

# Clase 51 9 Noviembre 2021

Título de la nota

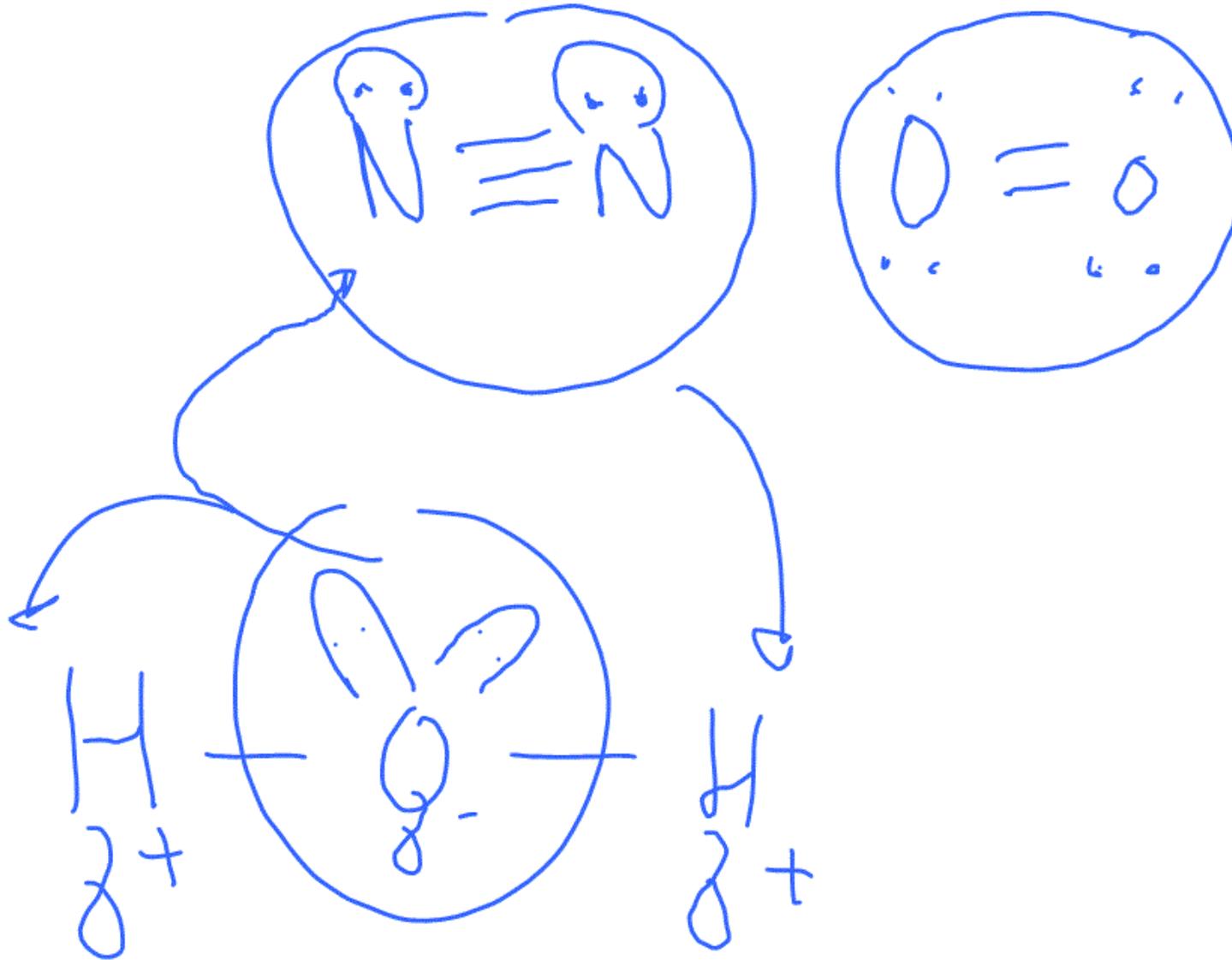
09/11/2021

Mezclado  
de  
gases  
(no reactivas)

- Ley de Dalton  
(presiones parciales)

