# Pauta Aux. #1

- gas ideal: Ec. de estado

$$\boxed{PV = nRT} \quad ó \quad \boxed{P\bar{V} = RT}$$

→ puntiforme ($V_{part.} \to 0$)

→ no hay interacción entre partículas

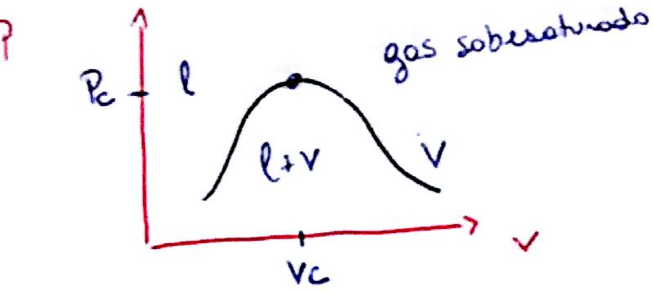
→ ocurre a bajas P° y altos T°

- gas de Van der Waals

$$\boxed{\left(P + \frac{a}{\bar{V}^2}\right)\left(\bar{V} - b\right) = RT}$$

a: cte. relacionada c/atracción de partículas
b: cte. " con volumen de c/partícula

- isoterma gases reales




$$\left.\frac{\partial P}{\partial \bar{V}}\right|_{P.C.} = 0$$

$$\left.\frac{\partial^2 P}{\partial \bar{V}^2}\right|_{P.C.} = 0$$

- Ley Barométrica

$$P_i(h) = P_i^{\circ} \exp\left(- \frac{M_i \, g \, h}{RT}\right)$$

P1]

| | $2NH_3 \leftrightarrow N_2 + 3H_2$ | | |
|---|---|---|---|
| $t_0$ | 1,6 | 0 | 0 |
| $t_{eq}$ | 1,6-2n | n | 3n |

$n_t = (1,6-2n)+n+3n$
$= 1,6 + 2n$

g.i. → $P_t V = n_t RT \Rightarrow n_t = \frac{P_t \cdot V}{RT}$

$$\Rightarrow 1,6 + 2n = \frac{4,85\,[MPa] \times \left(\frac{9,87\,[atm]}{1\,[MPa]}\right) \times 1,6\,[lt]}{0,082\left[\frac{lt \cdot atm}{mol \cdot K}\right] \times 500\,[K]}$$

$$\therefore n = 0,134\,[mol]$$

En el eq: $n_{NH_3} = 1,6 - 2n = 1,332$ mol

$n_{N_2} = n = 0,134$ mol

$n_{H_2} = 3n = 0,402$ mol

P2]

$P_i = X_i \cdot P_t$
$PV = nRT$

$$C_i = \frac{n_i}{V} = \frac{P_i}{RT} = \frac{X_i \cdot P_t}{RT}$$

(a) $$[CCl_3F] = \frac{n_{CCl_3F}}{V} = \frac{261 \times 10^{-12} \cdot 1\,[atm]}{0,082\left[\frac{lt \cdot atm}{mol \cdot K}\right] \times 283\,[K]} = 1,1 \times 10^{-11}\left[\frac{mol}{lt}\right]$$

$$[CCl_2F_2] = \frac{509 \times 10^{-12} \times 1\,[atm]}{0,082\left[\frac{lt \cdot atm}{mol \cdot K}\right] \times 283\,[K]} = 2,2 \times 10^{-11}\left[\frac{mol}{lt}\right]$$

(b) $$[CCl_3F] = \frac{261 \times 10^{-12} \cdot 0,05\,[atm]}{0,082\left[\frac{lt \cdot atm}{mol \cdot K}\right] \times 200\,[K]} = 8 \times 10^{-13}\left[\frac{mol}{lt}\right]$$

$$[CCl_2F_2] = \frac{509 \times 10^{-12} \times 0,05}{0,082 \times 200} = 1,6 \times 10^{-12}\left[\frac{mol}{lt}\right]$$

P3) Según ley barométrica:

$$P_{O_2} = P_{O_2}^{\circ} \exp\left(-\frac{M_{O_2} \cdot g \cdot h}{RT}\right) \quad (1)$$

$$P_{N_2} = P_{N_2}^{\circ} \exp\left(-\frac{M_{N_2} \cdot g \cdot h}{RT}\right) \quad (2)$$

• g.i → $P = \frac{nRT}{V} = \left(\frac{m}{M}\right)\frac{RT}{V}$

$$\Rightarrow \frac{(1)}{(2)} \Rightarrow \frac{\frac{m_{O_2}}{M_{O_2}} \cdot \frac{RT}{V}}{\frac{m_{N_2}}{M_{N_2}} \cdot \frac{RT}{V}} = \frac{\frac{m_{O_2}^{\circ}}{M_{O_2}} \cdot \frac{RT}{V}}{\frac{m_{O_2}^{\circ}}{M_{N_2}} \cdot \frac{RT}{V}} \cdot \exp\left(-\frac{(M_{O_2}-M_{N_2})gh}{RT}\right)$$

