

$P_1 = 20 \text{ kPa}$
 $P_2 = 5 \text{ MPa}$
 $P_3 = P_4 = P_5 = P_6 = 1.4 \text{ MPa}$
 $P_7 = 245 \text{ kPa}$
 $P_8 = 20 \text{ kPa}$
 $P_9 = P_{10} = P_{11} = P_{12} = P_w$
 $T_1 = 251.42^\circ\text{C}$
 $T_2 = 700^\circ\text{C}$
 $T_3 = 2900.3^\circ\text{C}$
 $T_4 = 2900.3^\circ\text{C}$
 $T_5 = 2900.3^\circ\text{C}$
 $T_6 = 2900.3^\circ\text{C}$
 $T_7 = 2900.3^\circ\text{C}$
 $T_8 = 2900.3^\circ\text{C}$
 $T_9 = 2900.3^\circ\text{C}$
 $T_{10} = 2900.3^\circ\text{C}$
 $T_{11} = 2900.3^\circ\text{C}$
 $T_{12} = 2900.3^\circ\text{C}$
 $h_1 = 251.42$
 $h_2 = 829.96$
 $h_3 = 829.96$
 $h_4 = 829.96$
 $h_5 = 829.96$
 $h_6 = 829.96$
 $h_7 = 829.96$
 $h_8 = 829.96$
 $h_9 = 829.96$
 $h_{10} = 829.96$
 $h_{11} = 829.96$
 $h_{12} = 829.96$
 $s_1 = 0.001017$
 $s_2 = 7.5130$
 $s_3 = 7.5130$
 $s_4 = 7.5130$
 $s_5 = 7.5130$
 $s_6 = 7.5130$
 $s_7 = 7.5130$
 $s_8 = 7.5130$
 $s_9 = 7.5130$
 $s_{10} = 7.5130$
 $s_{11} = 7.5130$
 $s_{12} = 7.5130$
 $u_1 = 250.48$
 $u_2 = 829.96$
 $u_3 = 829.96$
 $u_4 = 829.96$
 $u_5 = 829.96$
 $u_6 = 829.96$
 $u_7 = 829.96$
 $u_8 = 829.96$
 $u_9 = 829.96$
 $u_{10} = 829.96$
 $u_{11} = 829.96$
 $u_{12} = 829.96$

$$h_3 - h_2 = z(h_1) + y(h_{10}) - (z + y)(h_{11})$$

$$h_4 - h_3 = y(h_{10} - h_9)$$

$$y(h_{10}) + z(h_1) - h_2 = (y + z)(h_{11}) + (h_{12})$$

$$\dot{m}_w = \dot{m}_5 (1 - y - z)(h_8) + (y + z)(h_{12} - h_1)$$

$$\dot{m}_w = 3146.7 \frac{\text{kg}}{\text{s}}$$

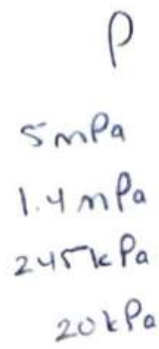
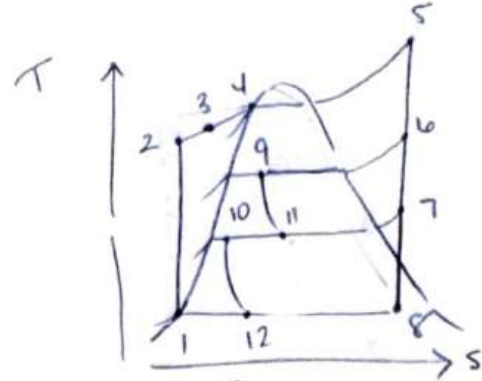
$$\dot{W}_{\text{out}} = h_5 - y h_6 - z h_7 - (1 - z - y) h_8$$

