Clase 45 17 Noviembre 2020

Título de la nota 17/11/2020

Mezclas de gases no reactivas

Mezclas
- Ley de Dalton (presiones parciales)
- Ley de Amagat (volumenes parciales)

Fracción mol → variable Termodinámica

(x_i) $i \neq 0, 1, 2 \cdots n$

$i = 1$ 1 solo componente

Ley de Daltón

$$p_{total} = \sum_{i=1}^{n} p_i$$

p_i = presión parcial.

Ley de Amagat

$$V_{total} = \sum_{i=1}^{n} V_i$$

V_i = volumen parcial.

$$p_{total} V_{total} = n_{total} R T_{eq}$$

1 mol O_2
1 atm
273.15 K
22.4 L

1 mol N_2
1 atm
273.15 K
22.4 L

Mezclado

2 moles
44.8 L
273.15 K

ptotal = ?
2 atm = X

Fracción mol.

$$x_i = \frac{n_i}{n_{totales}}$$

$$x_{O_2} = \frac{1}{2} = 0.5 \qquad x_{N_2} = \frac{1}{2} = 0.5$$

$$\sum_{i=1}^{n} x_i = 1$$

$x_i = y_i \rightarrow$ gases o vapores

$y_i =$ Fracción mol

$$\sum_{i=1}^{n} y_i = 1$$

$$y_{O_2} = \frac{1}{2} = 0.5 \qquad y_{N_2} = \frac{1}{2} = 0.5$$

$$p_{total} = \frac{n_{total} R T_{eq}}{V_{total}}$$

$$= \frac{(2\ mol)(0.082\ atm\,L/mol\,K)(273.15K)}{(44.8L)}$$

$$\boxed{p_{total} = 1\ atm}$$

Dalton

$$p_{total} = \sum_{i=1}^{n} p_i$$

$$\boxed{p_i = p_{total}\, y_i}$$

$$p_{N_2} = (1\,atm)(0.5) = 0.5\,atm$$

$$p_{O_2} = (1\,atm)(0.5) = 0.5\,atm$$

$$1\,atm = p_{total}$$

Amagat $V_{total} = \sum_{i=1}^{n} V_i$

$$V_i = V_{total}\, y_i$$

$$V_{N_2} = (44.8\,L)(0.5) = 22.4\,L$$

$$V_{O_2} = (44.8\,L)(0.5) = 22.4\,L$$

$$\frac{}{44.8\,L}$$

Mezclado Isotérmico

ideal o perfecto

$\Delta H_M = 0 \qquad \Delta U_M = 0$

$\Delta V_M = 0$

$q_M = w_M$

$\Delta S_M = \frac{q_M}{T_{eq}} = +$

$\Delta G_M = ? =$

$\Delta G = \Delta H - T\Delta S = -T\Delta S$

$$\Delta G_M = -T\Delta S_M = -$$

espontaneidad

Isotérmico

$$\Delta S = nR\ln\frac{V_2}{V_1}$$

$$\Delta s = nR\ln\frac{p_1}{p_2}$$

$$\Delta S_M = \Delta S_{O_2} + \Delta S_{N_2}$$

$$= n_{O_2} R \ln \frac{V_{total}}{V_{O_2}} + n_{N_2} R \ln \frac{V_{total}}{V_{N_2}}$$

Avogadro $V \propto n$

$$\Delta S_M = n_{O_2} R \ln \frac{n_{total}}{n_{O_2}} + n_{N_2} R \ln \frac{n_{total}}{n_{N_2}}$$

$$y_{O_2} = \frac{n_{O_2}}{n_{total}}$$

$$\Delta S_M = n_{O_2} R \ln \frac{1}{y_{O_2}} + n_{N_2} R \ln \frac{1}{y_{N_2}}$$

