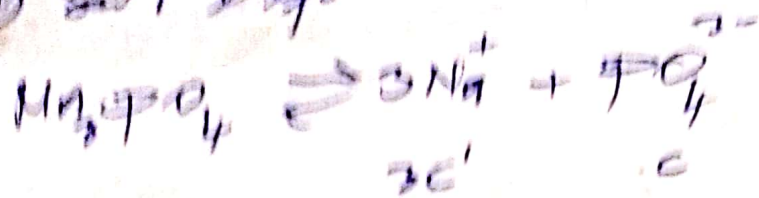


a) 2<sup>e</sup> et 3<sup>e</sup> étape



$$D = \frac{1}{2} \left( [\text{Na}^+] z_{\text{Na}^+}^2 + [\text{PO}_4^{3-}] z_{\text{PO}_4^{3-}}^2 \right)$$

$$C' = \frac{c}{100} = \frac{0,318}{100} = 0,318 \cdot 10^{-2}$$

$$[\text{Na}^+] = 3C' = 3 \times 0,318 \cdot 10^{-2}$$

$$[\text{PO}_4^{3-}] = C' = 0,318 \cdot 10^{-2}$$

$$D = \frac{1}{2} \left( 9,54 \cdot 10^{-3} (1)^2 + 0,318 \cdot 10^{-2} (-3)^2 \right)$$

$$D = 0,02 \text{ M}$$

$$\gamma_{\text{Na}^+} = 10^{-0,51 \sqrt{I} / (2 \cdot 303)^{1/2}} = 0,865$$

Si  $D < 10^{-2}$ , on divise par  $1 + \sqrt{I}$

pour  $\text{PO}_4^{3-}$

$$\gamma = 10^{-0,51 \sqrt{I} \cdot [2 \cdot 303]} = 0,267$$

SM CHM 202 : 20/11/20

Exo 1

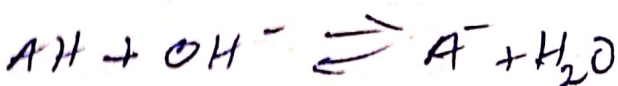
20 mmés :  $n_1 = 5 \cdot 10^{-2} \cdot 2 \cdot 10^{-3} = 10^{-3}$

AH  $\left\{ \begin{array}{l} V_1 = 20 \text{ mL} \\ C_1 = 5 \cdot 10^{-2} \text{ M} \end{array} \right. \quad pK_a = 4,10$

OH  $\left\{ \begin{array}{l} C_2 = 0,1 \text{ M} \\ V_2 = ? \end{array} \right.$

1-1- Calcul de pH à  $V_2 = 5$

$$n_2 = 0,1 \times 5 \cdot 10^{-3} = 5 \cdot 10^{-4}$$



$$\begin{array}{ccc} n_1 & n_2 & - \quad \text{ex} \\ & & n_2 \quad \text{ex} \\ n_1 - n_2 & & \end{array}$$

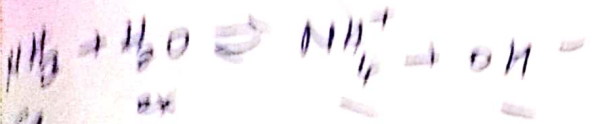
$$\text{pH} = pK_a + \log \left( \frac{[\text{A}^-]}{[\text{AH}]} \right)$$

$$pK_a + \log \left( \frac{\frac{n_2}{V_T}}{n_1 - n_2} \right)$$

$$= pK_a + \log \left( \frac{n_2 V_T}{(n_1 - n_2)} \right)$$

$$\text{pH} = 4,10 + \log \left( \frac{5 \cdot 10^{-4}}{3} \right)$$

# BROUILLON (For Rough Work)



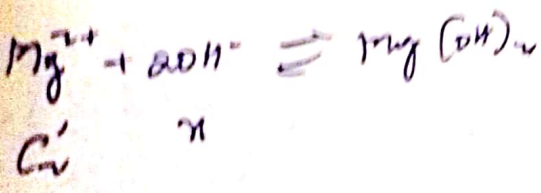
ca ox  
ca ox      x      x

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{x^2}{C_1 - x} \text{ or } C_1 - x \approx C_1$$

$$K_b = \frac{x^2}{C_1} \text{ so } x = \sqrt{C_1 K_b}$$

$$M = [OH^-] \text{ or } K_b = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-9.25}} = 10^{-4.75}$$