- Ley de Amagat  
(volumenes parciales)

- $pV = nRT$



Fracción mol.  
Variable  
intensiva

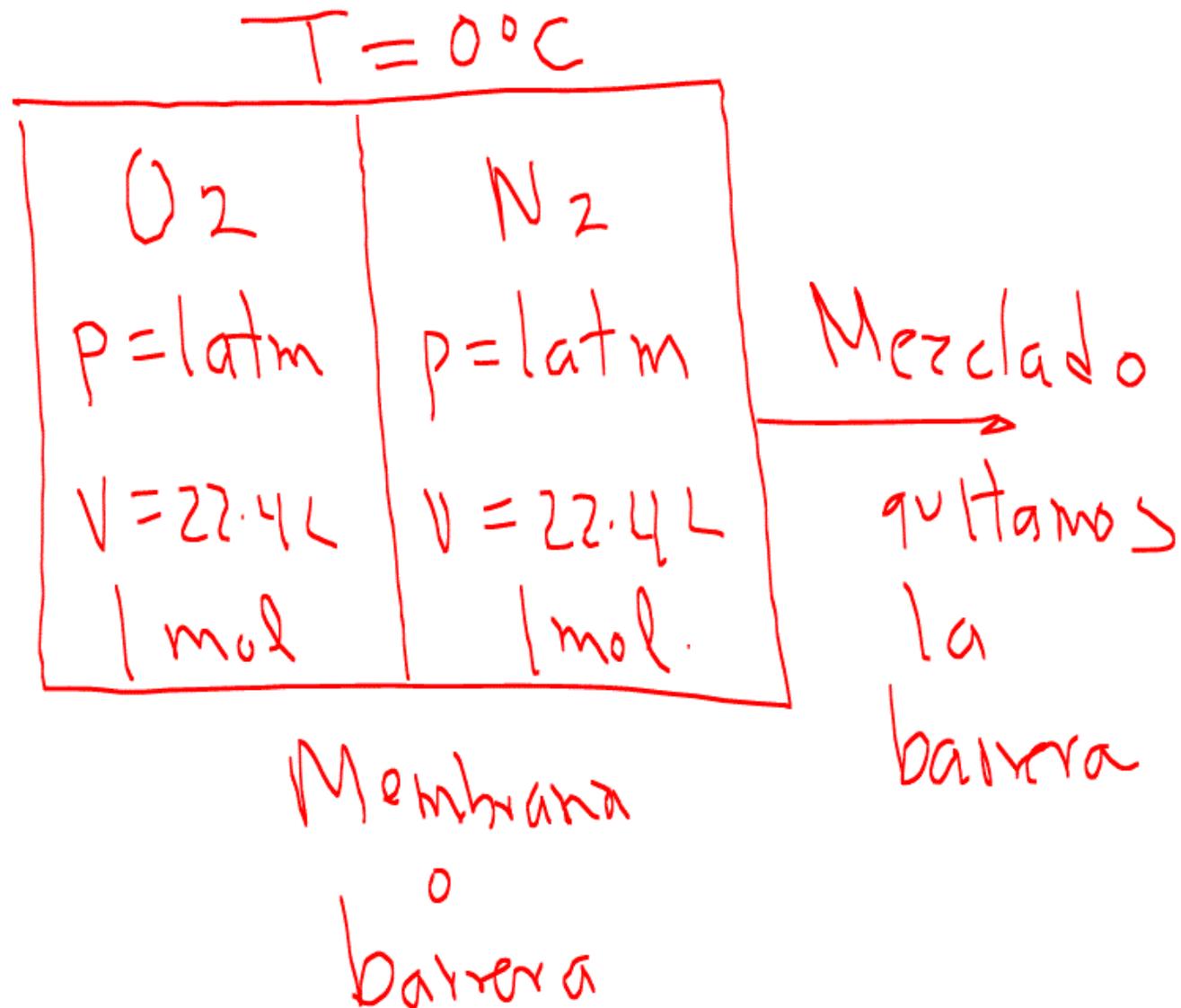
$$\sum_{i=1}^n y_i = 1$$

$y_i$  = gases  
vapores

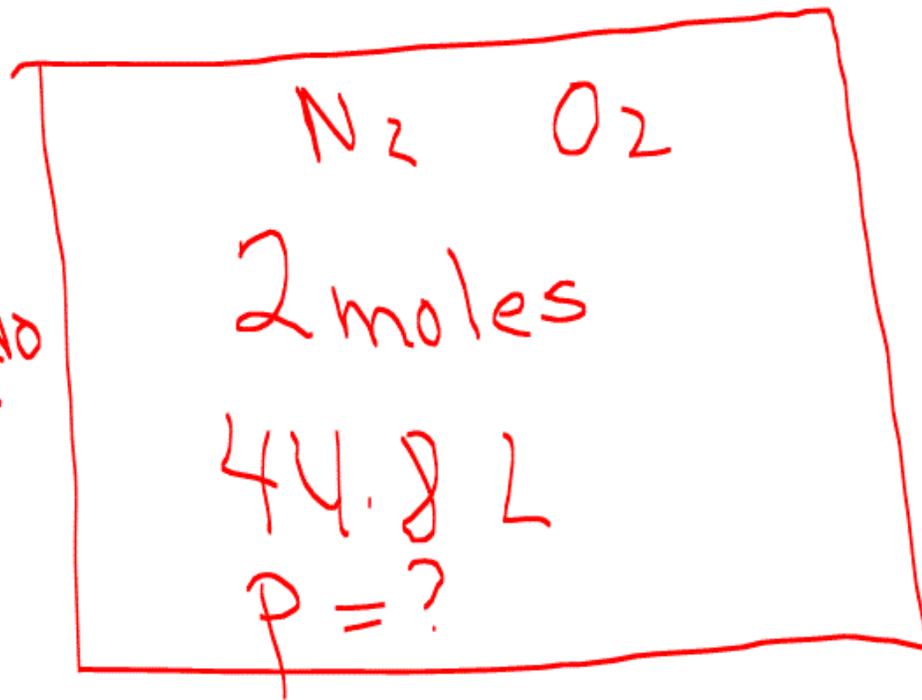
$x_i$  = sólidos  
y líquidos

$$y_i = \frac{n_i}{n_{\text{totales}}} \quad \frac{\text{ext}}{\text{ext}} = \text{Intensiva}$$

$$\rho = \frac{m}{V} \quad \frac{l}{\rho} = \hat{V}$$



Mezclado  
→



$$T = 0^{\circ}\text{C}$$

$$W_M = +$$

$$\Delta S_M = +$$

$$\Delta G_M = -$$

$$q_M = +$$

Mezclado Isotérmico

$$P_{\text{total}} = \frac{n_{\text{total}} R T_e}{V_{\text{total}}}$$

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

$$= 1 \text{ atm}$$

Ley Dalton

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

$$p_i = y_i p_{\text{total}}$$

$$y_{O_2} = \frac{1 \text{ mol}}{2 \text{ mol}} = 0.5$$

$$y_{N_2} = \frac{1 \text{ mol}}{2 \text{ mol}} = 0.5$$

$$y_{O_2} + y_{N_2} = 1 = 0.5 + 0.5 = 1$$

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

$$\begin{aligned} p_{O_2} &= y_{O_2} p_{total} \\ &= (0.5)(1 \text{ atm}) \\ &= 0.5 \text{ atm} \end{aligned}$$

$$\begin{aligned} p_{N_2} &= y_{N_2} p_{total} \\ &= 0.5(1 \text{ atm}) \\ &= 0.5 \text{ atm} \end{aligned}$$

