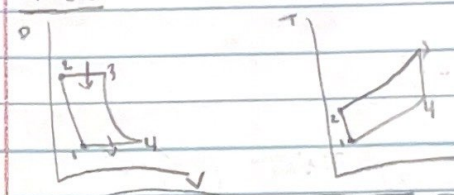
88, 99, 107, 119, 121

HW 1.4 - KAYLA DAMES - MET 350

9-88



brayton cycle

$r_p = 10 = P_2/P_1$

$Q_{in} = 500$ kw

① CP ② CP ③ isentrop ④

$P_1 = 70$ kPa

$T_1 = 273$ k

$T_2 = 273 \times 10^{0.4/1.4} = 527.1$ k

$P_2 = 10$

$T_3 = T_2 + \frac{Q_{2-3}}{mCp} = 527.1 + \frac{500}{1 \times 1.005} = 1025$ k

$P_3 = 10$

$P_4 = 1$

$T_4/T_3 = P_4^{k-1/k}/P_3$

$T_4 = 1025 \times \frac{1}{10}^{1.4-1/1.4} = 530.7$ k

$W_{1-2} = mCp(T_1 - T_2) = (1.005)(273 - 527.1) = -255.3$ kJ/s

$W_{2-3} = 0$

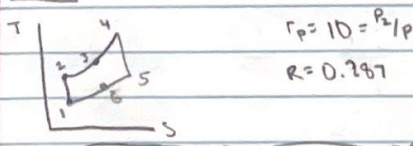
$W_{3-4} = mCp(T_4 - T_3) = 1 \times 1.005(1025 - 530.7) = 496.8$ kJ/s

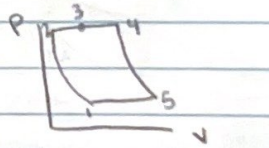
a) $W_{net} = W_{1-2} + W_{3-4}$

$= -255.3 + 496.8 =$ **241.5 kJ/s**

b) $\eta_{TH,BRAYTON} = \frac{W_{net}}{Q_{in}} = \frac{241.5}{500} = 0.483$ or **48.3%**

9-99





$r_p = 10 = P_2/P_1$ $C_p = 1.005$

$R = 0.287$ $C_v = 0.718$

① isentrop ② ③ ④ isentrop ⑤ ⑥

$T_1 = 303$ k $T_2 = 585$ k $T_3 = 545.71$ k $T_4 = 1073$ k $T_5 = 555.7$ k $T_6 = 595$ k

$T_2 = 303 \times 10^{1.4-1/1.4} = 585$ k

$T_5 = 1073 \times 0.5179 = 555.71$ k

$T_3 = T_5 - 10 = 545.71$ k

$T_6 = 55.71 - (545.71 - 585) = 595$ k

$W_{net} = W_a - W_c = C_p(T_4 - T_5) - C_p(T_2 - T_1)$

$= 1.005(1073 - 555.71) - 1.005(585 - 303) = 236.47$

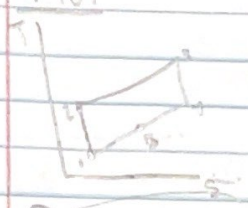
$\dot{m} = \frac{\dot{W}_{net}}{W_{net}} = 115/236.47 = 0.486$ kg/s

$Q_{in} = mCp(T_4 - T_3) = 0.486 \times 1.005(1073 - 545.71) =$ **257.7 kw**

$Q_{out} = mCp(T_6 - T_1) = 0.486 \times 1.005(595 - 303) =$ **142.71 kw**

HW 14 - KD

9-107



$r_p = 7$

$\eta_c = 75\%$ $\quad \varepsilon = 65\%$

$\eta_T = 82\%$

①	②	③	④
$T_1 = 310\ K$	$P_{r_2} = 7 \times 1.5546$	$h_3 = 1219.25\ kJ/kg$	$P_{r_4} = \frac{P_{r_3}}{P_{r_4}} = 28.59$
$h_1 = 310.24$	$P_{r_2} = 10.882$	$P_{r_3} = 200.15$	$h_{4s} = 711.77$
$P_{r_1} = 1.5546$	$h_{2s} = 541.26$	$T_3 = 1150\ K$	

$h_5 = h_2 + \varepsilon(h_{4s} - h_2) = 618.27 + .65(803.11 - 618.27) = 738.41\ kJ/kg$

$h_2 = h_1 + \frac{1}{\eta_c}(h_{2s} - h_1) = 310.24 + \frac{1}{0.75}(541.26 - 310.24) = 618.27\ kJ/kg$

