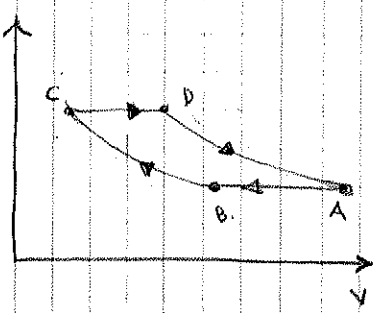
F2 2d. PARCIAL 7/7/2016.

PROB 1. $P_A = 100\ kPa$, $V_A = 30\ l$. $V_B = 10\ l$.

$P_C = 5P_B$ $PV = nRT$ $V_C = 2\ l$

$V_A = 3V_B$ $T_B = T_C = \frac{T_A}{3}$ $V_D = 6\ l$



b) $Q_{AB} = nC_p(T_B - T_A) = \frac{7}{2} nR(T_B - T_A) = \frac{7}{2} P_A(V_B - V_A) = -7000\ J$

$Q_{BC} = -W_{BC} = nRT_B \ln\left(\frac{V_C}{V_B}\right) = P_B V_B \ln\left(\frac{V_C}{V_B}\right) = -1609\ J$

$Q_{CD} = nC_p(T_D - T_C) = 7000\ J$

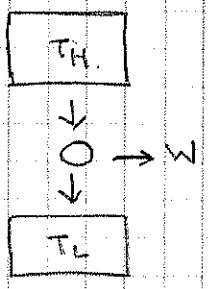
$Q_{DA} = -W_{DA} = P_A V_A \ln\left(\frac{V_A}{V_D}\right) = 4828\ J$

$|W_T| = |Q_T| = 3219\ J$

c) $\eta = \frac{|W_T|}{|Q_H|} = \frac{|W_T|}{Q_{CD} + Q_{DA}} = 0{,}272 \rightarrow 27\%$.

d) $\eta_C = 1 - \frac{T_L}{T_H} = 1 - \frac{1}{3} = 0{,}67 \rightarrow 67\%$.

$\eta_C = \frac{|W_T|}{|Q_{HC}|} \rightarrow |Q_{HC}| = |W_T|/\eta_C = 4828\ J$



$\Delta S_u = -\frac{|Q_H|}{T_H} + \frac{|Q_L|}{T_L}$

Si $|Q_{AB}| = |Q_{CD}| \rightarrow \begin{cases} |Q_H| = |Q_{DA}| \\ |Q_L| = |Q_{BC}| \end{cases} \rightarrow \Delta S_u = 0$

EL CICLO ES REVERSIBLE

PREGUNTA: $T_{H'} = 25°C = 298K$. $T_{L'} < 298K$.

A) $\eta_C = 1 - \frac{T_{L'}}{T_{H'}} = 0{,}12 \rightarrow T_{L'} = T_{H'}(1 - 0{,}12) = 262\ K$.

$COP \equiv \frac{|Q_{L'}|}{|W|} = \frac{|Q_{L'}|}{|Q_{H'}| - |Q_{L'}|} = \frac{T_{L'}}{T_{H'} - T_{L'}} = 7{,}33$.

B) $|W_{HT}| = 54\ kJ$, $|Q_{LHT}| = 102\ kJ$ $\rightarrow |Q_{HHT}| = 156\ kJ$

$T_L = 20°C = 293K$

$T_H = 230°C = 503\ K$

$Q_{L'}(máx) = COP \times |W_{HT}| = 396\ kJ$

$\eta_{HT} = \frac{|W_{HT}|}{|Q_{HHT}|} = 34{,}6\%$.

$\eta_C = 1 - \frac{T_L}{T_H} = 1 - \frac{293}{503} = 42\%$.

HT NO ES REVERSIBLE.

PROB 2.

ESTADO INICIAL $T_1 = 150K$

$V_1 = 1{,}0 m^3$

$P_1 = P_0 = 101{,}325 kPa$

$\Big\}$ $nR = \frac{P_1 V_1}{T_1} = 0{,}6755\ kJ/K$

PARTE A) PROCESO ISÓBARO A P_0 : $V_2 = 2V_1 \longrightarrow T_2 = 2T_1 = 300K$

$Q_{12} = n c_p (T_2 - T_1) = \frac{5}{2} nR \times 150 = 253{,}3\ kJ.$

$Q_{12} = m_{H_2O} \ell_v \longrightarrow m_{H_2O} = 0{,}1123\ kg.$ (mínima)

PARTE B) $m_{H_2O} = 200 g = 0{,}2\ kg. \longrightarrow$ $m_2 = 0{,}1123\ kg.$ (líquido)

$\searrow$ $m_2 = 0{,}0877\ kg$ (vapor)

Supongo que $T_3 = 100°C$. ¿Cuánto calor requiere el gas?

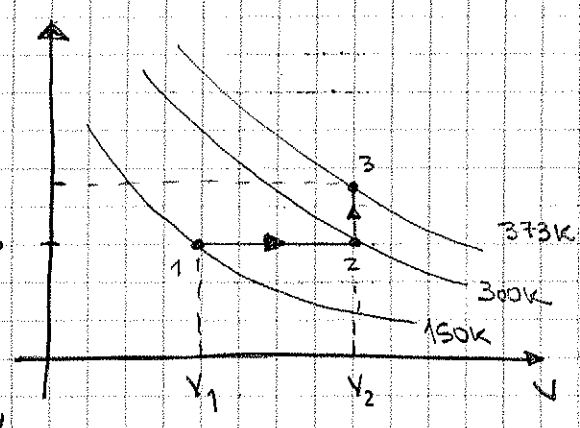
$Q_{23} = n c_v (T_3 - T_2) = \frac{3}{2} nR (373K - 300K) = 73{,}97\ kJ$

¿Qué cantidad de vapor debe condensarse para entregar ese calor?

$m_{H_2O} = \frac{Q_{23}}{\ell_v} = 0{,}0328\ kg$

Se concluye que $T_3 = 100°C = T_{H_2O}$ y que restan $0{,}055\ kg$ de agua que no se condensó.

PARTE C) $P_3 = \frac{nRT_3}{V_3} = 126\ kPa$



PARTE D) $\Delta S_u = \Delta S_g + \Delta S_{H_2O}$

$\Delta S_g = n c_v \ln\left(\frac{T_3}{T_1}\right) + nR \ln\left(\frac{V_3}{V_1}\right)$

$\Delta S_g = \frac{3}{2} nR \ln\left(\frac{373}{150}\right) + nR \ln\left(\frac{2}{1}\right) = 1{,}39\ kJ/K.$

$\Delta S_{H_2O} = -\frac{m_e \ell_v}{T_{H_2O}} = -\frac{(0{,}2 - 0{,}155) \times 2256}{373} = -0{,}88\ kJ/K.$

$\Delta S_u = 0{,}51\ kJ/K.$