$$= 1245.71 \frac{\text{kJ}}{\text{kg}}$$

$$\dot{W}_{\text{net}} = \dot{W}_{\text{out}} - \dot{W}_{\text{in}} = 1240.65$$

$$\eta_{\text{th}} = \frac{\dot{W}_{\text{net}}}{\dot{Q}_{\text{in}}}$$

$$\eta_{\text{th}} = \frac{1240.65}{3070.34} = 0.404$$



$$z = 0.0981$$

$$y = 0.1446$$

$$m = 75$$

$$C_p = 4.18$$

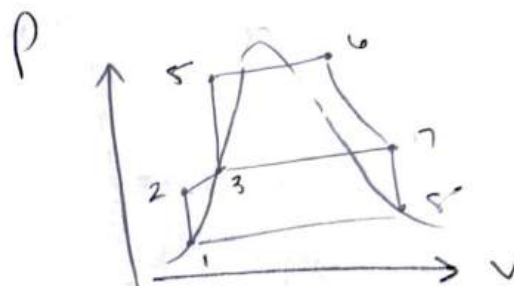
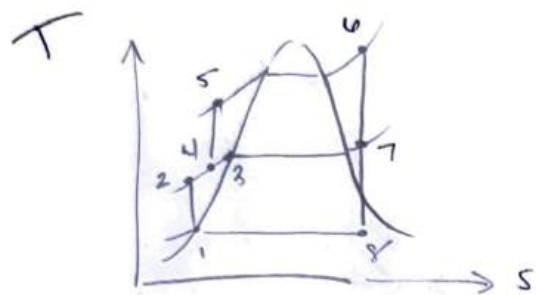
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$$P_{TIN} = 4 \text{ MPa} = 4000 \text{ kPa} \quad T_{TIN} = 500^\circ\text{C}$$

$$\dot{m} = 1/4 = 0.25 \quad P_{EXTRACTED} = 1200 \text{ kPa}$$

$$P_{EXPAND} = 10 \text{ kPa}$$

$$P_{BOILER} = 7 \text{ MPa} = 7000 \text{ kPa}$$



1	2	3	4	5	6	7	8
$P_1 = 10 \text{ kPa}$	$P_2 = 1200 \text{ kPa}$	$P_3 = P_2$	$P_4 = P_3$	$P_5 = 4000 \text{ kPa}$	$P_6 = P_5$	$P_7 = P_6$	$P_8 = P_7$
$h_1 = 191.81$		$h_3 = 798.6$		$h_5 = 3445.4$		$h_7 = 3079.7$	
$v_1 = 0.00101$		$\frac{\text{kJ}}{\text{kg}}$		$s_6 = 7.090$		$s_7 = s_6$	$h_8 = 2246$
							$s_8 = s_6$

$$w_{P1} = v_1 (P_2 - P_1)$$

$$= 1.2019 \frac{\text{kJ}}{\text{kg}}$$

$$w_{P1} = h_2 - h_1$$

$$h_2 = w_{P1} + h_1$$

$$= 193.0119 \frac{\text{kJ}}{\text{kg}}$$

$$m_3 h_3 + m_2 h_2 = m_4 h_4$$

$$(0.25)(798.6) + (0.75)(193.0119) = (1)(h_4)$$

$$h_4 = 344.409 \frac{\text{kJ}}{\text{kg}}$$

$$v_4 = 0.0010 \frac{\text{m}^3}{\text{kg}}$$

$$w_{P2} = v_4 (P_5 - P_4)$$

$$= 2.8 \frac{\text{kJ}}{\text{kg}}$$

$$w_{P2} = h_5 - h_4$$

$$h_5 = w_{P2} + h_4$$

$$= 347.209 \frac{\text{kJ}}{\text{kg}}$$

$$m_6 = 7 \text{ MT}$$

$$55 = 7 \text{ MT}$$

$$m_7 = 7.857 \frac{\text{kg}}{\text{s}}$$

$$w_T = m_7 (h_6 - h_7) + m_8 (h_6 - h_8)$$

$$7.857 (3445.4 - 3079.7) + (55 - 7.857) (3445.4 - 2246)$$

$$= 59410.62 \text{ kW}$$

$$\begin{aligned}
 W_P &= m_1 W_{P1} + m_8 W_{P2} \\
 &= (55 - 7.857)(1.2019) + (55)(2.8) \\
 &= 203.5783 \text{ kW}
 \end{aligned}$$

$$\begin{aligned}
 W_{NET} &= W_T - W_P = 59416.62 - 203.58 \\
 &= 59213.04 \text{ kW}
 \end{aligned}$$

$$\begin{aligned}
 \dot{Q}_{IN} &= m_5 (h_6 - h_5) \\
 &= 55 (3445.4 - 347.21) \\
 &= 170400.45 \text{ kW}
 \end{aligned}$$

$$\begin{aligned}
 \dot{Q}_{PROC} &= m_7 (h_7 - h_3) \\
 &= 7.857 (3097.7 - 798.6) \\
 &= 18064.0287 \text{ kW}
 \end{aligned}$$

$$\dot{Q}_U = W_{NET} + \dot{Q}_{PROC}$$

$$\dot{Q}_{IN}$$

$$= 59213.04 + 18064.03$$

$$170400.45$$

$$\boxed{= 0.4535}$$

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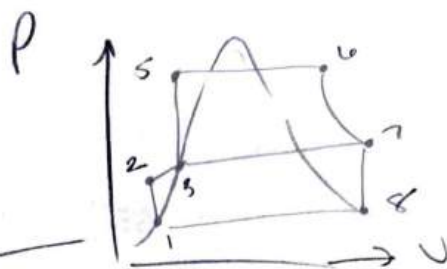
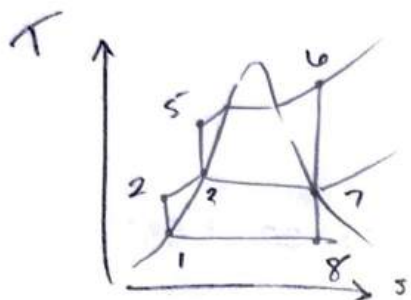
$$P_r = 9 \text{ MPa} \quad T_r = 400^\circ\text{C}$$

