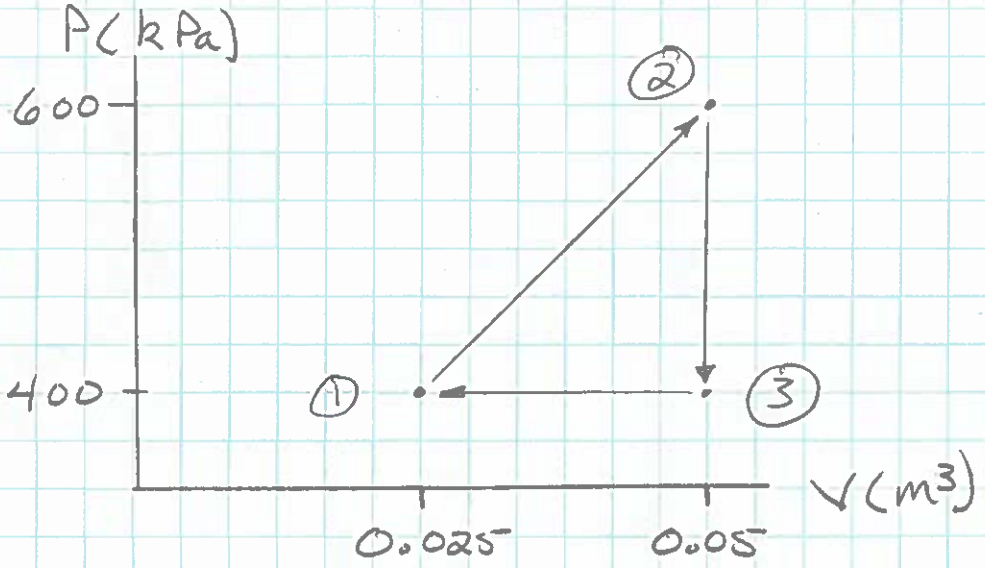


$n = 2$ mol  Monatomic $\Rightarrow C_V = \frac{3}{2}R$ ; $C_P = \frac{5}{2}R$

a.) use IGL, $PV = nRT$ (convert pressures)

$T_1 = \frac{P_1 V_1}{nR} = \underline{601.4\ K}$ ; $T_2 = \frac{P_2 V_2}{nR} = \underline{1804.2\ K}$

$T_3 = \frac{P_3 V_3}{nR} = \underline{1202.8 K}$

b.) Going around the cycle:

$\underline{1 \to 2}$: $\Delta E_{th} = nC_V \Delta T = \frac{3}{2} nR(T_2 - T_1) = \underline{3 \times 10^4\ J}$

$W_S$ = area under $1 \to 2$ process

$= \frac{1}{2}(P_2 - P_1)(V_2 - V_1) + P_1(V_2 - V_1)$

$= \underline{1.25 \times 10^4 J}$

1st Law: $\Delta E_{th} = Q - W_S$

$Q = \Delta E_{th} + W_S = \underline{4.25 \times 10^4 J}$

$2 \to 3$: $W_s = 0$

$\Delta E_{th} = nC_V \Delta T = \frac{3}{2} nR(T_3 - T_2) = -1.5 \times 10^4$ J

either, 1st law: $\Delta E_{th} = Q - W_s = Q$

or isochoric $Q = nC_V \Delta T = -1.5 \times 10^4$ J

$3 \to 1$: $\Delta E_{th} = nC_V \Delta T = \frac{3}{2} nR(T_1 - T_3) = -1.5 \times 10^4$ J

isobaric: $Q = nC_p \Delta T = \frac{5}{2} nR(T_1 - T_3)$

$= -2.5 \times 10^4$ J

1st law: $\Delta E_{th} = Q - W_s$

$W_s = Q - \Delta E_{th} = -1.0 \times 10^4$ J

or, just calculate area.

c.) $\eta = \frac{W_{out}}{Q_H}$

$W_{out} = W_{s\,1\to2} + W_{s\,2\to3} + W_{s\,3\to1} = 2.5 \times 10^3$ J

could also get this as the area of the cycle.

$Q_H = |\Sigma + Q's| = Q_{1\to2} = 4.25 \times 10^4$ J

So $\eta = 5.88 \times 10^{-2} = 5.88\%$

could also use $\eta = 1 - \frac{Q_L}{Q_H}$