$$\Delta S_M = -\left[n_{O_2} R \ln y_{O_2} + n_{N_2} R \ln y_{N_2} \right]$$

$$y_{O_2} = \frac{n_{O_2}}{n_{total}} \qquad n_{O_2} = y_{O_2}\, n_{total}$$

$$\Delta S_M = -\left[y_{O_2}\, n_{total} R \ln y_{O_2} + y_{N_2} n_{total} R \ln y_{N_2} \right]$$

$$\Delta S_M = -n_{total} R \left[y_{O_2} \ln y_{O_2} + y_{N_2} \ln y_{N_2} \right]$$

$$\Delta S_M = -n_{total} R \sum_{i=1}^{n} y_i \ln y_i$$

$-$ $+$

entropía = +

$$= \frac{\cancel{mol}\ J}{\cancel{mol}\ K} = \frac{J}{K}$$ ✓

$$\Delta G_M = -T\Delta S_M$$

$$= -T\left[n_{total} R \sum_{i=1}^{n} y_i \ln y_i\right]$$

$$\Delta G_M = n_{total} R T_{eq} \sum_{i=1}^{n} y_i \ln y_i \quad -$$

ΔG_M = siempre negativa

espontáneo

$q_M = +$ endotérmico

$q_M = w_M = +$ expansión

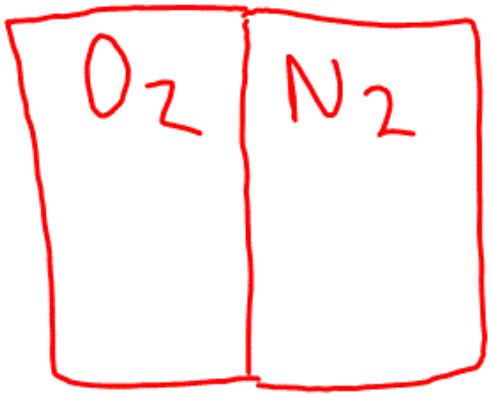
$$C_{pM} = \sum_{i=1}^{n} \overline{C}_{pi} \qquad \overline{C}_{pi} = \overline{C}_p y_i$$

$$\overline{C}_{vM} = \sum_{i=1}^{n} \overline{C}_{vi} \qquad \overline{C}_{vi} = \overline{C}_v y_i$$

$$M_M = \sum_{i=1}^{n} M_i y_i$$

Calcular ΔG_M ΔH_M ΔS_M $\underline{q}_M$ W_M
ΔU_M M_M $\overline{C}_{pM}$ $\overline{C}_{vM}$