Dalton

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

$$0.5 \text{ atm} + 0.5 \text{ atm} = 1 \text{ atm}$$

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# Amagat

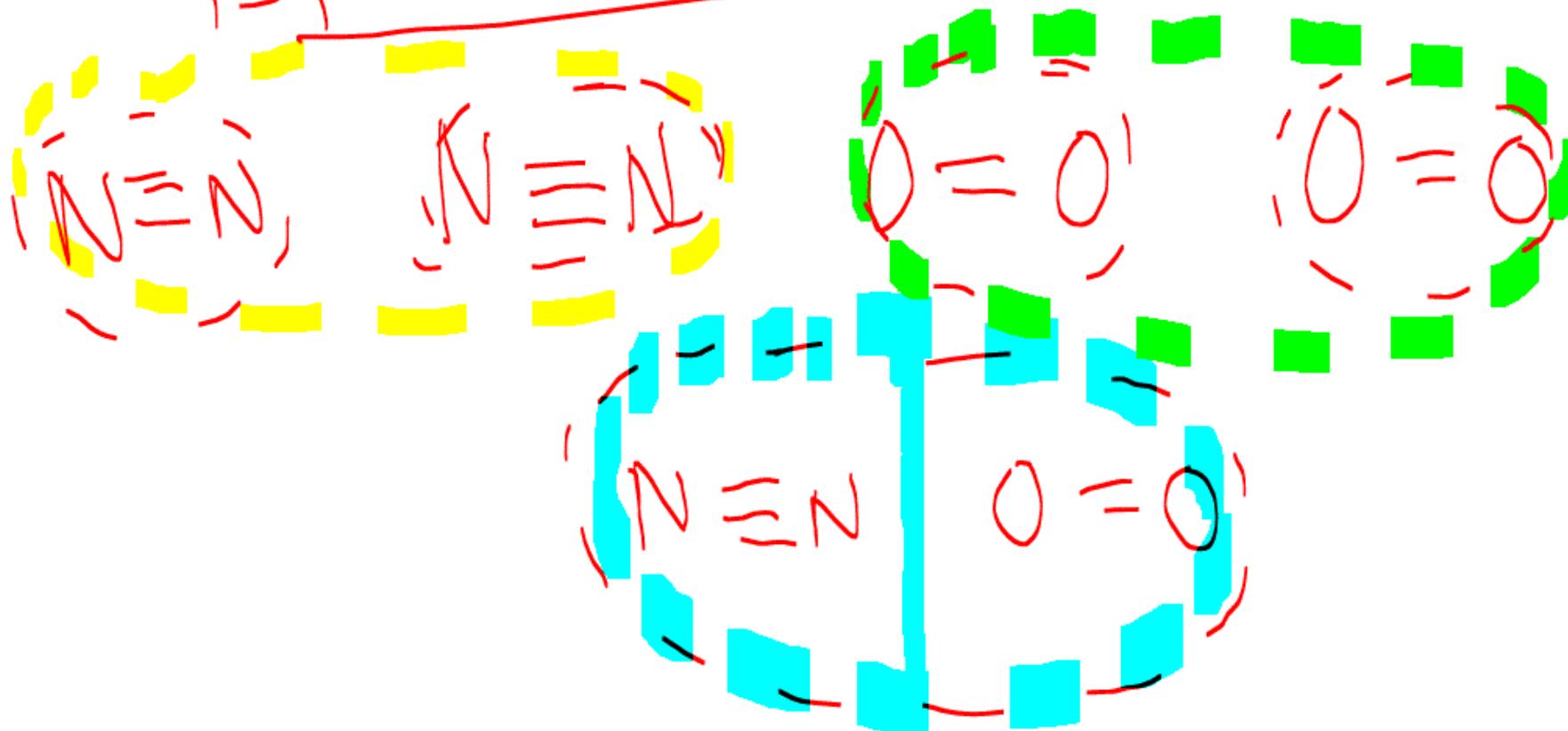
$$\sum_{i=1}^n v_i = v_{total}$$

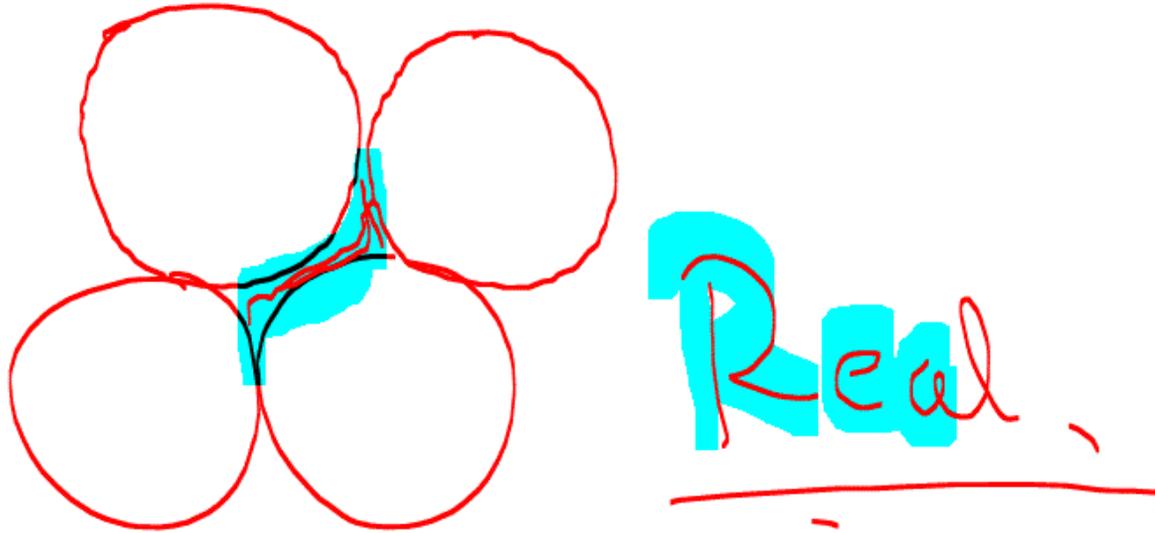
$$v_i = y_i v_{total}$$

$$\begin{aligned} v_{O_2} &= y_{O_2} v_{total} \\ &= 0.5(44.82) \\ &= 22.42 \end{aligned}$$

$$\begin{aligned} v_{N_2} &= y_{N_2} v_{total} \\ &= 0.5(44.82) \\ &= 22.42 \end{aligned}$$

$$\sum_{i=1}^n v_i = 22.4L + 22.4L = 44.8L$$





$$\Delta S_M = \Delta S_I + \Delta S_{II}$$

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

Isotermico

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

$$V \propto n$$

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

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

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

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

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

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

$$\Delta S_M = - n_{total} R \sum_{j=1}^n y_j \ln y_j = +$$

Isotérmico

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

$$\Delta G_M = 0 - T \Delta S_M$$

