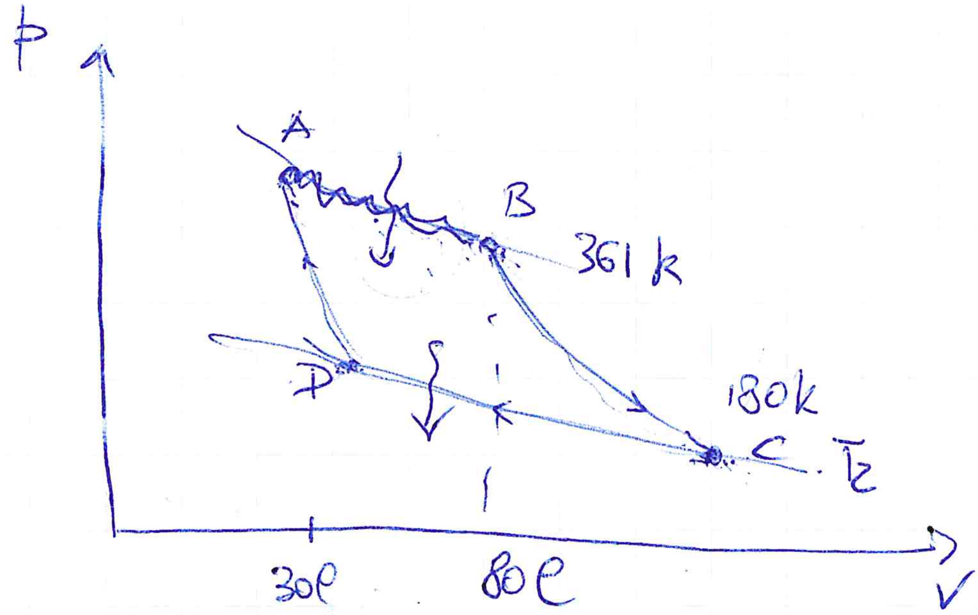
Es 1



$n = 1$

$p = 1\,\text{atm} = 1.013\times10^5\ Pa$

$V = 30\,l = 30\times10^{-3}\,m^3$

$\boxed{pV = nRT}$

$T_A = T_B = T_1 = 361\ K$

$T_D = T_C = T_2$

$$\boxed{L^R_{AB} = Q^R_{AB} = nRT_1 \ln\frac{V_B}{V_A}}$$

$$\boxed{\eta = \frac{L}{Q_{ASS}} = \frac{Q_{ASS} + Q_{CED}}{Q_{ASS}} = 1 + \frac{Q_{CED}}{Q_{ASS}}}$$

$Q_{CED} < 0 \qquad Q_{ASS} > 0$

$$\eta = 1 + \frac{Q_{CED}}{\frac{Q^R_{ASS}}{2}}$$

$$= 1 + \frac{nRT_2 \cdot \ln\frac{V_D}{V_C}}{\frac{1}{2}\cdot nRT_1 \ln\frac{V_B}{V_A}}$$

$$\left.\begin{aligned} T_A V_A^{\gamma-1} &= T_D V_D^{\gamma-1} \\ T_B V_B^{\gamma-1} &= T_C V_C^{\gamma-1} \end{aligned}\right\} \quad \begin{aligned} T_1 V_A^{\gamma-1} &= T_2 V_D^{\gamma-1} \\ T_1 V_B^{\gamma-1} &= T_2 V_C^{\gamma-1} \end{aligned}$$

$$\eta = 1 - \frac{\cancel{nR}T_2}{\frac{1}{2}nRT_1} \geq 0$$

$$= 1 - 2\frac{\cancel{nR}T_2}{T_1} \geq 0$$

$$T_2 \leq T_1/2$$

$T_1 = 361\ K$

$T_2 \leq 180\ K$

$$\eta_C = 1 - \frac{T_2}{T_1} = 0.5 \qquad 50\%$$

ΔS_u

$$\Delta S_{U_{AB}} = \Delta S_{SIS_{AB}} + \Delta S_{AMB_{AB}}$$

$$\boxed{\Delta S_{SIS_{AB}} = nR \ln \frac{V_B}{V_A}}$$

$$\Delta S_{AMB_{AB}} = -\frac{Q_{ASS}}{T_1} = \frac{-\frac{1}{2} nRT_1 \ln \frac{V_B}{V_A}}{T_1}$$

$$\Delta S_{U_{AB}} = nR \ln \frac{V_B}{V_A} - \frac{nR}{2} \ln \frac{V_B}{V_A}$$

$$= \frac{nR}{2} \ln \frac{V_B}{V_A} = \frac{1 \times 8.3145}{2} \ln \frac{80}{30} = 4.08\ J/K$$

Es 2

$$\boxed{dU = \underline{TdS} - p\,dV}$$

$$\delta Q_R = TdS$$

$$\boxed{S = \frac{4}{3}\sqrt[4]{aVU^3} + b}$$

$$dS = \frac{dU}{T} + \frac{p}{T}dV$$

$$= \frac{1}{T}\cdot dU + \frac{p}{T}\cdot dV$$

$$dS = \left(\frac{\partial S}{\partial U}\right)_V dU + \left(\frac{\partial S}{\partial V}\right)_U dV$$

$$\left(\frac{\partial S}{\partial U}\right)_V = \frac{1}{T} \qquad \left(\frac{\partial S}{\partial V}\right)_U = \frac{p}{T}$$

$$\frac{a^{1/4}V^{1/4}}{U^{1/4}} = \frac{1}{T} \qquad \frac{1}{3}\frac{a^{1/4}U^{3/4}}{V^{3/4}} = \frac{p}{T}$$

$$\boxed{U^{1/4} = a^{1/4}V^{1/4}T} \qquad \boxed{\frac{1}{3}a^{1/4}U^{3/4}\cdot T = pV^{3/4}}$$

