Exo 1

$A \rightarrow 3B$; $k = 0{,}4\ min^{-1}$; φ gaz ; $T = cte$. $P = cte$

Reacteur agité ouvert (R.A.O), $Q_0 = 0{,}7\ l/min$

1- Pour un $C_{A0} = 0{,}187$ mol/l à $t=0$, calculer le V_{RAO}. Pour un taux de Conversion $X_A = 0{,}7$ (70%). puis calculer le debit molaire de B. (F_B).

$\tau_{RAO} = \frac{V_{RAO}}{Q_0}$; ordre 1 : $-r_A = r = k\,C_A$ car $r = \frac{r_A}{\nu_A}$ et $n = 1$.

$C_A = \frac{F_A}{Q} = \frac{F_{A0} - F_{A0}X_A}{Q_0\,\beta(1+\varepsilon_A X_A)} = \frac{F_{A0}(1-X_A)}{Q_0(1+\varepsilon_A X_A)}$ car $\beta = 1 = \frac{P_0 T}{P T_0} = 1$

$P = cte$, $T = cte$

$$\boxed{C_A = \frac{C_{A0}(1-X_A)}{(1+\varepsilon_A X_A)}}$$ car φ gaz

$\varepsilon X = \varepsilon_A X_A$ $\Rightarrow \varepsilon = \varepsilon_A$ car $X = X_A$. En effet, $\left\{\begin{array}{l} F_A = F_{A0} - F_{A0}X_A \\ F_A = F_{A0} - F_0 X \end{array}\right.$ mais $F_{A0} = F_0$ car A est pur

$\varepsilon_A = \frac{\varepsilon}{1+I} = \varepsilon$ car $I = \frac{F_{I0}}{F_0} = 0 \Rightarrow$ donc $X_A = X$ (car $F_{A0} = F_0$)

$\varepsilon_A = \varepsilon = 3 - 1 = 2.$ $\Rightarrow \boxed{C_A = \frac{C_{A0}(1-X_A)}{(1+2X_A)}}$

$$\tau_{RAO} = \frac{V_{RAO}}{Q_0} = \frac{C_{A0}X_A}{-r_A} = \frac{C_{A0}X_A}{k\,C_A} = \frac{C_{A0}X_A}{k\,\frac{C_{A0}(1-X_A)}{(1+2X_A)}} = \frac{X_A(1+2X_A)}{k(1-X_A)}$$

$$\Rightarrow \boxed{V_{RAO} = Q_0\,\frac{X_A(1+2X_A)}{k(1-X_A)}}$$

$$A.N:\ V_{R.AO} = \frac{0{,}7 \cdot 0{,}7(1+2 \cdot 0{,}7)}{0{,}4(1-0{,}7)} \Rightarrow \boxed{V_{R.AO} = 9{,}8\ l.}$$

$$F_B = Q\, C_B = Q_0 \beta (1+\varepsilon_A X_A) \cdot \frac{C_{B0} + 3 C_{A0} X_A}{\beta(1+\varepsilon_A X_A)}$$

$$F_B = Q_0 (C_{B0} + 3 C_{A0} X_A)$$; mais $C_{B0} = 0$

$$\boxed{F_B = Q_0\, 3\, C_{A0} X_A}$$

$$F_B = 0{,}7 \cdot 3 \cdot 0{,}187 \cdot 0{,}7 = 0{,}275 \text{ mol/min}$$

2- La nouvelle conversion (X_A) si Q_0 est double ($Q_0 = 1{,}4$ l/min)

$$\frac{V_{RA0}}{Q_0} = \frac{X_A(1+2X_A)}{k \cdot (1-X_A)}$$ (question 1) ; on calcul alors X_A ??

$$\frac{X_A(1+2X_A)}{(1-X_A)} = \frac{V_{RA0}}{Q_0} \cdot k = \lambda = \frac{9{,}8 \cdot 0{,}4}{1{,}4} = \boxed{2{,}8 = \lambda}$$

$$X_A(1+2X_A) = (1-X_A) \cdot \lambda \Rightarrow X_A + 2X_A^2 - \lambda + \lambda X_A = 0$$

$$\boxed{2X_A^2 + (1+\lambda) X_A - \lambda = 0} \Rightarrow \boxed{2X_A^2 + 3{,}8\, X_A - 2{,}8 = 0}$$

$$\Delta = b^2 - 4ac = (3{,}8)^2 + 4 \cdot 2 \cdot 2{,}8 = 36{,}84 \Rightarrow \sqrt{\Delta} = 6{,}07$$

$$\begin{cases} X_{A_1} = \dfrac{-b-\sqrt{\Delta}}{2a} < 0 \text{ rejetée} \\[2ex] X_{A_2} = \dfrac{-b+\sqrt{\Delta}}{2a} = \dfrac{-3{,}8+6{,}07}{4} = 0{,}5675 \end{cases}$$

$$\boxed{X_A = 56{,}75\%}$$

3- La nouvelle Conversion X_A si la Concentration initiale est doublée.

$$\tau_{RAO} = \frac{V_{RAO}}{Q_0} = \frac{X_A(1+2X_A)}{k(1-X_A)}$$; ici la Conversion X_A est indépendante de C_{A0} ; Elle est plutôt fonction de V_{RAO}, Q_0 (donc du τ_{RAO}) et bien sûr de la C_{te} de vitesse