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

$$\Delta G_M = - \text{espontáneo}$$

$$\Delta G_M = -T \left( -n_{\text{total}} R \sum_{i=1}^n y_i \ln y_i \right)$$

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

$$\Delta G_M = n_{\text{total}} R T \sum_{i=1}^n y_i \ln y_i$$

$$M_M = \sum_{i=1}^n M_i = y_{O_2} M_{O_2} + y_{N_2} M_{N_2}$$

Binaria

Aire  $N_2$   $O_2$

28 g/mol - 32 g/mol

Maire

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

$$ds = \frac{\delta q}{T}$$

$$\overline{C_{pM}} = \sum_{i=1}^n \overline{C_{pi}}$$

$$\overline{C_{pM}} = y_{O_2} \overline{C_{pO_2}} + y_{N_2} \overline{C_{pN_2}}$$

perfecta

$$\overline{C_{vM}} = \overline{C_{pM}} - R$$

$$C_p = f(T)$$

$$\begin{pmatrix} a \\ b \\ c \\ d \end{pmatrix}$$

$$\begin{pmatrix} y_{O_2} \\ a_{O_2} \\ b_{O_2} \\ c_{O_2} \\ d_{O_2} \end{pmatrix}$$

$$\begin{pmatrix} a \\ b \\ c \\ d \end{pmatrix} \begin{pmatrix} y_{N_2} \\ a_{N_2} \\ b_{N_2} \\ c_{N_2} \\ d_{N_2} \end{pmatrix}$$

$$a_m = a_{O_2} + a_{N_2}$$

$$b_m = b_{N_2} + b_{O_2}$$

$$c_m = c_{N_2} + c_{O_2}$$

$$d_m = d_{N_2} + d_{O_2}$$

MEZCLADO DE GASES	
Modelo perfecto e ideal	
Insertar en las celdas de color amarillo los valores correspondientes	Los resultados en las celdas de color verde