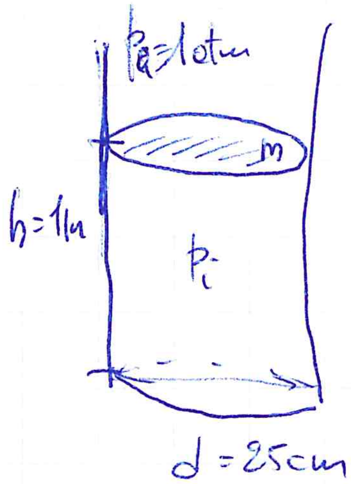
$$U = aVT^4 \qquad \underline{p = \frac{1}{3}aT^4}$$

$$\boxed{G = U - TS + PV}$$

$$= aVT^4 - T\frac{4}{3}(aVU^3)^{1/4} + \frac{1}{3}aT^4\cdot V =$$

$$= \cancel{a}VT^4 - \frac{4}{3}aVT^4 + \frac{1}{3}aVT^4 = \phi$$

Es 3



$n = 2 \qquad \gamma = \frac{5}{3}$

$p_a = 1\,atm$

$p_e = p_a + p_m$

$p_i = 1.1\,atm$

$p_i = p_e = p_a + p_m$

$\boxed{p_m = 10\%\, p_a}$

$p_m = \frac{F_m}{S} = \frac{mg}{\pi (d/2)^2} = 0.1\, p_a$

$m = 50.7\,kg$

$pV = nRT \rightarrow T = \frac{pV}{nR} = \frac{1.1 \times 1.013 \times 10^5 \cdot \pi \left(\frac{d}{2}\right)^2 \cdot h}{2 \times 8.3145}$

$\boxed{= 329\,K}$

$L_F = 400\,J$

$\Longrightarrow \quad T_f = \frac{p_f V_f}{nR} = \frac{1.5\, p_i\, S(h - \Delta h)}{nR} = 395\,K$

$\boxed{\begin{array}{l}\Delta h = 20\,cm \\ L_F = 400\,J\end{array}}$

$L = -L_F - mg\Delta h + p_a (V_f - V_i)$

$= -400\,J - 50.7 \cdot 9.81 \cdot 0.2 - 1.013 \times 10^5 (S \cdot (h - \Delta h))$

$= -1494\,J$

$$\Delta U = Q - L$$

$$\boxed{L = -1484\ J}$$

$$\Delta U = n c_v (385 - 328) = 1631\ J$$

$$Q = 1631 - 1484 = 147\ J$$

$$\boxed{\Delta S_{sis\, if} = n c_v \ln \frac{T_f}{T_i} + nR \ln \frac{V_f}{V_i}}$$

$$\Delta S_{AMB} = \frac{-Q}{T_{AMB}} = \frac{-147}{328} = -0.45\ J/K$$

$$\Delta S_{SIS} = 0.85\ J/K$$

$$\Delta S_U = 0.85 - 0.45 = 0.40\ J/K$$

$$2 \cdot \frac{3}{2} R \ln \frac{385}{328} + 2R \ln \frac{4}{5} =$$

$$= 2 \times 8.3145 \left[\frac{3}{2} \ln \frac{385}{328} + \ln \frac{4}{5} \right] = 0.85$$

$$Q = \boxed{L = nRT \ln \frac{V_f}{V_i}} = -1220\ J$$

$$\boxed{L_F^R = -126\ J}$$

$$\Delta S_U = 0 \Rightarrow \boxed{nR \ln \frac{V_f}{V_i} - \frac{Q}{T_i} = 0}$$

$$\Delta S_0 = nR \ln \frac{V_f}{V_i} - \frac{Q}{T} = 0$$

$$2 \times 8.3145 \cdot \ln \frac{4}{5} - \frac{Q}{328} = 0$$

$$Q = 328 \times 2 \times 8.3145 \cdot \ln \frac{4}{5} = -1220\ J$$

Es 4

$$Q_{coppe} = mc(T_h - T_i) = 0.2 \times 4186 \cdot 80 \doteq 67 \text{ kJ}$$

$$Q_{TOT} = Q_{copp} + Q_{AMB} = 67 + 45 = 112 \text{ kJ}$$

$$t = \frac{112 \text{ kJ}}{800 W} = 140 \text{ s}$$

$$\boxed{\Delta S_U = \Delta S_{coppe} + \Delta S_{AMB}}$$

$$= \int_{20}^{100} \frac{\delta Q}{T} + \frac{1}{T_{20}} \int \delta Q$$

$$= m c_s \ln \cancel{\frac{100}{}} \frac{T_f}{T_i} + \frac{1}{293.15} \cdot Q_{AMB}$$

$$= 354 \text{ J/K}$$

100 → 45

$$Q_{cess\ coppe}(100 \to 45) = mc_s(T_{45} - T_{100})$$

$$= -46 \text{ kJ} = Q_{ass}.$$

$$\Delta S_U = \Delta S_{sis}(100 \to 45) + \Delta S_{AMB}$$

$$= \underbrace{m c_s}_{} \ln \frac{T_{45}}{T_{100}} + \frac{46 \text{ kJ}}{293.15}$$

$$\Delta S_U(100-45) = 23.6\ J/K$$

Il caffè torna a 20 °C pertanto

$$\Delta S_U(20 \to 100 \to 45 \to 20) =$$

$$= \frac{P \cdot t}{T_i} = 381\ J/K$$

$$381 - (354 + 23.6) = 3.4\ J/K$$