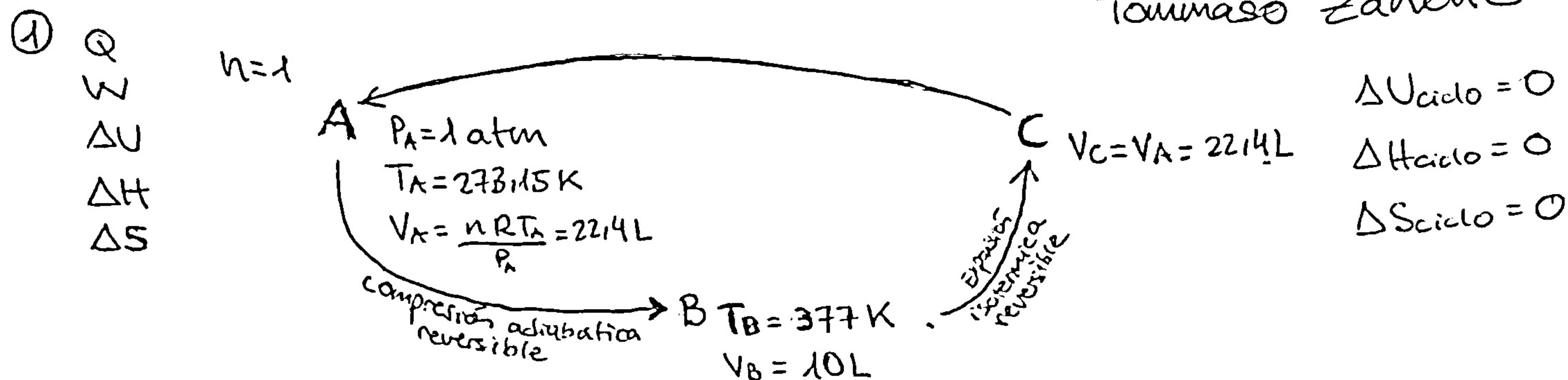




$$\Delta U = Q - W$$

$$Q = 0 \rightarrow \Delta U = -W \Rightarrow W = -2159 \text{ J}$$

$$\Delta S = 0 \quad \Delta U = C_V \cdot (T_F - T_i) = \frac{5}{2} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot 1 \text{ mol} \cdot (377 - 273,15) = 2159 \text{ J}$$

O_2 $C_V = \frac{5}{2} R$
 $C_P = \frac{7}{2} R$

$\gamma = \frac{C_P}{C_V} = \frac{7}{5} = 1,4$

$T_B = \frac{T_A (\bar{V}_A)^{\gamma-1}}{(\bar{V}_B)^{\gamma-1}} = \frac{273 \text{ K} \cdot 22,14 \text{ L}^{(1,4-1)}}{10 \text{ L}^{(1,4-1)}} = 377 \text{ K}$

$$\Delta H = C_P \cdot (T_F - T_i) = \frac{7}{2} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot 1 \text{ mol} \cdot (377 - 273,15) = 3022 \text{ J}$$

$$\Delta S = n \cdot R \cdot \ln\left(\frac{V_C}{V_B}\right) = 1 \text{ mol} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot \ln\left(\frac{22,14 \text{ L}}{10 \text{ L}}\right) = 617 \text{ J/K}$$

$$W = Q = nRT \ln\left(\frac{V_C}{V_B}\right) = 1 \text{ mol} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot 377 \text{ K} \cdot \ln\left(\frac{22,14 \text{ L}}{10 \text{ L}}\right) = 2528 \text{ J}$$

$$\Delta U = Q - W \Rightarrow \Delta U = 0 \quad \Delta H = C_P \cdot (T_F - T_i) = 0$$

$$\Delta U = Q - W \quad W = 0 \Rightarrow \Delta U = Q$$

$$\Delta U = C_V \cdot (T_F - T_i) = \frac{5}{2} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot 1 \text{ mol} \cdot (273,15 - 377) = -2159 \text{ J}$$

$$\Delta H = C_P \cdot (T_F - T_i) = \frac{7}{2} \cdot 8,314 \frac{\text{J}}{\text{mol K}} \cdot 1 \text{ mol} \cdot (273,15 - 377) = -3022 \text{ J}$$

$$\Delta S = -617 \text{ J/K} \quad Q = -2159 \text{ J}$$

Al final del ciclo los valores se compensan ya que la variación tiene que ser nula.