Constantes de Cp como función de T (cal/molK)

Gases	a	b	c	d	e	mi (g)	ni (mol)	yi	Mi (g/mol)	pi (atm)	Vi (L)
N2	6.4500e+000	1.4100e-003	-3.1000e-008	0.0000e+000	0.0000e+000	14.0000	0.5000	0.5000	28.0000	0.1019	60.0000
O2	6.1000e+000	3.2500e-003	-1.0200e-006	0.0000e+000	0.0000e+000	16.0000	0.5000	0.5000	32.0000	0.1019	60.0000
Ne	4.9715e+000			0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	20.1700	0.0000	0.0000
Ar	4.9715e+000			0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	39.9400	0.0000	0.0000
CO2	6.4000e+000	1.0200e-002	-3.5600e-006	0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	44.0000	0.0000	0.0000
ntotal							1.0000	1.0000			

p total (atm)	0.2037
V total (L)	120.00

CpM como función de T (cal/molK)					R (cal/molK)	T (K)	p total (atm)	V total (L)
a	b	c	d	e				
6.2750	2.33e-3	-5.50e-7	0	0	1.9886	298.15	0.2037	120.00

CvM como función de T (cal/molK)				
a	b	c	d	e
4.2864	2.33e-3	-5.50e-7	0	0



M <sub>M</sub> (g/mol)	30.0000	ΔH <sub>M</sub> (cal)	0	ΔU <sub>M</sub> (cal)	0	ΔS <sub>M</sub> (cal/K)	1.3784	ΔG <sub>M</sub> (cal)	-410.9677
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q <sub>M</sub> (cal)	410.9677	w <sub>M</sub> (cal)	410.9677
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Dr. Juan Carlos Vázquez Lira 2020

Con apoyo del programa DGAPA-UNAM-PAPIME PE-200419

MEZCLADO DE GASES	
Modelo perfecto e ideal	
Insertar en las celdas de color amarillo los valores correspondientes	Los resultados en las celdas de color verde

Constantes de Cp como función de T (cal/molK)

Gases	a	b	c	d	e	mi (g)	ni (mol)	yi	Mi (g/mol)	pi (atm)	Vi (L)
N2	6.4500e+000	1.4100e-003	-8.1000e-008	0.0000e+000	0.0000e+000	14.0000	0.5000	0.5000	28.0000	0.1196	60.0000
O2	6.1000e+000	3.2500e-003	-1.0200e-006	0.0000e+000	0.0000e+000	16.0000	0.5000	0.5000	32.0000	0.1196	60.0000
Ne	4.9715e+000			0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	20.1700	0.0000	0.0000
Ar	4.9715e+000			0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	39.9400	0.0000	0.0000
CO2	6.4000e+000	1.0200e-002	-3.5600e-006	0.0000e+000	0.0000e+000	0.0000	0.0000	0.0000	44.0000	0.0000	0.0000
							ntotal	1.0000	1.0000		

p total (atm)	0.2392
V total (L)	120.00

CpM como función de T (cal/molK)					R (cal/molK)	T (K)	p total (atm)	V total (L)
a	b	c	d	e				
6.2750	2.33e-3	-5.50e-7	0	0	1.9886	350	0.2392	120.00
CvM como función de T (cal/molK)								
a	b	c	d	e				
4.2864	2.33e-3	-5.50e-7	0	0				



M <sub>M</sub> (g/mol)	30.0000	ΔH <sub>M</sub> (cal)	0	ΔU <sub>M</sub> (cal)	0	ΔS <sub>M</sub> (cal/K)	1.3784	ΔG <sub>M</sub> (cal)	-482.4374
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q <sub>M</sub> (cal)	482.4374	w <sub>M</sub> (cal)	482.4374
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