)(-297)$$

$$2385z = -254.0538 + 297z$$

$$2088z = -254.05$$

$$z = 0.122$$

c)

$$1 - y - z = 1 - 0.1448 - 0.1217 = 0.7337$$

$$\dot{Q}_{out} = \dot{m}(1 - y - z)(h_8 - h_1)$$

$$= 122,491.22 \text{ kW}$$

$$\dot{Q} = \dot{m}_{cw} c_p \Delta T$$

$$122,491.22 = \dot{m}_{cw} (4.18)(100)$$

$$122,491.22 = \dot{m}_{cw} (41.8)$$

$$\dot{m}_{cw} = 2930.41 \text{ kg/s}$$

d)

$$W_t = 75(h_5 - h_6) + (1 - y)(h_6 - h_7) + (1 - y - z)(h_7 - h_8)$$

$$W_t = 75(3900 - 3406) + (1 - 0.1448)$$

$$\cdot (3405 - 2918) + (1 - 0.1448 - 0.122)(2918 - 2477)$$

$$W_t = 92550.69 \text{ kW}$$

$$W_p = v_f(p_2 - p_1) = 0.00102(5000 - 20)$$

$$W_p = 5.0796 \cdot 75 = 381 \text{ kW}$$

$$W_{net} = 92550.69 - 381 = 92169.69 \text{ kW}$$

$$Q_{in} = 75(h_5 - h_4)$$

$$Q_{in} = 75(3900 - 154) = 205,950 \text{ kW}$$

$$\eta = \frac{92,169.69}{205,950} = 0.448 \cdot 100 = 44.8\%$$

10-69

$$p_1 = 4 \text{ MPa} \quad T_1 = 500^\circ\text{C}$$

$$p_2 = 1200 \text{ kPa} \quad y = \frac{1}{4} = 0.25$$

$$p_3 = 10 \text{ kPa}$$

$$p_6 = 7 \text{ MPa}$$

$$\dot{m} = 55 \text{ kg/s}$$

<u>State 1</u>	<u>2</u>	<u>3</u>
$h_1 = 3448.0$	$h_2 = 3046.3$	$h_3 = 2382.1$
$s_1 = 7.0922$	$s_1 = s_2$	

<u>1200 kPa</u>	<u>10 kPa</u>
$h_f = 798.33$	$191.8 = h_f$

$$W_{t1} = \dot{m}(h_1 - h_2) = 55(3448.0 - 3046.3)$$

$$W_{t1} = 24878.5 \text{ kW}$$

$$1 - 0.25 = 0.75$$

$$W_{t2} = 55(0.75)(3046.3 - 2382.1)$$

$$W_{t2} = 26985.75 \text{ kW}$$

$$W_t = 24878.5 + 26985.75 = 51864.25 \text{ kW}$$

$$W_p = \dot{m} v_f (p_2 - p_1) = 0.001(7000 - 10) = 6.49 \frac{\text{kJ}}{\text{kg}}$$

$$W_p = 55 \cdot 6.49 = 384.45 \text{ kW}$$

$$W_{\text{net}} = W_t - W_p = 51864.25 - 384.45 = 51479.8 \text{ kW}$$

$$W_{\text{net}} = 51479.8 \text{ kW}$$

$$h_{in} = 798.33$$

$$Q_{in} = \dot{m}(h_1 - h_{in}) = 55(3448 - 798.33)$$

$$Q_{in} = 145621.85 \text{ kW}$$

$$Q_{\text{res.}} = \dot{m} y (h_2 - h_f) = 55(0.25)(3046.3 - 798.3)$$

$$Q_{\text{res.}} = 30909.59 \text{ kW}$$

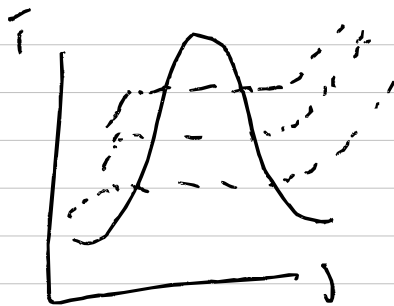
$$UF = \frac{W_{\text{net}} + Q_{\text{res.}}}{Q_{in}} = \frac{51479.8 + 30909.59}{145621.85}$$

$$UF = 0.56, \text{ } 100 = \boxed{56\%}$$

10-72 | $P_1 = 9 \text{ MPa} \quad T_1 = 400^\circ\text{C}$

$P_2 = 1.6 \text{ MPa}$

$\gamma = 0.35$



$P_3 = 10 \text{ kPa}$

$W_{net} = 25 \text{ MW} = 25,000 \text{ kW}$

1	2	3
$h_1 = 3118.4$	$h_2 = 2792$	$2892.1 = h_3$
$s_1 = 8.2876$	$s_1 = s_2$	$s_3 = s_1$

$W_{t1} = 3118.4 - 2792 = 326.4$

$1 - \gamma = 0.65$

$W_{t2} = 0.65(h_2 - h_3) = 0.65(2792 - 2892.1)$

$W_{t2} = 257.935$

$W_t = 326.4 + 257.935 = 586.335$

$W_p = v_f (P_2 - P_1)$

↓

$W_p = 0.001(9000 - 10) = 8.99 = 9 \text{ kJ/kg}$

$W_{net} = W_t - W_p = 586.335 - 9$

$W_{net} = 577.335 \frac{\text{kJ}}{\text{kg}}$

$W_{net} = \dot{m} \cdot w_{net} \rightarrow 25000 = \dot{m}(577.335)$

$\dot{m} = 43.302$