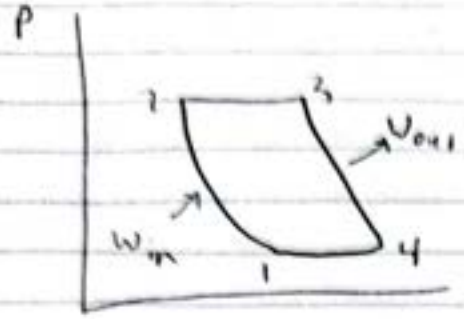
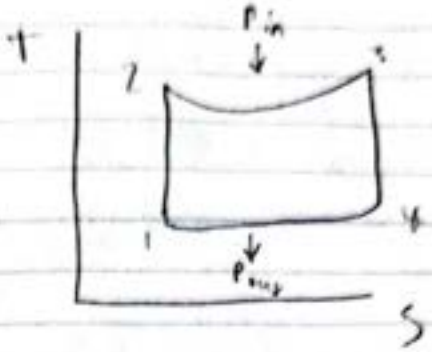
9-80





Isent Pconst Isent Pconst

Pconst ① ② ③ ④

$T_1 = 273°K$ $T_2 = 527°K$ $T_3 = 1027K$ $T_4 = 532K$

$P_1 = 70 kPa$ $P_2 = 700 kPa$ $P_3 = 700 kPa$ $P_4 = 70 kPa$

$T_2 = T_1 \cdot (P_r)^{\frac{k-1}{k}}$

$T_2 = 273 \cdot (10)^{\frac{1.4-1}{1.4}}$

$T_2 = 527°K$

$P_2 = P_r \cdot P_1$

$P_2 = 10 \cdot 70 = 700 kPa$

$q_{in} = C_p(T_3 - T_2)$

$T_3 = 527 + \frac{500}{1}$

$T_3 = 1027k$

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

$T_4 = 1027\left(\frac{1}{10}\right)^{\frac{0.4}{1.4}}$

$T_4 = 532k$

$$W_{1-2} = C_p(T_2 - T_1)$$

$$W_{1-2} = 1(527 - 273)$$

$$W_{1-2} = 254 \text{ kJ/kg}$$

$$W_{3-4} = C_p(T_3 - T_4)$$

$$W_{3-4} = 1(1027 - 537)$$

$$W_{3-4} = 495 \text{ kJ/kg}$$

$$P = m(W_{3-4} - W_{1-2})$$

$$P = 1(495 - 254)$$

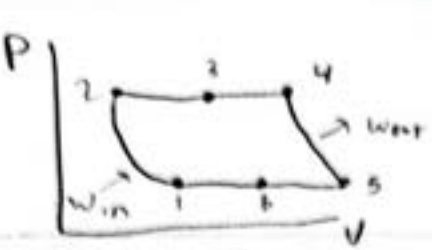
$$P = 241 \text{ kW}$$

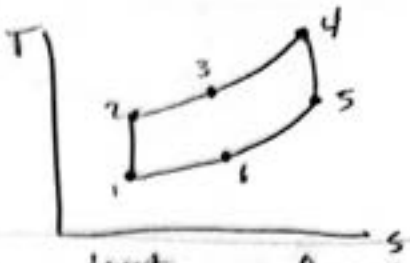
$$\eta_{th} = \frac{\text{Power}}{q_{in}}$$

