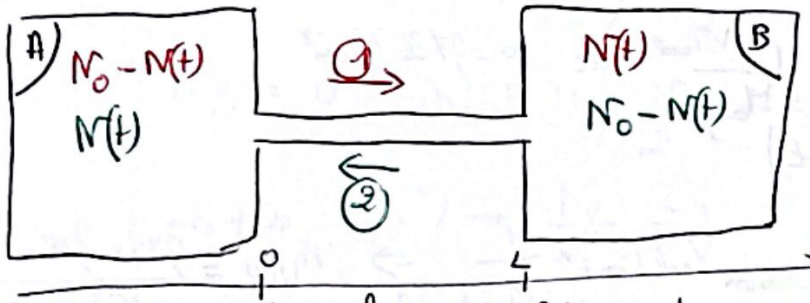
Diffusion mutuelle de 2 gaz

à $t=0$ N_0 N_0

gaz ① = N_2

gaz ② = CO



$$N_0 = \frac{P_0 V_0}{R T_0} \times \mathcal{N}_a .$$

On a N_0 gaz dans chaque, $2N_0$ en tout.

⚠ Ox orienté en sens inverse de la diffusion de 2

1- a) gaz ① $\quad n_1(0,t) = \dfrac{N_0 - N(t)}{V_0}$ et $n_1(L,t) = \dfrac{N(t)}{V_0}$

b) profil linéaire $\quad \dfrac{\partial n_1}{\partial x} = \dfrac{n_1(L,t) - n_1(0,t)}{L} = \dfrac{2N(t) - N_0}{V_0 L}$

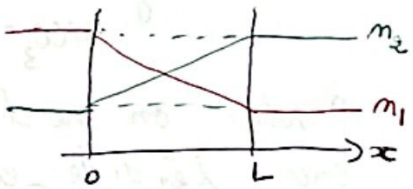
$n_1 =$

c) gaz ② $\quad n_2(0,t) = \dfrac{N(t)}{V_0}$ et $n_2(L,t) = \dfrac{N_0 - N(t)}{V_0}$

$$\frac{\partial n_2}{\partial x} = \frac{N_0 - N(t) - N(t)}{V_0 L} = \frac{N_0 - 2N(t)}{V_0 L}$$

d'où
$$\begin{cases} n_1(x,t) = \dfrac{N_0 - N(t)}{V_0} + \dfrac{2N(t) - N_0}{L \cdot V_0} x \\ n_2(x,t) = \dfrac{N(t)}{V_0} + \dfrac{N_0 - 2N(t)}{L V_0} x \end{cases}$$

" $n_i = ax + b$ "



d) $n_1(x,t) + n_2(x,t) = \dfrac{N_0}{V_0} = \text{cste}$ ($2N_0$ dans $2V_0$, direct)

2- $j_1(t) = -D \dfrac{dn_1}{dx} = -D \dfrac{2N(t) - N_0}{V_0 L}$ et $j_2 = +D \dfrac{N_0 - 2N(t)}{V_0 L} = +D \dfrac{dn_2}{dx}$

⚠ sens inverse de l'axe Ox

On a $j_1 = j_2$ (pb symétrique)

On note $j = j_1 = j_2$

3) On a $\phi = \dfrac{dN}{dt} = jS = DS \dfrac{N_0 - 2N(t)}{V_0 L}$

$$\Leftrightarrow \frac{dN}{dt} = \frac{DSN_0}{V_0 L} - \frac{2DS}{V_0 L} N(t) \Leftrightarrow \frac{dN}{dt} + \underbrace{\frac{2DS}{V_0 L}}_{\frac{1}{\tau}} N(t) = \frac{DSN_0}{V_0 L}$$

On pose $\boxed{\tau = \dfrac{LV_0}{2DS}}$

On a donc $N(t) = K \exp\left(-\frac{t}{\tau}\right) + \frac{N_0}{2}$

A $t=0$, $N(0) = 0 \Rightarrow N(t) = \frac{N_0}{2}\left(1 - \exp -\frac{t}{\tau}\right)$

4) Rem: si $t \to +\infty$, $N(t) \to \frac{N_0}{2}$ $\Rightarrow$ le gaz est uniformément réparti entre les 2 compartiments

$$N_{eq} = \frac{N_0}{2}$$

5 - AN $\tau = \frac{20 \cdot 10^{-2} \times 10 \cdot 10^{-3}}{2 \times 10^{-5} \times 10^{-4}} =$ [illegible] 10^6 s (environ 1 mois)

temps caractéristique : $t_c = \frac{L^2}{D} = \frac{(20 \cdot 10^{-2})^2}{10^{-5}} = 4000$ s ($\sim$ 1h)

On a $\tau \gg t_c$

$\rightarrow$ Valide l'hyp de conc uniforme dans les 2 compartiments