$$P_{\text{exhaust}} = 1.6 \text{ MPa}$$

$$m = 35\% = 0.35$$

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

$$\text{Net Power} = 25 \text{ MW}$$



$$\begin{array}{llllllllll}
 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\
 P_1 = 10 \text{ kPa} & P_2 = 1.6 \text{ MPa} & P_3 = 1.6 \text{ MPa} & P_4 = P_3 & P_5 = 9 \text{ MPa} & P_6 = P_5 & P_7 = 1.6 \text{ MPa} & P_8 = P_7 & P_9 = P_8 \\
 h_1 = 191.81 \frac{\text{kJ}}{\text{kg}} & h_2 = 858.5 \frac{\text{kJ}}{\text{kg}} & h_3 = 858.5 \frac{\text{kJ}}{\text{kg}} & h_4 = h_3 & T_5 = 400^\circ\text{C} & h_6 = 3118.8 \frac{\text{kJ}}{\text{kg}} & h_7 = 2876 \frac{\text{kJ}}{\text{kg}} & h_8 = h_7 & h_9 = h_8 \\
 v_1 = 0.00101 \frac{\text{m}^3}{\text{kg}} & & & v_4 = 0.001159 & & & & &
 \end{array}$$

$$w_{p1} = v_1 (P_2 - P_1)$$

$$\begin{aligned}
 &= 0.00101 (16000 - 10) \\
 &= 1.606 \frac{\text{kJ}}{\text{kg}}
 \end{aligned}$$

$$w_{p1} = h_2 - h_1$$

$$\begin{aligned}
 h_2 &= w_{p1} + h_1 \\
 &= 193.416 \frac{\text{kJ}}{\text{kg}}
 \end{aligned}$$

$$w_{p2} = v_4 (P_5 - P_4)$$

$$\begin{aligned}
 &= 0.001159 (9000 - 1600) \\
 &= 8.576 \frac{\text{kJ}}{\text{kg}}
 \end{aligned}$$

$$w_{p2} = h_5 - h_4$$

$$\begin{aligned}
 h_5 &= w_{p2} + h_4 \\
 &= 867.076 \frac{\text{kJ}}{\text{kg}}
 \end{aligned}$$

$$P_7 = 1.6 \text{ MPa}$$

$$h_f = 858.5$$

$$h_{fg} = 1934.3$$

$$s_f = 2.3435$$

$$s_{fg} = 4.0764$$

$$s_7 = s_6$$

$$s_7 = s_f + x_7 (s_{fg})$$

$$x_7 = \frac{s_7 - s_f}{s_{fg}} = 0.9675$$

$$h_7 = h_f + x_7 (h_{fg}) = 2729.935 \frac{\text{kJ}}{\text{kg}}$$

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

$$h_f = 191.81 \frac{\text{kJ}}{\text{kg}}$$

$$h_{fg} = 2392.1 \frac{\text{kJ}}{\text{kg}}$$

$$s_f = 0.6492 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$$

$$s_{fg} = 7.4996 \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$$

$$s_g = s_g$$

$$s_g = s_f + x_g (s_{fg})$$

$$x_g = \frac{s_g - s_f}{s_{fg}} = 0.7518$$

$$h_g = h_f + x_g (h_{fg})$$

$$= 1990.19 \frac{\text{kJ}}{\text{kg}}$$

$$(w_r)_{\text{out}} = (h_u - h_m) + (1 - m)(h_m - h_g)$$

$$= (3118.8 - 2729.935) + (1 - 0.35)(2729.935 - 1990.19)$$

$$= 869.69 \frac{\text{kJ}}{\text{kg}}$$

$$(w_p)_{\text{in}} = (1 - m)w_{p1} + w_{p2}$$

$$= (1 - 0.35)1.606 + 8.576$$

$$= 9.6199 \frac{\text{kJ}}{\text{kg}}$$

$$w_{\text{NET}} = (w_r)_{\text{out}} - (w_p)_{\text{in}}$$

$$= 869.69 - 9.6199$$

$$= 860.07 \frac{\text{kJ}}{\text{kg}}$$

$$P = \dot{m} (w_{\text{NET}})$$

$$25000 = \dot{m} (860)$$

$$\boxed{\dot{m} = 29.1 \frac{\text{kg}}{\text{s}}}$$