24/25
Toussaint

DM2

Exercices supplémentaires de cinétique

Exercice 1

1/ Ester + soude → ...

	0,01	0,01
	0,01 − ξ	0,01 − ξ

$\forall t \quad [\text{ester}] = [\text{soude}]$

$$v = k[\text{ester}][\text{soude}] = k[\text{soude}]^2 = -\frac{d[\text{soude}]}{dt}$$

$$\frac{1}{[\text{soude}]} - \frac{1}{[\text{soude}]_0} = kt$$

3/4 saponifié ⇒ il reste $1/4 \times 0{,}01$

$$\frac{4}{0{,}01} - \frac{1}{0{,}01} = k t_{3/4}$$

$$\frac{3}{0{,}01} = k \times 2$$

$$k = \frac{3}{0{,}02} = \underline{150\ h^{-1}\ mol^{-1}\ L}$$

$$t_{1/2} = \frac{1}{k[A]_0} = \frac{1}{150 \times 0{,}01} = 0{,}66\ h = \underline{40\ \text{minutes}}$$

2/ $k' = 4k = 4 \times 150 = \underline{600\ mol^{-1}\ L\ h^{-1}}$

$$t'_{1/2} = \frac{1}{600 \times 0{,}01} = 0{,}16\ h = \underline{10\ \text{minutes}}.$$

$$\ln k'(400) - \ln k(300) = -\frac{E_a}{R}\left(\frac{1}{400} - \frac{1}{300}\right)$$

$$(\ln 4) \times \frac{8{,}31}{\frac{1}{300} - \frac{1}{400}} = E_a = \underline{13{,}8\ kJ\ mol^{-1}}$$

Exercice 2

Ordre 2 $\quad t_{1/2} = \frac{1}{k[A]_0}$

1/ temps de fin de réaction $[A]_f = 0{,}01[A]_0$

$$\frac{1}{0{,}01[A]_0} - \frac{1}{[A]_0} = \frac{99}{[A]_0} = k t_f$$

$$t_f = \frac{99}{k[A]_0} \quad \text{et} \quad t_{1/2} = 1\ h = \frac{1}{k[A]_0}$$

$$t_f = 99\, t_{1/2} = \underline{99\ h}$$

2/ On veut $t_f = 1\ h = \frac{99}{k[A]_0}$

$$k(T') = \frac{99}{[A]_0}$$

et $k(300) = \frac{1}{[A]_0}$

$$\ln k(T') - \ln k(T) = -\frac{E_a}{R}\left(\frac{1}{T'} - \frac{1}{T}\right)$$

$$-\frac{R}{E_a}(\ln 99) + \frac{1}{300} = \frac{1}{T'}$$

$$\Rightarrow \quad -\frac{8{,}31}{23000} \ln 99 + \frac{1}{300} = \frac{1}{T'}$$

$$\frac{1}{T'} = 1{,}67 \times 10^{-3} \Rightarrow \underline{T' = 597{,}7\ K}$$

Exercice 3

$$N_2O(g) = N_2(g) + 2O_2(g)$$

n_0

$n_0 - \xi$ $\quad \xi \quad$ 2ξ $\quad n_T = n_0 + 2\xi$

Ordre 1 $\quad \ln [N_2O] - \ln [N_2O]_0 = -kt$

$$\ln \frac{n_0 - \xi}{n_0} = -kt$$

$$\xi = n_0 (1 - e^{-kt})$$

$$P_T = n_T \frac{RT}{V}$$

$$= (n_0 + 2\xi) \frac{RT}{V}$$

$$= P_0 + 2P_0 (1 - e^{-kt})$$

$$= \underline{3P_0 - 2P_0 e^{-kt}}$$

$$\frac{3P_0 - P_T}{2P_0} = e^{-kt}$$

$$-kt = \ln \left(\frac{3P_0 - P_T}{2P_0} \right)$$

Calcul de k : $\quad k = -\frac{1}{26,5} \ln \left(\frac{3 \times 37,43 - 41,5}{2 \times 37,43} \right)$

$$= \underline{2,13 \times 10^{-3} \, h^{-1}}$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{\ln 2}{2,13 \times 10^{-3}}$$

$$= \underline{325,3 \, h}$$