$$\eta_{th} = \frac{241}{500}$$

$$\eta_{th} = .482 = 48.2\%$$

9-97





Isent P const P const Isent P const P const

(1) $P_1 = 100\ kPa$, $T_1 = 303°K$

(2) $P_2 = 1000\ kPa$, $T_2 = 585°K$

$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}}$

$T_2 = 303(10)^{\frac{1.4-1}{1.4}}$

$T_2 = 585°K$

(3) $P_3 = 1000\ kPa$, $T_3 = 546°K$

$T_3 = T_2 - 10°K$

$T_3 = 556 - 10$

$T_3 = 546$

(4) $P_4 = 1000\ kPa$, $T_4 = 1073°K$

$\frac{T_4}{T_5} = \left(\frac{P_4}{P_5}\right)^{\frac{k-1}{k}}$

$T_5 = 1073\left(\frac{1}{10}\right)^{\frac{.4}{1.4}}$

$T_5 = 555.76°K$

(5) $P_5 = 100\ kPa$, $T_5 = 556°K$

(6) $P_6 = 100\ kPa$, $T_6 = 595°K$

$T_6 = T_5 - (T_3 - T_2)$

$T_6 = 556 - (546 - 585)$

$T_6 = 595$

$W_{1-2} = C_p(T_2 - T_1)$

$W_{1-2} = 1(585 - 303)$

$W_{1-2} = 282\ kJ/kg$

$W_{3-4} = C_p(T_4 - T_5)$

$W_{3-4} = 1(1073 - 556)$

$W_{3-4} = 517\ kJ/kg$

$W_{net} = (W_{4-5} - W_{1-2})$

$W_{net} = 517 - 282 = 235$

$m = \frac{W_{NET\ given}}{W_{net\ calc}}$

$m = \frac{115}{235} = .489\ kg/s$

$q_{in} = m C_p(T_4 - T_3)$

$q_{in} = .489(1073 - 546)$

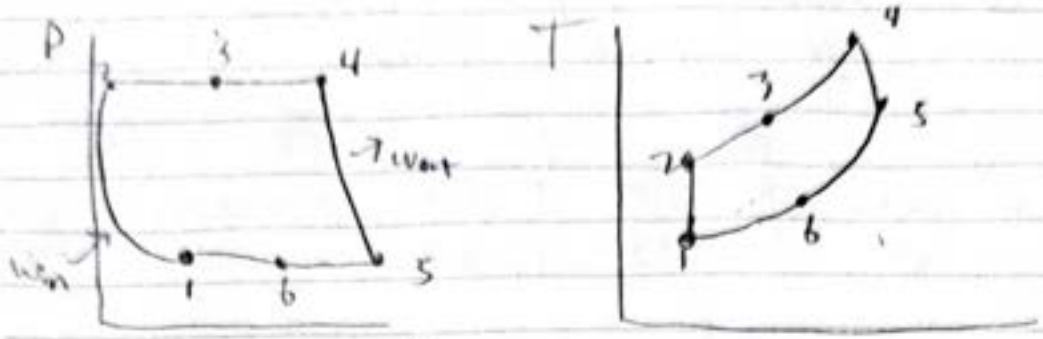
$q_{in} = 258\ kW$

$q_{in} = m C_p(T_6 - T_1)$

$q_{out} = .489(595 - 303)$

$q_{out} = 143\ kW$

107



P const isent P const V const isent S const P const

①	②	③	④	⑤	⑥
$P_1 = 100\ kPa$	$P_2 = 700 kPa$	$P_3 = 700 kPa$	$P_4 = 700 kPa$	$P_5 = 100 kPa$	$P_6 = 100 kPa$
$T_1 = 310°k$	$T_2 = 612°k$	$T_3 = 774°k$	$T_4 = 1140°k$	$T_5 = 788°k$	$T_6 =$
$h_1 = 310.24$	h_2 618.3	$h_3 = 738.4$	$h_4 = 1219.3$	$h_5 = 803.3$	
$P_{r_1} = 1.556$	$P_{r_2} = 17.4$		$P_{r_4} = 200$		