$$\Rightarrow \frac{m_{O_2}(h)}{m_{N_2}(h)} = \frac{m_{O_2}^{\circ}}{m_{N_2}^{\circ}} \exp\left(-\frac{(M_{O_2}-M_{N_2})g \cdot h}{RT}\right)$$

$$\Rightarrow \frac{0,1}{0,9} = \frac{0,2}{0,8} \exp\left(-\frac{(32-28)\, g \cdot h}{RT}\right)$$

$$\left(-\frac{(32-28)\left[\frac{gr}{mol}\right] \cdot 9,8\left[\frac{m}{s^2}\right] \cdot h[m]}{8,314\left[\frac{kg \cdot m^2}{s^2} \cdot \frac{1}{mol \cdot K}\right] \cdot 298[K] \cdot \frac{10^3 [g]}{1[kg]}}\right)$$

$$\therefore \boxed{h = 51.253\,[m]}$$

• $P_t(h) = P_{O_2}(h) + P_{N_2}(h)$ } $P_t = P_{O_2}^{\circ} \exp\left(-\frac{M_{O_2}\, g h}{RT}\right) + P_{N_2}^{\circ} \exp\left(\frac{-M_{N_2}\, g\, h}{RT}\right)$ (3)

• $1\,[atm] = P_{O_2}^{\circ} + P_{N_2}^{\circ}$ (4)

• g.i. → $\frac{P_{O_2}^{\circ}}{P_{N_2}^{\circ}} = \frac{\left(\frac{m_{O_2}^{\circ}}{M_{O_2}}\right) \cdot \frac{RT}{V}}{\left(\frac{m_{N_2}^{\circ}}{M_{N_2}}\right) \cdot \frac{RT}{V}} = \frac{m_{O_2}^{\circ} \cdot M_{N_2}}{m_{N_2}^{\circ} \cdot M_{O_2}} = \left(\frac{0,2}{0,8}\right) \cdot \left(\frac{28}{32}\right) = 0,22\,($

$(4) \text{ y } (5) \Rightarrow \quad P_{O_2}^{\circ} = 0{,}18 \text{ [atm]}$

$\qquad\qquad\qquad P_{N_2}^{\circ} = 0{,}82 \text{ [atm]}$

$$(3) \Rightarrow P_t = 0{,}18 \exp\left(\frac{-32 \cdot 9{,}8 \cdot 51253}{8{,}314 \cdot 10^3 \cdot 298}\right) + 0{,}82 \exp\left(\frac{-28 \cdot 9{,}8 \cdot 51253}{8{,}314 \cdot 10^3 \cdot 298}\right)$$

$$\therefore \boxed{P_t = 3 \cdot 10^{-3} \text{ [atm]}} \;//$$

**P4** (a) $P = \frac{RT}{\bar{V}-b} - \frac{a}{T\bar{V}^2}$ (1) $\;/\;$ en P.C. $\left.\frac{\partial P}{\partial \bar{V}}\right|_{PC} = \left.\frac{\partial^2 P}{\partial \bar{V}^2}\right|_{PC} = 0$

$$\Rightarrow \left.\frac{\partial P}{\partial \bar{V}}\right|_{PC} = -\frac{RT_c}{(\bar{V}_c - b)^2} + \frac{2a}{T_c \bar{V}_c^3} = 0 \Rightarrow \boxed{a = \frac{RT_c^2 \bar{V}_c^3}{2(\bar{V}_c - b)^2}} \quad (2)$$

$$\Rightarrow \left.\frac{\partial^2 P}{\partial \bar{V}^2}\right|_{PC} = \frac{2RT_c}{(\bar{V}_c - b)^3} - \frac{6a}{T_c \bar{V}_c^4} = 0 \Rightarrow \boxed{a = \frac{RT_c^2 \bar{V}_c^4}{3(\bar{V}_c - b)^3}} \quad (3)$$

$$\Rightarrow (2) = (3) \Rightarrow \boxed{b = \frac{\bar{V}_c}{3}} \quad (4)$$

$$\Rightarrow (4) \text{ en } (2) \Rightarrow \boxed{a = \frac{9}{8} R \bar{V}_c T_c^2} \quad (5)$$

$$\Rightarrow (4) \text{ y } (5) \text{ en } (1): \quad P_c = \frac{RT_c}{\bar{V}_c - \frac{\bar{V}_c}{3}} - \frac{\frac{9}{8} R \bar{V}_c T_c^2}{T_c \bar{V}_c^2} \Rightarrow \boxed{\bar{V}_c = \frac{3}{8} \frac{RT_c}{P_c}} \; (6)$$

$$\Rightarrow (6) \text{ en } (4) \text{ y } (5) \Rightarrow \boxed{a = \frac{27}{64} \cdot \frac{R^2 T_c^3}{P_c}} \checkmark \qquad \boxed{b = \frac{RT_c}{8P_c}} \checkmark$$

(b) $P\bar{V} = ZRT$

$$\Rightarrow Z_c = \frac{P_c \bar{V}_c}{RT_c} = \frac{P_c}{RT_c}\left(\frac{3}{8} \frac{RT_c}{P_c}\right) = 3/8 \;//$$