$h_4 = h_3 - \eta_T(h_3 - h_{4s}) = 1219.25 - 0.82(1219.25 - 711.77) = 803.11\ kJ/kg$

a) T_4 @ $h_4 = 803.11$ (entrada)

$\boxed{T_4 = 782.8}$

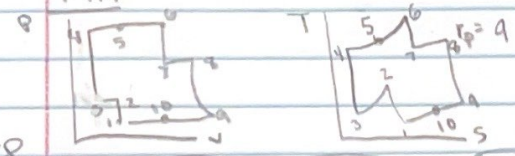
b) $W_{net} = (h_3 - h_4) - (h_2 - h_1)$

$= (1219.25 - 803.11) - (618.27 - 310.24) = \boxed{108.11\ kJ/kg}$

c) $\eta_{TH} = \frac{W_{net}}{Q_{in} \rightarrow h_3 - h_5}$

$= \frac{108.11}{1219.25 - 738.42} = 0.225$ or $\boxed{22.5\%}$

9-119



$r_p = 9$

① isen	② CP	③ isen	④ CP	⑤ CD	⑥ isen	⑦	⑧
$T_1 = 300\ k$	$P_{r_2} = 3 \times 1.3860$	$h_3 = 300.19$		$T_5 = 1200\ k$	$P_{r_6} = \frac{1}{3} \times 238$		$h_4 = 1277.79$
$h_1 = 300.19$	$P_{r_2} = 4.158$	$P_{r_3} = 1.3860$		$h_5 = 1277.79$	$r_{r_6} = 79.33$		
$P_{r_1} = 1.386$				$P_{r_5} = 238$			

$\frac{h_2 - 411.12}{421.411.12} = \frac{4.158 - 4.153}{4.822 - 4.153}$ $\quad \therefore h_2 = 411.257\ kJ/kg$

$\frac{h_6 - 932.93}{988.30 - 932.93} = \frac{79.33 - 75.29}{82.05 - 75.29}$ $\quad \therefore h_6 = 946.357\ kJ/kg$

$W_{comp_{in}} = 2(h_2 - h_1) = 2(411.257 - 300.19) = 222.13\ kJ/kg$

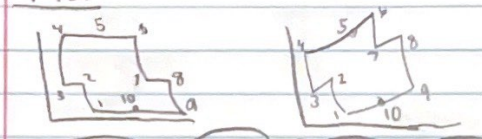
$W_{turb_{out}} = 2(h_5 - h_6) = 2(1277.9 - 946.357) = 662.866\ kJ/kg$

$W_{net} = 662.866 - 222.13$

$= 440.732\ kJ/kg$

$\dot{W} = \dot{m} \times W_{net} \rightarrow 110.3 = \dot{m} \times 440.732 \rightarrow \boxed{\dot{m} = 250\ kg/s}$

9-121



①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
$T_1 = 300$ K	$P_{r_2} = 4.158$	$h_3 = h_1$	$h_2 = h_4$	$T_5 = 1200$ K	$P_{r_6} = 79.33$	$T_7 = T_5$	$h_8 = h_6$		
$P_{r_1} = 1.386$	$h_2 = 411.26$			$h_5 = 1277.7$	$h_6 = 946.36$	$h_7 = h_5$			
$h_1 = 300.19$				$P_{r_5} = 238$					

$w_{in} = 2(h_2 - h_1) = 2(411.26 - 300.19) = 222.14$ kJ/kg

$w_{out} = 2(h_5 - h_6) = 2(1277.79 - 946.36) = 662.86$ kJ/kg

a) $r_{bw} = \frac{w_{in}}{w_{out}} = \frac{222.14}{662.86} = 0.335$ or $\boxed{33.5\%}$

$Q_{in} = (h_5 - h_4) + (h_7 - h_6)$

$= (1277.7 - 411.26) + (1277.79 - 946.36) = 1197.96$ kJ/kg

$w_{net} = 662.86 - 222.14 = 440.72$ kJ/kg

$\eta_{TH} = \frac{440.62}{1197.96} = 0.368 \rightarrow \boxed{36.8\ \%}$

b) $\epsilon = 0.75$

$Q_{reg} = \epsilon(h_4 - h_4) = 0.75(946.36 - 414.26) = 401.33$ kJ/kg

$Q'_{in} = 1197.96 - 401.33 = 796.63$ kJ/kg

$\eta_{TH} = \frac{440.72}{796.63} = 0.553$ $\boxed{55.3\%}$