EX04 $2A \longrightarrow 2B + C$, réaction d'ordre 2 $(n=2)$ en gaz.

$T = 1015 K$, $V = 5L$ (cte) et A est pur

1- Montrer que $t_{1/2} = \frac{RT}{K.P_0}$.

La vitesse de réaction d'ordre 2 : $r = k\, C_A^n$, $n=2 \Rightarrow r = k\, C_A^2$

$r = \frac{r_A}{\nu_A} \Rightarrow r_A = \nu_A r = \nu_A \cdot k\, C_A^2 = -2k\, C_A^2$ car $\nu_A = -2$

on pose $\boxed{2k = K} \Rightarrow \boxed{r_A = -K\, C_A^2}$ --(1)

B.M : $\frac{dn_A}{dt} = r_A \cdot V \Rightarrow \frac{dn_A}{V dt} = r_A$; $V = cte \Rightarrow$

$\frac{dC_A}{dt} = r_A = -K\, C_A^2 \Rightarrow -\frac{dC_A}{C_A^2} = +K\, dt$.

on intègre C_A entre C_{A0} et C_A et le temps entre 0 et t.

$$\Rightarrow -\int_{C_{A0}}^{C_A} \frac{dC_A}{C_A^2} = K \int_0^t dt \Rightarrow \frac{1}{C_A}\Bigg|_{C_{A0}}^{C_A} = \boxed{Kt \Rightarrow \frac{1}{C_A} - \frac{1}{C_{A0}} = Kt} \quad (2)$$

Phase gaz $\Rightarrow P_A \cdot V = n_A \cdot RT \Rightarrow \frac{n_A}{V} = \frac{P_A}{RT} \Rightarrow \boxed{C_A = \frac{P_A}{RT}}$ (3)

On remplace (3) dans (2) $\Rightarrow \boxed{Kt = \frac{1}{\left(\frac{P_A}{RT}\right)} - \frac{1}{\left(\frac{P_{A0}}{RT}\right)}}$ (4).

à $t_{1/2}$: $\begin{cases} C_A = C_{A0}/2 \\ n_A = n_{A0}/2 \\ P_A = P_{A0}/2 \end{cases} \Rightarrow Kt_{1/2} = \frac{1}{\left(\frac{P_{A0}}{2RT}\right)} - \frac{1}{\left(\frac{P_{A0}}{RT}\right)} \Rightarrow Kt_{1/2} = \frac{2RT}{P_{A0}} - \frac{RT}{P_{A0}}$

$Kt_{1/2} = \frac{RT}{P_{A0}} \Rightarrow \boxed{t_{1/2} = \frac{RT}{K.P_{A0}}}$ (5)

Mais le réactif A est pur : à $t=0$ $\begin{cases} n_0 = n_{A0} \\ P_0 = P_{A0} \\ C_0 = C_{A0} \end{cases} \Rightarrow \boxed{t_{1/2} = \frac{RT}{K.P_0}}$ (6

2- Détermination de la cte de vitesse K   EX04 (suite)

$y = t_{1/2}$ (s)	1060	500	344	209
P_0 atm	0,135	0,286	0,416	0,683
$x = \frac{1}{P_0}$ (atm⁻¹)	7,41	3,50	2,4	1,46

on a $t_{1/2} = \frac{RT}{K P_0}$; on trace $t_{1/2} = f\left(\frac{1}{P_0}\right)$.

car l'equation $\boxed{t_{1/2} = \frac{RT}{K} \cdot \left(\frac{1}{P_0}\right)}$

avec $y = t_{1/2}$; $x = \frac{1}{P_0}$ et $A = tg\alpha = \frac{RT}{K}$.

du graphe $A = tg\alpha = \frac{RT}{K} = \frac{y_2 - y_1}{x_2 - x_1}$

$A = tg\alpha = \frac{RT}{K} = \frac{500 - 344}{3,50 - 2,4} = \frac{156}{1,1} = 141,81$

$A = tg\alpha = \frac{RT}{K} = 141,81 \Rightarrow K = \frac{RT}{141,81} = \frac{0,082 \cdot 1015}{141,81}$

$K = 0,587$ l/mol.s