Clase 85 20 enero 2021

Título de la nota 20/01/2021

Vap = L → V

Sublimación = S → V

Antonio

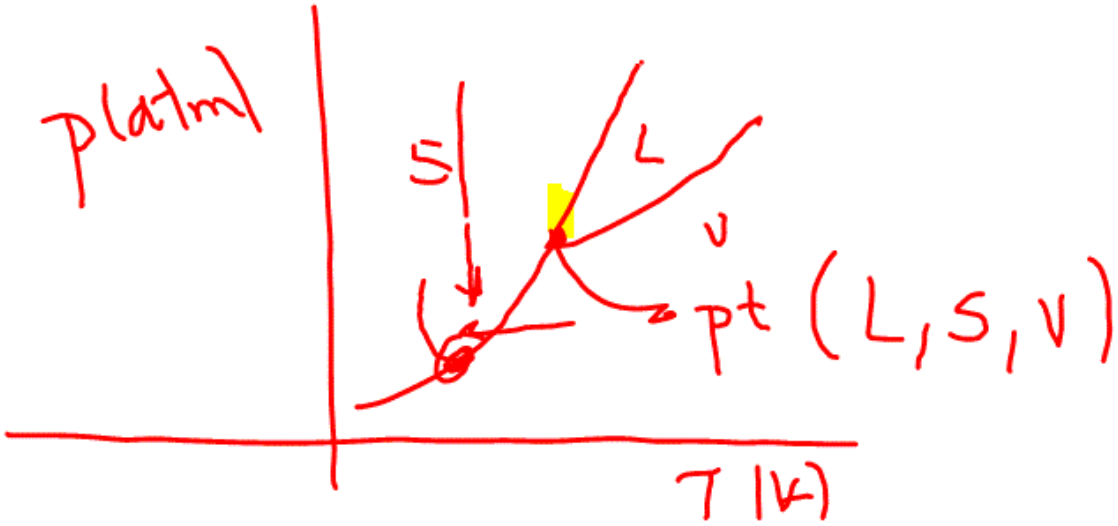
Vap = ~~L~~ → V

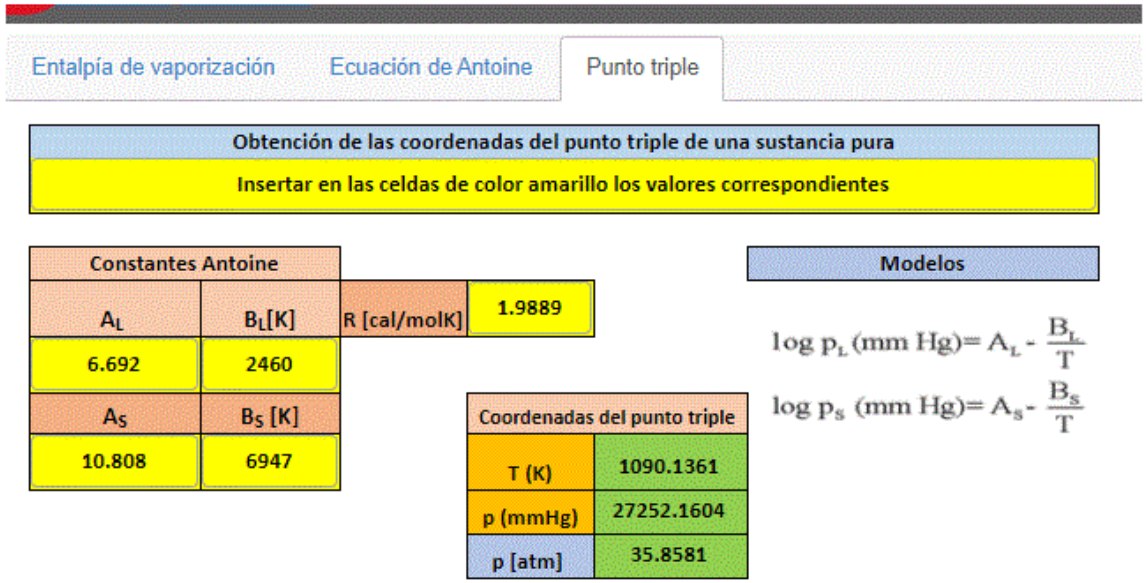
Fusión = S → ~~L~~

Sublimación S → V

$\overline{\Delta H_S} = \overline{\Delta H_V} + \overline{\Delta H_F}$

$$\overline{\Delta H_f} = \overline{\Delta H_S} - \overline{\Delta H_V}$$





Entalpía de vaporización | Ecuación de Antoine | Punto triple

Obtención de las coordenadas del punto triple de una sustancia pura

Insertar en las celdas de color amarillo los valores correspondientes

Constantes Antoine			
A_L	B_L[K]	R [cal/molK]	1.9889
6.692	2460		
A_S	B_S [K]		
10.808	6947		