Binaria

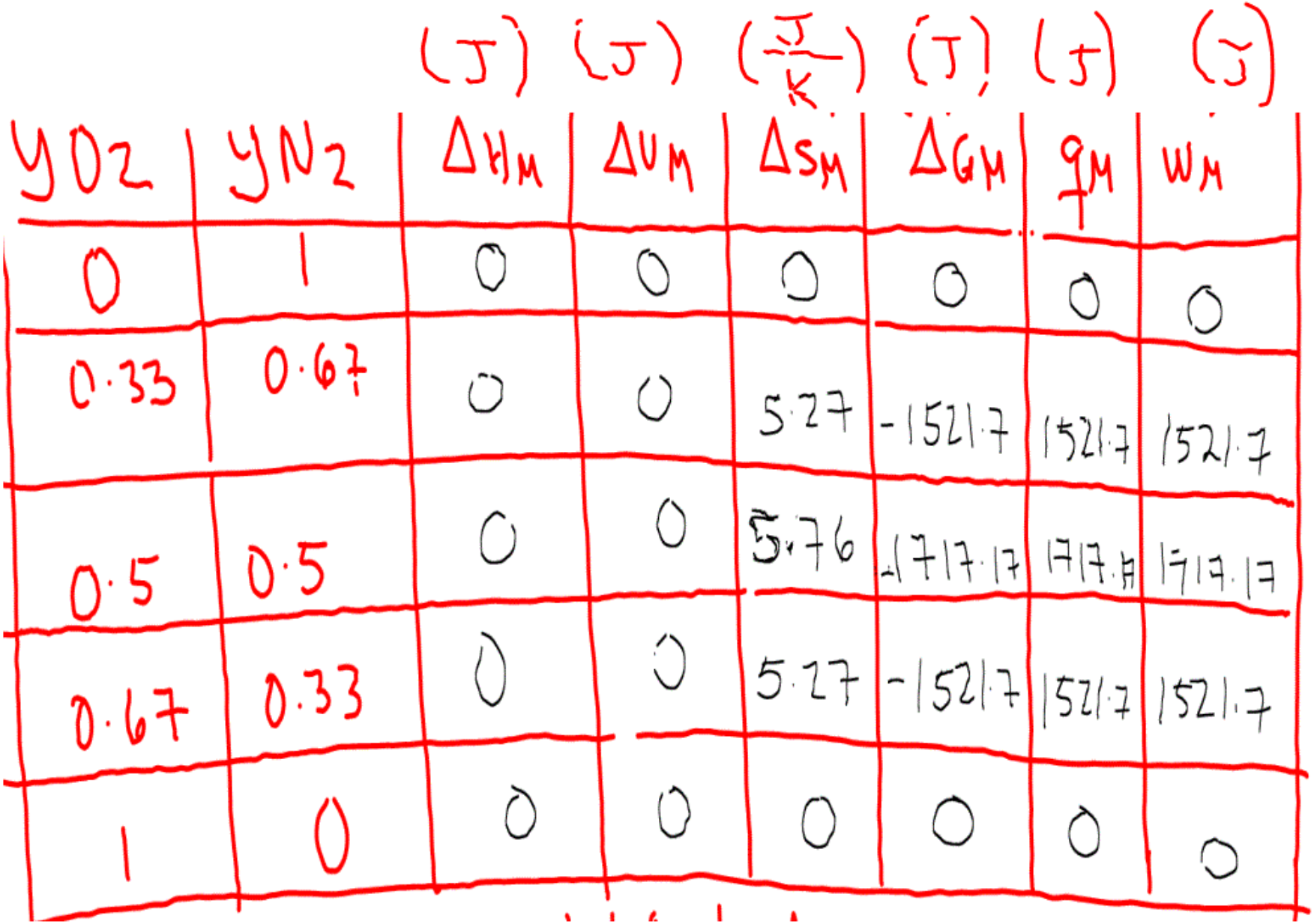


298.15 K

ptotal = 1atm

Vtotal = ?

$n\,O_2$	$n\,N_2$
1	1
2	1
2	4
4	2
1	2



y_{O_2}	y_{N_2}	ΔH_M (J)	ΔU_M (J)	ΔS_M ($\frac{J}{K}$)	ΔG_M (J)	q_M (J)	w_M (J)
0	1	0	0	0	0	0	0
0.33	0.67	0	0	5.27	-1521.7	1521.7	1521.7
0.5	0.5	0	0	5.76	-1717.17	1717.17	1717.17
0.67	0.33	0	0	5.27	-1521.7	1521.7	1521.7
1	0	0	0	0	0	0	0

$n_{total} = 1\ mol.$

$$\Delta S_M = -(1\ mol)(8.314\ J/mol\,K)[(0.33 \ln 0.33 + 0.67 \ln 0.67$$

$$= +5.27\ J/K$$

$$\Delta G_M = -T\Delta S_M = (-298.15\,K)(5.27\,J/K)$$

$$= -1571.25\,J$$

$$q_M = T\Delta S_M = 1571.25\,J$$

$$q_M = W_M$$

$$\Delta S_M = -\left[(1mol)(8.314\,J/molK)(0.5\ln 0.5 + 0.5\ln 0.5)\right]$$

$$= 5.76\,J/K$$

$$\Delta G_M = -T\Delta S_M$$

$$= -\left[(298.15K)(5.76\,J/K)\right]$$

$$= -1717.34$$

$$q_M = T\Delta S_M = 1717.34 = W_M$$