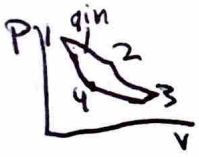
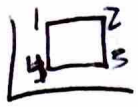
18) 



a) $P_4 = 300$

$P_1 = P_4 \frac{P_{r1}}{P_{r4}}$

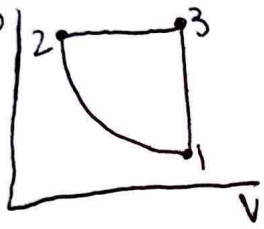
$= 300 \cdot \frac{238}{2.379}$ kPa

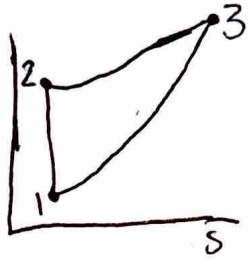
$= 300\,13$ kpa $=$ **30 MPa**

b) $\eta = 1 - \frac{T_L}{T_H}$ $\quad Q_{in} = \frac{T_H W_{net}}{T_H - T_L}$

$\frac{W_{net}}{Q_{in}} = 1 - \frac{T_L}{T_H}$ $\quad = \frac{1200 \cdot 0.5}{1200 - 350}$ kJ

$=$ **0.706 kJ**

22) a) 



$T_1 = 293$

b)

2-3

$q_{2-3} = w_{2-3} + \Delta u_{2-3}$

$= (R + c_v) T_1 r^{R/c_v}(r-1)$

$= (0.3 + 0.7) \cdot 293 \cdot 5^{0.3/0.7}(5-1)$ kJ/kg

$= 2336.1$ kJ/kg

1-2

$w_{1-2} = \Delta u_{1-2}$

$= c_v T_1 (r^{R/c_v} - 1)$

$= 0.7 \cdot 293 (5^{0.3/0.7} - 1)$ kJ/kg

$= 293.7$ kJ/kg

3-1

$q_{3-1} = \Delta u_{3-1}$

$= -c_v T_1 (1 - r^{R/c_v + 1})$

$= -0.7 \cdot 293 (1 - 5^{0.3/0.7+1})$ kJ/kg

$= 1839$ kJ/kg

2-3

$w_{2-3} = P(q_{2-3} - q_2)$

$= RT_1 r^{R/c_v}(r-1)$

$= 0.3 \cdot 293 \cdot 5^{0.3/0.7}(5-1)$ kJ/kg

$= 700.8$ kJ/kg

c) $\eta_{th} = 1 - \frac{q_{out}}{q_{in}}$

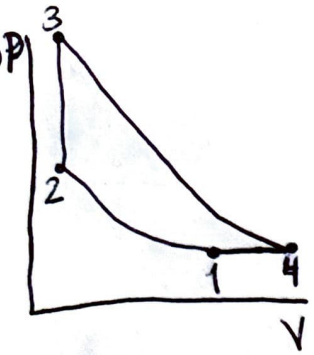
$= 1 - \frac{q_{4-1}}{q_{2-3}}$

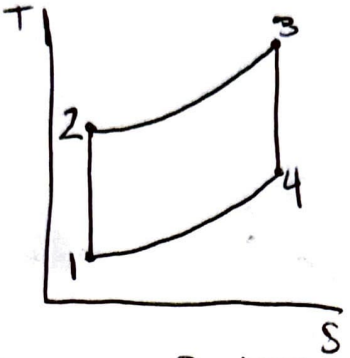
$= 1 - \frac{0.7(5^{0.3/0.7+1} - 1)}{(0.3+0.7)(5-1)5^{0.3/0.7}}$

$= 0.213$

Ramzie Abbas
MET 350
HW 1.2

13)





b) from A-17 $P_1 = 100$ $P_2 = 600\,kPa$ $P_3 = 1835.6\,kPa$ $P_4 = 100$

$T_2 = 490.3K$ $T_3 = 1500K$

$h_1 = 295.17 \frac{kJ}{kg}$

$P_{r1} = 1.3068$

$P_{r2} = \frac{P_2}{P_1} P_{r1}$

$= \frac{600}{100} \cdot 1.3068$

$= 7.8408$

$P_3 = P_2 \frac{T_3}{T_2}$

$= 600 \cdot \frac{1500}{490.3}\,kPa$

$= 1835.6\,kPa$

$P_{r4} = \frac{P_4}{P_3} P_{r3}$

$= \frac{100}{1835.6} \cdot 601.9$

$= 32.79$

from A-17 using interpolation:

$u_2 = 352.29 \frac{kJ}{kg}$

$T_2 = 490.3K$

$u_3 = 1205.41 \frac{kJ}{kg}$

$P_{r3} = 601.9$

$h_4 = 740.92 \frac{kJ}{kg}$

$w = u_3 - u_2 - (h_4 - h_1)$

$= (1205.41 - 352.29 - (740.92 - 295.17))$

$= \boxed{407.37 \frac{kJ}{kg}}$

c) $\eta_{th} = \frac{w}{q_{in}} = \frac{w}{u_3 - u_2}$

$= \frac{407.37}{1205.41 - 352.29}$

$= \boxed{0.478}$

31) $r = 10.5$

$P_1 = 90 kpa$

$T_1 = 40°C = 313K$

$W = 90kW$

$k = 1.4$ (from A-2)

$$\eta = \frac{W}{Q_{in}}$$

$$Q_{in} = \frac{W}{\eta} = \frac{90 kW}{0.61}$$

$$= 147.541 kW$$

$$= 61\%$$

$$\eta = 1 - \frac{1}{r^{k-1}}$$

$$= 1 - r^{1-k}$$

$$= 1 - 10.5^{1-1.4}$$

$$= \eta = 0.61$$

$Q_{in} = 147.541 kW$
61%