$$P_{r_2} = P_r \cdot P_{r_1}$$

$$P_{r_2} = 7 \cdot 1.556$$

$$P_{r_2} = 10.885$$

$$h_{2s} = 541.3$$

$$\eta_c = \frac{h_{2s} - h_1}{h_2 - h_1}$$

$$h_2 = 310.24 (541.3 - 310.24) / .75$$

$$h_2 = 618.3$$

$$\varepsilon = \frac{h_3 - h_2}{h_5 - h_2}$$

$$h_3 = 618.34 .65 (803 - 618)$$

$$h_3 = 738.4$$

$$P_{r_5} = \frac{1}{P_r} \cdot P_{r_4}$$

$$P_{r_2} = \frac{1}{7} \cdot 200$$

$$P_{r_5} = 28.6$$

$$h_{5s} = 717$$

$$\eta_T = \frac{h_4 - h_5}{h_4 - h_{5s}}$$

$$h_5 = 1219 - .82 (1219 - 717)$$

$$h_5 = 803.3$$

$$T_5 = 788°k$$

$W_{net} = W_{out} - W_{in}$

$W_{out} = (1719 - 868) = 410$

$W_{in} = (614.3 - 310) = 302$

$W_{net} = 410 - 302 = 108 kJ/kg$

$q_{in} = h_4 - h_3$

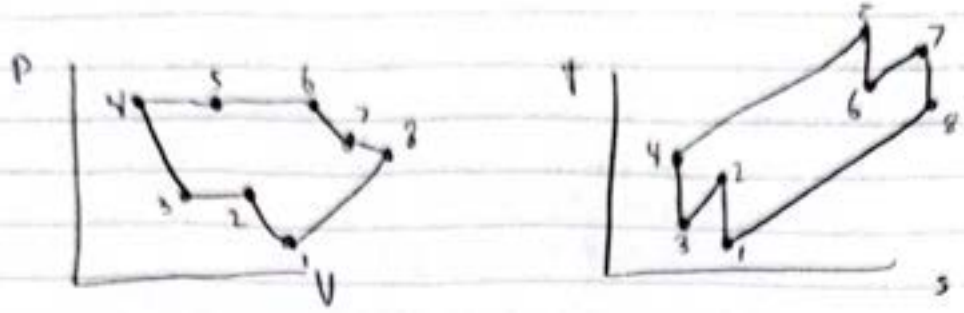
$q_{in} = 1719 - 738.4$

$q_{in} = 980$

$\eta_{th} = \frac{W_{net}}{q_{in}}$

$\eta_{th} = \frac{108}{486.3}$

$\eta_{th} = .775 = 77.5\%$



1	2	3	4	5	6	7	8
$P_1 = 100\ kPa$	$P_2 =$	$P_3 =$	$P_4 =$	$P_5 =$	$P_6 =$	$P_7 =$	$P_8 =$
$T_1 = 300°k$	$T_2 = 410°k$	$T_3 = 300°k$	$T_4 = 410°k$	$T_5 = 1200°k$	$T_6 = 910°k$	$T_7 = 1200°k$	$T_8 =$
$h_1 = 300$	$h_2 = 411.3$	$h_3 = 200$	$h_4 = 611.3$	$h_5 = 1278$	$h_6 = 948.4$	$h_7 = 1278$	
$P_{r1} = 1.386$	$P_{r2} = 4.150$			$P_{r5} = 238$	$P_{r6} = 70.3$		

$P_{r2} = (P_r)\,P_{r1}$

$P_{r2} = (3)\,1.386$

$P_{r2} = 4.150$

$h_2 = 411.3$

$T_2 = T_4 = 410°k$

$P_{r6} = \left(\frac{1}{P_r}\right) P_{r5}$

$P_{r6} = \left(\frac{1}{3}\right) 238$

$P_{r6} = 70.3$

$h_6 = 948.4$

$T_6 = T_8 = 910°k$

$w_{in} = 2(h_2 - h_1)$

$w_{in} = 2(411 - 300)$

$w_{in} = 222$

$w_{out} = 2(h_5 - h_6)$

$w_{out} = 2(1278 - 948) = 663$

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

$w_{net} = 663 - 222 = 441$

$\dot{m} = \frac{\dot{w}}{w_{net}}$

$\dot{m} = \frac{110{,}000}{441} = 250\ kg/s$

(2)