Tarea tema 4

Tommaso Zanette

② $n = 1 \text{ mol}$

Ⓐ $P_A = 1 \text{ atm}$

$T_A = 273 \text{ K}$

$V_A = \frac{nRT_A}{P_A} = 22.14 \text{ L}$

compression
isotermica
reversible
 $\Delta U_1 = \Delta H_1 = 0$

Ⓑ $T_B = 273 \text{ K}$
 $V_B = 10 \text{ L}$

expansion
Adiabatica
reversible
 T_C
 P_C

Ⓒ $V_C = V_A = 22.14 \text{ L}$

ΔU	$\Delta U_{\text{ciclo}} = 0$
ΔH	$\Delta H_{\text{ciclo}} = 0$
ΔS	$\Delta S_{\text{ciclo}} = 0 = Q - W$
Q	$\downarrow$ $Q = W$
W	
$\Delta U_1 = Q_1 - W_1 = 0$	

$$\Delta U = C_V (T_F - T_i)$$

A $\Delta H = C_P (T_F - T_i)$

$$Q_1 = W_1 = nRT \cdot \ln\left(\frac{V_B}{V_A}\right) = 8.314 \text{ J/molK} \cdot 273 \text{ K} \cdot \ln\left(\frac{10 \text{ L}}{22.14 \text{ L}}\right) \cdot 1 \text{ mol} = -1830 \text{ J}$$

$$\Delta S_1 = C_V \cdot \ln\left(\frac{T_B}{T_A}\right) + n \cdot R \cdot \ln\left(\frac{V_B}{V_A}\right) \Rightarrow \Delta S_1 = 1 \text{ mol} \cdot 8.314 \text{ J/molK} \cdot \ln\left(\frac{10 \text{ L}}{22.14 \text{ L}}\right) = -617 \text{ J/K}$$

B $Q_2 = 0 \rightarrow \Delta U_2 = -W_2$

$\Delta S_3 = 0$

$O_2 \begin{cases} C_P = \frac{7}{2} R \\ C_V = \frac{5}{2} R \end{cases}$

$$T_2 = \frac{T_1 (V_1)^{\gamma-1}}{(V_2)^{\gamma-1}} = \frac{273 \text{ K} \cdot 10^{\frac{1.4-1}{1.4}}}{22.14 \text{ L}^{\frac{1.4-1}{1.4}}} = 198 \text{ K}$$

$$\gamma = \frac{C_P}{C_V} = \frac{\frac{7}{2} R}{\frac{5}{2} R} = \frac{7}{5} = 1.4$$

$$\Delta U = C_V (T_F - T_i) = \frac{5}{2} 8.314 \cdot 1 (198 - 273) = -1560 \text{ J}$$

$$\Delta H = C_P (T_F - T_i) = \frac{7}{2} 8.314 \cdot 1 (198 - 273) = -2182 \text{ J}$$

