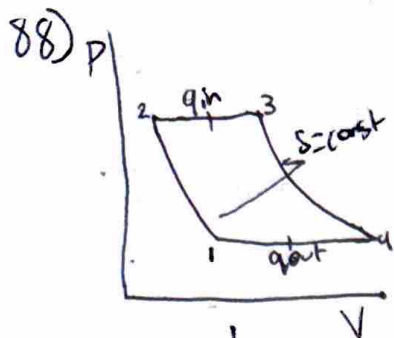
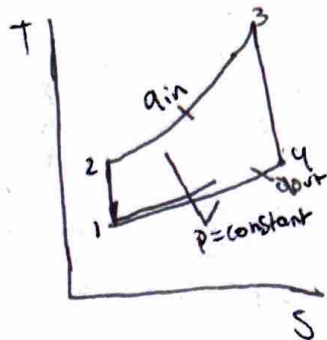




$$\eta_{th} = 1 - \frac{1}{r_p^{(k-1)/k}}$$

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

$$\eta_{th} = 0.482$$



$$W = \eta_{th} Q_{in}$$

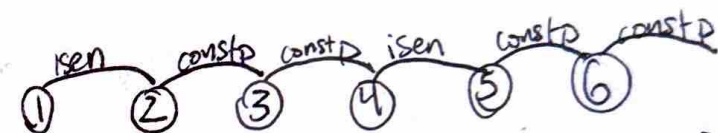
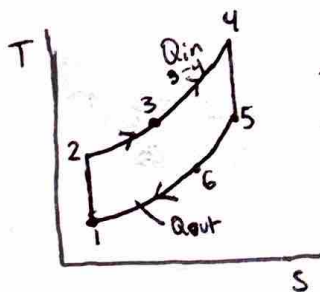
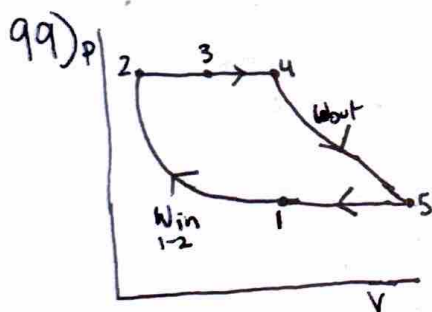
$$= 0.482 \cdot 500$$

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



$$T_1 = 273.15 \text{ K}$$

$$P_1 = 70 \text{ kPa}$$



$$T_1 = 303 \text{ K}$$

$$P_1 = 100 \text{ kPa}$$

$$T_2 = 1073 \text{ K}$$

$$T_6 = T_1 r_p^{(k-1)/k} + 10 \text{ K}$$

$$T_6 = 595 \text{ K}$$

$$m = \frac{W}{h_3 - h_4 - (h_2 - h_1)}$$

$$= \frac{W}{c_p(T_3(1 - r_p^{-(k-1)/k}) + T_1(1 - r_p^{(k-1)/k}))}$$

$$= \frac{115}{1.005(1073(1 - 10^{-(1.4-1)/1.4}) + 303(1 - 10^{(1.4-1)/1.4}))}$$

$$m = 0.496 \frac{\text{kg}}{\text{s}}$$

$$Q_{out} = m \cdot c_p (T_6 - T_1)$$

$$= 0.496 \cdot 1.005 (595 - 303)$$

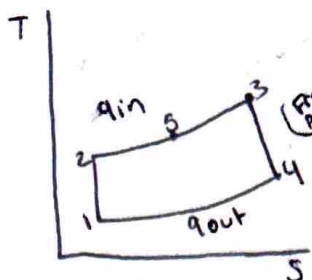
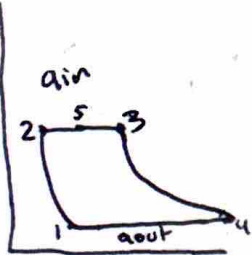
$$Q_{out} = 143 \text{ kW}$$

$$Q_{in} = W + Q_{out}$$

$$= (115 + 143)$$

$$Q_{in} = 258 \text{ kW}$$

107)