Coordenadas del punto triple	
T (K)	1090.1361
p (mmHg)	27252.1604
p [atm]	35.8581

Modelos

$$\log p_L\,(\text{mm Hg}) = A_L - \frac{B_L}{T}$$

$$\log p_S\,(\text{mm Hg}) = A_S - \frac{B_S}{T}$$

$$A_L - \frac{B_L}{T} = A_S - \frac{B_S}{T}$$

$$A = \text{Ordenada} \quad A_L - A_S = -\frac{B_S}{T} + \frac{B_L}{T}$$

$$B = K$$

$$A_L - A_S = (B_L - B_S)\frac{1}{T}$$

$$T = \frac{B_L - B_S}{A_L - A_S}(K) = 1090.1361$$

$$p_{vap} = 10^{\left(A_L - \frac{B_L}{T}\right)} = 27252.1663 \text{ (K)}$$

$$(mmHg) = 10^{\left(A_S - \frac{B_S}{T}\right)} = 27252.1770 \text{ (K)}$$

T (K)	1/T	p (mm Hg)	Ln p
645.4683	0.00154926	760.00	6.633318
644.4955	0.00155160	750.00	6.620073
643.5127	0.00155397	740.00	6.606650
642.5196	0.00155637	730.00	6.593045

b (ordenada al origen)	15.4089
m (pendiente) K	-5664.3593
r	-1.0
ΔH_v (cal/mol)	11265.8443

T (K)	1/T	p (mm Hg)	Ln p
876.3513	0.00114109	760.00	6.633318
875.7158	0.00114192	750.00	6.620073
875.0728	0.00114276	740.00	6.606650
874.4219	0.00114361	730.00	6.593045

b =ordenada al origen	24.8863
m (pendiente) K	-15996.0586
r	-1.0
ΔH_{sub} (cal/mol)	31814.5610

ΔH_v [cal/mol]	11265.8443
ΔH_v [J/mol]	47158.8241
ΔH_F [cal/mol]	20548.7168
ΔH_F [J/mol]	86016.9284
ΔH_{sub} [cal/mol]	31814.5610
ΔH_{sub} [J/mol]	133175.7525