$$W_2 = -\Delta U_2 \Rightarrow W_2 = 1560 \text{ J}$$

C $\Delta U_3 = Q_3 - W_3$

$W = 0$

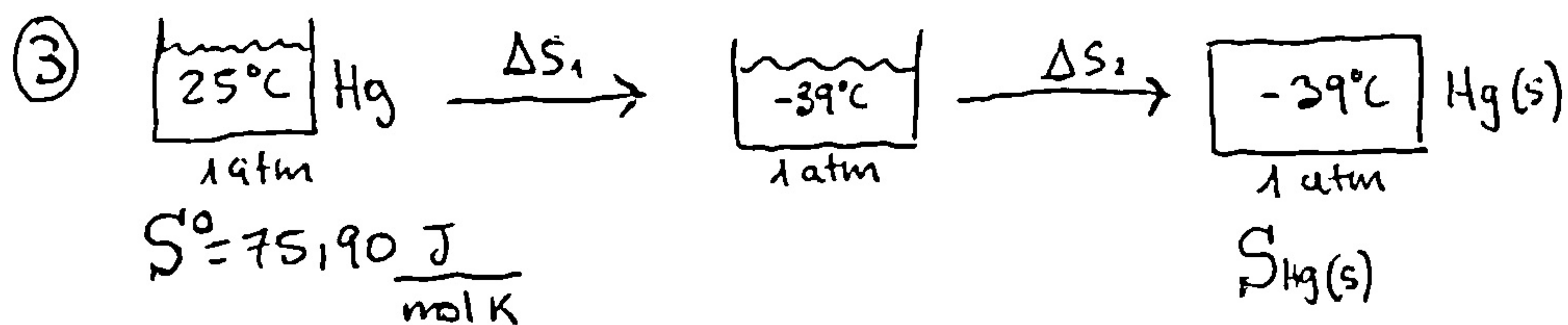
$$\Delta U = C_V (T_F - T_i) = \frac{5}{2} 8.314 \cdot 1 (273 - 198) = 1560 \text{ J}$$

$$\Delta H = C_P (T_F - T_i) = \frac{7}{2} 8.314 \cdot 1 (273 - 198) = 2182 \text{ J}$$

$$Q_3 = 1560 \text{ J}$$

$$\Delta S_3 = 617 \text{ J/K}$$

Como al final del ciclo la variación tiene que ser 0, los resultados que faltan salen de que al sumarlos todos el resultado tiene que ser 0; despejando y para compensar las variaciones salen esos números



$$C_p = 27,98 \frac{\text{J}}{\text{mol K}}$$

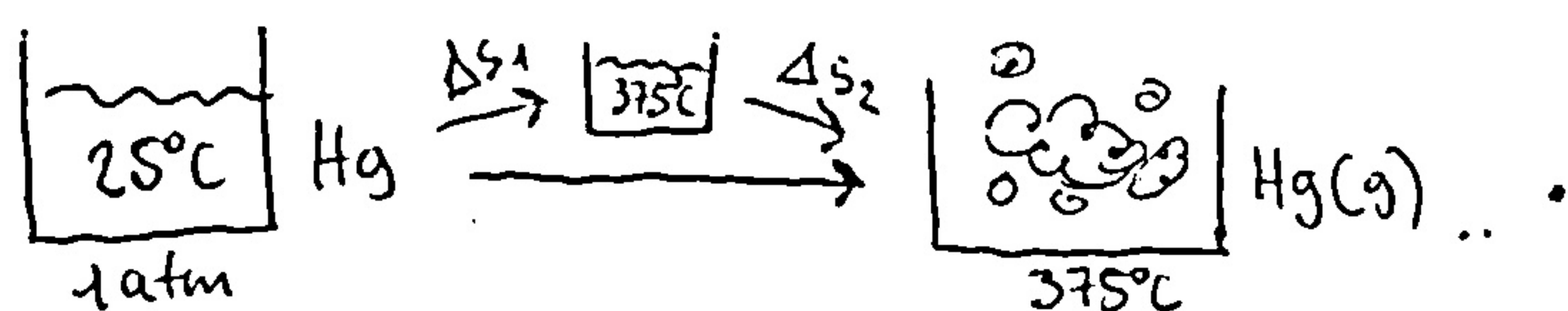
$$\Delta H_f = 2,30 \text{ kJ/mol}$$

$$S_{\text{Hg}(s)} = S^\circ + \Delta S_1 + \Delta S_2$$

$$\Delta S_1 = C_p \cdot \ln\left(\frac{T_f}{T_i}\right) \Rightarrow \Delta S_1 = 27,98 \ln\left(\frac{-39+273,15}{25+273,15}\right) = -6,77 \text{ J/mol K}$$

$$\Delta S_2 = \frac{Q_{\text{rev}}}{T} = \frac{\Delta H}{T} = \frac{-2300}{234} = -9,83 \text{ J/mol K}$$