$$h_2 = h_1 + \frac{1}{\eta_c} (h_{2s} - h_1)$$

$$= (310.24 + \frac{1}{0.75} (541.26 - 310.24))$$

$$h_2 = 618.27 \frac{\text{kJ}}{\text{kg}}$$

$$h_4 = h_3 - \eta_T (h_3 - h_{4s})$$

$$= (1219.25 - 0.82 (1219.25 - 711.77))$$

$$h_4 = 803.11 \frac{\text{kJ}}{\text{kg}}$$

$$w = h_3 - h_4 - (h_2 - h_1)$$

$$= (1219.25 - 803.11) - (618.27 - 310.24)$$

$$w = 108.11 \frac{\text{kJ}}{\text{kg}}$$

$$\text{① } h_1 = 310.24 \frac{\text{kJ}}{\text{kg}}, Pr_1 = 1.5546$$

$$\text{② } Pr_2 = r_p Pr_1 = 7.15546$$

$$Pr_2 = 10.88$$

$$h_{2s} = 541.26$$

$$h_2 = 618.27 \frac{\text{kJ}}{\text{kg}}$$

$$\text{③ } h_3 = 1219.25 \frac{\text{kJ}}{\text{kg}}, Pr_3 = 200.15$$

$$Pr_4 = \frac{Pr_3}{r_p} = \frac{200.15}{7}$$

$$Pr_4 = 28.59$$

$$h_{4s} = 711.77$$

$$h_4 = 803.11 \frac{\text{kJ}}{\text{kg}}$$

$$h_5 = h_2 + \epsilon (h_4 - h_2)$$

$$= (618.27 + 0.65 (803.11 - 618.27))$$

$$h_5 = 738.42 \frac{\text{kJ}}{\text{kg}}$$

$$\eta_{th} = \frac{w}{q_{in}} = \frac{w}{h_3 - h_5}$$

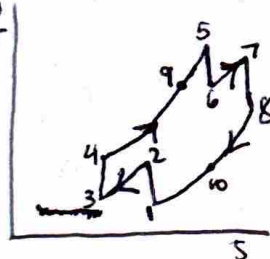
$$= \frac{108.11}{1219.25 - 738.42}$$

$$\eta_{th} = 0.225$$

$$T_4 = 782.8 \text{ K}$$

From A-17 using enthalpy

119)



$$\text{① } T_1 = 300 \text{ K}, h_1 = 300.19 \frac{\text{kJ}}{\text{kg}}, Pr_1 = 1.3860$$

$$\text{② } Pr_2 = \frac{P_2}{P_1} Pr_1 = 3 \cdot 1.386$$

$$Pr_2 = 4.158$$

$$h_2 = 411.26 \frac{\text{kJ}}{\text{kg}}$$

$$\text{⑤ } T_5 = 1200 \text{ K}, h_5 = 1277.79 \frac{\text{kJ}}{\text{kg}}, Pr_5 = 238$$

$$\text{⑥ } h_6 = 1277.79 \frac{\text{kJ}}{\text{kg}}, Pr_6 = 238$$

$$Pr_7 = \frac{Pr_6}{3} = \frac{238}{3}$$

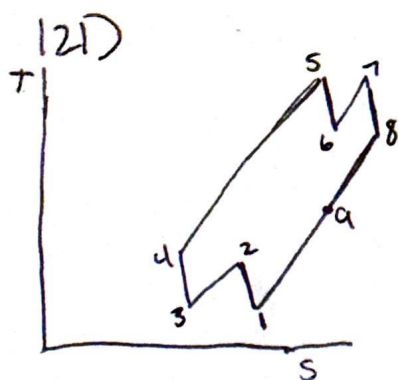
$$Pr_7 = 79.33$$

$$h_7 = 946.35$$

$$M = \frac{w}{2(h_6 - h_7) - 2(h_2 - h_1)}$$

$$m = \frac{110000}{2(1277.79 - 946.35) - 2(411.26 - 300.19)}$$

$$m = 250 \frac{\text{kg}}{\text{s}}$$



$$rbw = \frac{w_c}{w_t} = \frac{2(h_2 - h_1)}{2(h_6 - h_7)}$$

$$= \frac{411.26 - 300.19}{1277.79 - 946.35}$$

a) $rbw = 0.335$

$$\eta_{th} = \frac{w}{q_{in}} = \frac{2(h_6 - h_7) - 2(h_2 - h_1)}{h_6 - h_4 + h_8 - h_7}$$

$$= \frac{2(1277.79 - 946.35) - 2(411.26 - 300.19)}{1277.79 - 411.26 + 1277.79 - 946.35}$$

a) $\eta_{th} = 0.368$

1 2 3 4 5 6 7 8 9

$T_1 = 300K$
 $P_{r1} = 1.386$
 $h_1 = 300.19 \frac{kJ}{kg}$

$h_3 = 300.19 \frac{kJ}{kg}$

$P_{r2} = \frac{P_2}{P_1} P_{r1}$
 $= 3 \cdot 1.386$
 $P_{r2} = 4.158$
 $h_2 = 411.26 \frac{kJ}{kg}$

$h_3 = 300.19 \frac{kJ}{kg}$

$h_4 = 411.26 \frac{kJ}{kg}$

$h_6 = 1277.79 \frac{kJ}{kg}$
 $P_{r6} = 238$

$h_8 = 1277.79 \frac{kJ}{kg}$
 $P_{r8} = 238$

$P_{r7} = \frac{P_7}{P_6} P_{r6}$
 $= \frac{238}{3}$
 $P_{r7} = 79.33$
 $h_7 = 946.35 \frac{kJ}{kg} = h_9$

b) $\eta = \frac{w}{q_{in} - q_{reg}} = \frac{2(h_6 - h_7) - 2(h_2 - h_1)}{h_6 - h_4 + h_8 - h_7 - \epsilon(h_9 - h_4)}$

$$= \frac{2(1277.79 - 946.35) - 2(411.26 - 300.19)}{1277.79 - 411.26 + 1277.79 - 946.35 - 0.75(946.35 - 411.26)}$$

$\eta = 0.553$