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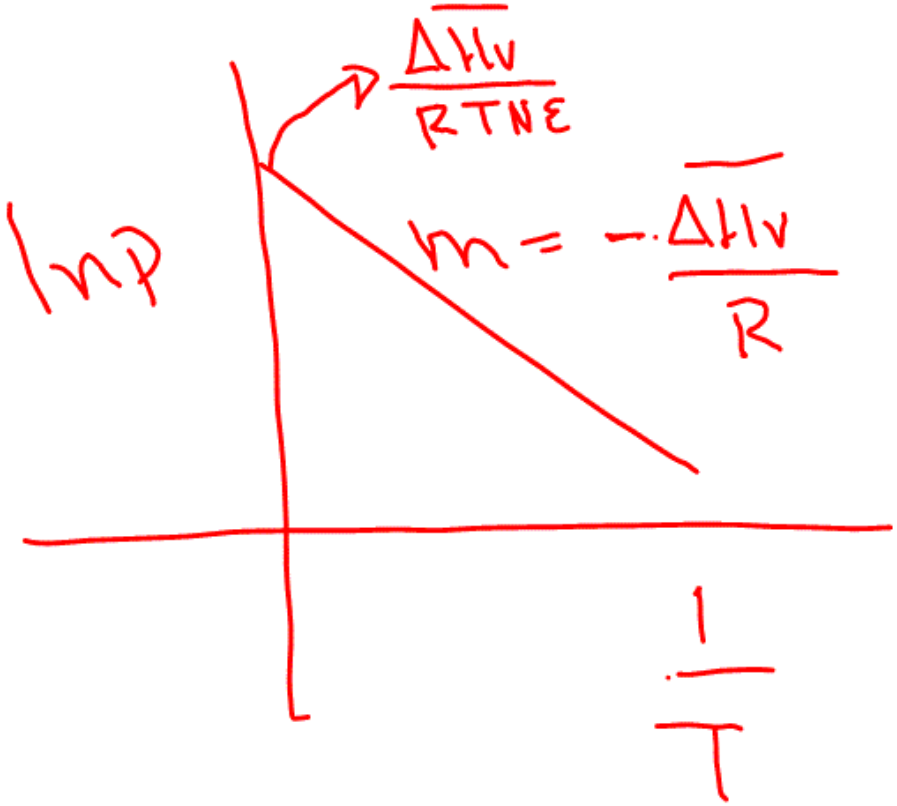
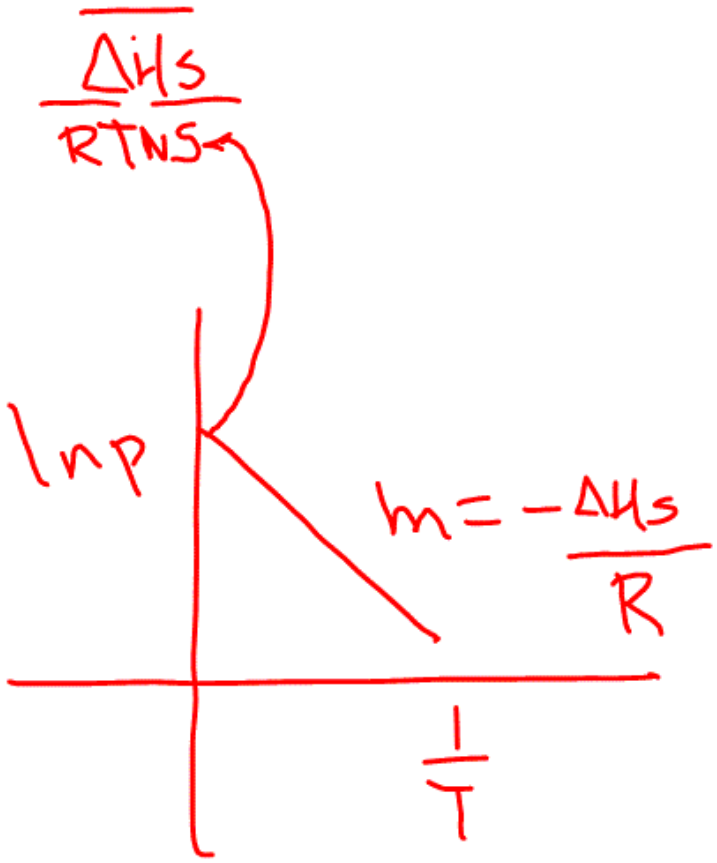
$$\log p_{vap} = A - \frac{B}{T}$$

$$\log p_{vap} - A = -\frac{B}{T}$$

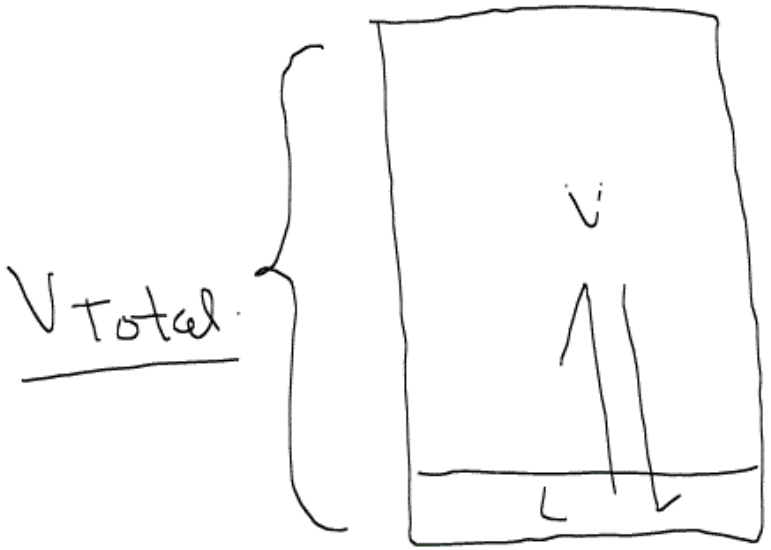
$$T = \left\{ \frac{-B}{\log[(760\ mmHg) - A]} \right\} = 645.12\ K$$