$$S_{\text{Hg}(s)} = 75,90 + (-6,77) + (-9,83) = 59,3 \text{ J/mol K}$$



$$S^\circ = 75,90 \text{ J/mol K}$$

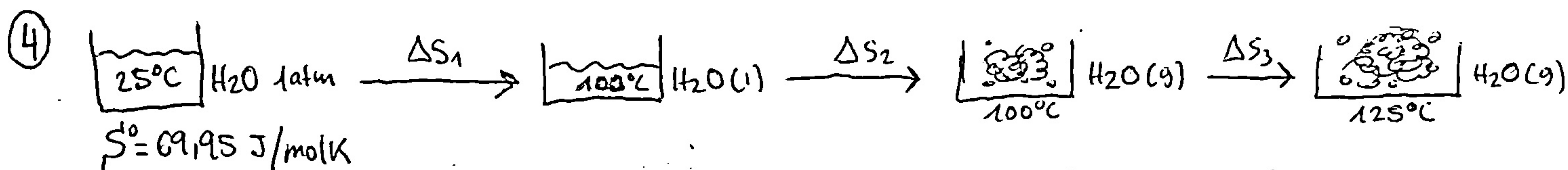
$$C_p = 27,98 \frac{\text{J}}{\text{mol K}}$$

$$\Delta H_v = 59,23 \text{ kJ/mol}$$

$$\Delta S_1 = C_p \cdot \ln\left(\frac{375+273}{25+273}\right) \Rightarrow \Delta S_1 = 21,73 \text{ J/mol K}$$

$$\Delta S_2 = \frac{Q_{\text{rev}}}{T} = \frac{\Delta H}{T} = \frac{59230}{648} = 91,4 \text{ J/mol K}$$

$$S_{\text{Hg}(g)} = 75,90 + 21,73 + 91,4 = 189,03 \text{ J/mol K} \approx 190,8 \text{ J/mol K}$$



$$S^\circ = 69,95 \text{ J/mol K}$$

$$(l) C_p = 1 \text{ cal/g K} = 75,24 \text{ J/mol K}$$

$$\Delta H_{\text{ebu}} = 44 \text{ kJ/mol}$$

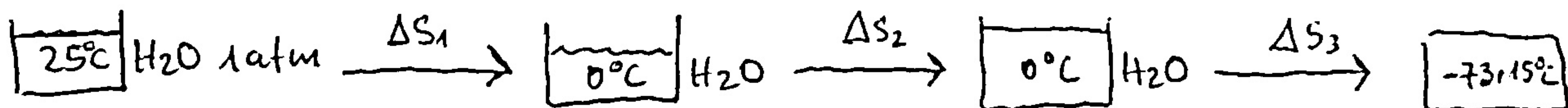
$$(g) C_p = \frac{9}{2} R = 37,41 \text{ (vapor)}$$

$$\Delta S_1 = 75,24 \frac{\text{J}}{\text{mol K}} \cdot \ln\left(\frac{273+100}{273+25}\right) = 16,88 \text{ J/mol K}$$

$$\Delta S_2 = \frac{\Delta H}{T} = \frac{44000}{373} = 118 \text{ J/mol K}$$

$$\Delta S_3 = 37,41 \frac{\text{J}}{\text{mol K}} \cdot \ln\left(\frac{273+125}{273+100}\right) = 2,43 \text{ J/mol K}$$

$$S_{\text{H}_2\text{O}(g)} = 69,95 + 16,88 + 118 + 2,43 = 207,3 \text{ J/mol K}$$



$$S^\circ = 69,95 \text{ J/mol K}$$

$$(l) C_p = 1 \text{ cal/g K} = 75,24 \text{ J/mol K}$$

$$\Delta H_f = 6 \text{ kJ/mol}$$

$$(s) C_p = 2,09 \text{ kJ/Kg K} = 37,62 \text{ J/mol K}$$

$$\Delta S_1 = 75,24 \frac{\text{J}}{\text{mol K}} \cdot \ln\left(\frac{0+273}{25+273}\right) = -6,59 \text{ J/mol K}$$

$$\Delta S_2 = \frac{\Delta H}{T} = \frac{-6000}{273} = -22 \text{ J/mol K}$$

$$\Delta S_3 = 37,62 \frac{\text{J}}{\text{mol K}} \cdot \ln\left(\frac{-73,15+273}{0+273}\right) = -11,73 \text{ J/mol K}$$

$$S_{\text{H}_2\text{O}(s)} = 69,95 - 6,59 - 22 - 11,73 = 29,63 \text{ J/mol K}$$