$$-m = -\frac{\Delta \bar{H}_v}{R} \quad \frac{cal/mol}{cal/molK} = K$$

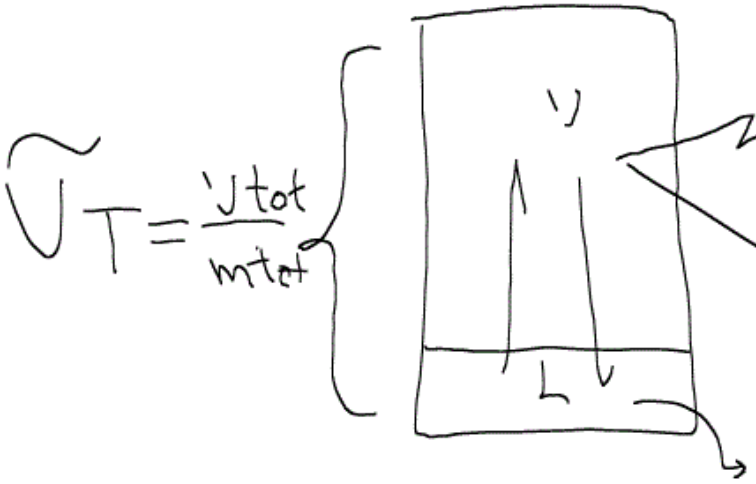
$$= \Delta \bar{H}_v = mR = (5664.3543)\left(1.9889 \frac{cal}{molK}\right) = 11265.84 \frac{cal}{mol}$$



P = ?

T = 80°C

→ agua m total agrego



$m_V = ?$

$V_V = ?$

$m_L = ?$

$V_L = ?$

y = calidad de vapor

y = Fracción molar vapor

= Fracción masa vapor

$$y = \frac{n_{vap}}{n_{vap} + n_{Liq}}$$

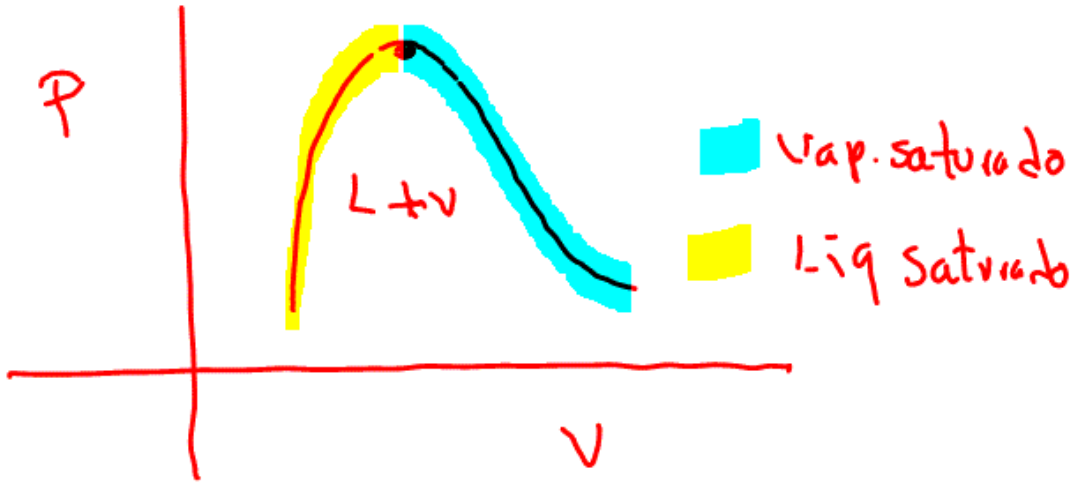
$$y = \frac{m_v / M_v}{m_v / M_v + m_L / M_L}$$

$M_v = M_L$ $\quad y = \dfrac{m_v}{m_{total}}$

$0 \leq y \leq 1$

$y = 0$

$y = 1$



$$\tilde{V}_T\left(\frac{L}{kg}\right) = y\,\tilde{V}_V + (1-y)\,\tilde{V}_L$$

$y = 0$ solo líquido

$y = 1$ solo vapor saturado Seco

Tabla I. Propiedades termodinámicas del agua.

Región de dos fases: liquido y vapor saturados									
T	p	Volumen.		U		H		S	
°C	bar	Líquido L/kg	Vapor m³/kg	Líquido kJ/kg	Vapor kJ/kg	Líquido kJ/kg	Vapor kJ/kg	Líquido kJ/kgK	Vapor kJ/kgK
0	0.006107	1.0002	206.3	0	2374.5	0	2500.5	0	9.1545
5	0.008722	1.0000	147.1	21.05	2360.4	21.05	2509.7	0.0764	9.0234
10	0.012275	1.0002	106.4	42.03	2388.3	42.03	2518.9	0.1511	8.8985
15	0.017045	1.0008	77.96	62.96	2395.2	62.96	2528.1	0.2244	8.7793
20	0.02337	1.0017	57.84	83.86	2402.1	83.86	2537.3	0.2963	8.6652
25	0.03166	1.0029	43.41	104.74	2409	104.74	2546.4	0.366	8.5561
30	0.04241	1.0043	32.94	125.61	2415.7	125.61	2555.5	0.4364	8.4516
35	0.05621	1.0059	22.26	146.46	2422.5	146.47	2564.5	0.5046	8.3514
40	0.07374	1.0078	19.56	167.33	2429.3	167.34	2573.5	0.5718	8.2553
45	0.09581	1.0099	15.28	188.21	2436	188.22	2582.4	0.6379	8.1631
50	0.12334	1.0121	12.05	209.1	2442.7	209.11	2591.3	0.7031	8.0747
55	0.1574	1.0146	9.583	229.98	2449.3	230	2600.1	0.7672	7.9893
60	0.1992	1.0172	7.682	250.89	2455.8	250.91	2608.8	0.8304	7.9074
65	0.2501	1.02	6.205	271.81	2462.2	271.84	2617.4	0.8928	7.8286
70	0.3116	1.0229	5.048	292.75	2468.6	292.78	2625.9	0.9542	7.7526
75	0.3855	1.026	4.135	313.7	2474.8	313.74	2634.2	1.0149	7.6794
80	0.4736	1.0293	3.41	334.67	2481	334.72	2642.5	1.0747	7.6088
85	0.578	1.0327	2.829	355.66	2487.2	355.72	2650.7	1.1337	7.5407

$$\hat{V}_t = \frac{V_{Total}}{m_{total}} = \frac{800\,L}{1\,Kg}$$

$$= 800\ L/Kg$$

$$\tilde{V}_T = y\,\tilde{V}_V + (1-y)\,\tilde{V}_L$$

$$\hat{V}_T = y\hat{V}_V + \hat{V}_L - y\hat{V}_L$$

$$\tilde{V}_T - \tilde{V}_L = y\hat{V}_V - y\tilde{V}_L \therefore y = \left(\frac{\hat{V}_T - \tilde{V}_L}{\hat{V}_V - \tilde{V}_L}\right)$$

$$\tilde{V}_T - \tilde{V}_L = y(\hat{V}_V - \tilde{V}_L)$$

$$y = \left(\frac{800\ J/kg - 1.0293\ J/kg}{3410\ J/kg - 1.0293\ J/kg} \right)$$

$$= 0.2343$$

$$m_v = m_{total}\, y$$

$$m_L = m_{Total} - m_{vapor}$$

$$m_v = (1\,kg)(0.23437) = 0.23437\,kg$$

$$m_L = 1\,kg - 0.23437\,kg = 0.76563\,kg$$

$$V_V = m_V \tilde{V}_V = (0.23437\,kg)\left(3410\,\frac{L}{kg}\right)$$

$$= 799.2\,L$$

$$V_L = m_L \tilde{V}_L = (0.76563\,kg)\left(1.0293\,\frac{L}{kg}\right)$$

$$= 0.7880\,L$$

$$V_{Total} = 799.2\,L + 0.7880\,L = 799.98 \simeq 800\,L$$

$$\rho_L = \frac{m_L}{V_L} = \frac{0.76563\ kg}{0.7881\ L}$$

$$= 0.97153\ \frac{kg}{L}$$

$$= 0.9715\ \frac{g}{mL}$$