$$x = [OH^-] = 3.33 \cdot 10^{-3} M$$



$$K_s = [Mg^{2+}][OH^-]^2$$

$$\text{so } [OH^-]^2 = \frac{K_s}{[Mg^{2+}]} \text{ or } [OH^-] = \sqrt{\frac{K_s}{[Mg^{2+}]}}$$

$$[OH^-]_2 = \sqrt{\frac{1.8 \cdot 10^{-11}}{0.01}} = 4.26 \cdot 10^{-5} M$$

OH<sup>-</sup> est le réactif limitant

$$\frac{m}{M} = \frac{[OH^-] \cdot V_T}{2} \text{ so } m = \frac{M [OH^-] \cdot V_T}{2}$$

or  $[OH^-] = x + [OH^-]$  car on

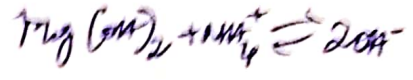
considère les équilibres acido-basique et de précipitation

$$m = \frac{(3.33 \cdot 10^{-3} + 4.26 \cdot 10^{-5}) \cdot 200 \cdot 10^{-3}}{2}$$

$$m \approx 0.023 \text{ g}$$

resp) A ou E

3) Calcul de  $m_{NH_4^+}$



$$m_{NH_4^+} = C \cdot M_{NH_4^+} \text{ or}$$

$$C = [Mg^{2+}]_{\text{résidu}}$$

$$\text{so } m_{NH_4^+} = 0.01 \cdot 200 \cdot 10^{-3} + 53.5 = 20.1078$$

resp) A ou E

4) Calcul du pH

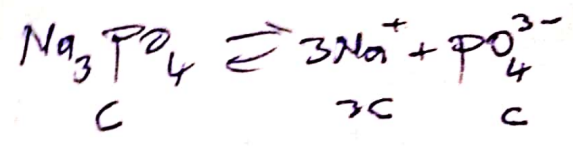
$$pH = 14 + \log [OH^-]$$

$$pH = 14 + \log (3.33 \cdot 10^{-3} + 4.26 \cdot 10^{-5})$$

$$pH = 11.6$$

resp A ou E

## Exo 4



$$t = 5\% \quad d = 1.043$$

$$t = \frac{C \cdot M \times 100}{d \rho} \text{ so } C = \frac{t \cdot d \rho}{100 \cdot M}$$

$$C = \frac{5 \times 1.043 \times 10^3}{100 \times 164} = 0.318$$

$$[Fe(SCN)^{2+}] < 10^{-5.5} = 3,16 \cdot 10^{-6}$$

$$[Fe(SCN)^{2+}] = 3,16 \cdot 10^{-6} = \epsilon'$$

$$[Fe^{2+}] = C_1 - \epsilon'$$

$$= 10^{-1} - 3,16 \cdot 10^{-6} = 9,99 \cdot 10^{-2}$$

$$[SCN^-] = C_2 = 10^{-3} M$$

4) Calculer  $[F^-]$ ,  $[FeF^{2+}]$



$$[Fe^{3+}]_0 = [Fe^{3+}] + [FeF^{2+}] + [Fe(SCN)^{2+}]$$

$$[FeF^{2+}] = [Fe^{3+}]_0 - [Fe^{3+}] - [Fe(SCN)^{2+}]$$

$$\text{or } \beta = \frac{[Fe(SCN)^{2+}]}{[Fe^{3+}] \cdot [SCN^-]}$$

$$[Fe^{3+}] = \frac{[Fe(SCN)^{2+}]}{[SCN^-] \beta}$$

$$[Fe^{3+}] = \frac{3,16 \cdot 10^{-6}}{9,1 \times 10^{-2}}$$

$$[Fe^{3+}] = 3,56 \cdot 10^{-8} M$$

$$[FeF^{2+}] = 10^{-1} - 3,56 \cdot 10^{-8} - 3,16 \cdot 10^{-6}$$

$$=$$

- Cas du calcul du pH

$$\beta = \frac{[FeF^{2+}]}{[F^-] \cdot [Fe^{3+}]} \Rightarrow [F^-] = \frac{[FeF^{2+}]}{\beta [Fe^{3+}]}$$

$$pH = pF_m + \log \frac{[F^-]}{[HF]} \quad (1)$$

5) En déduire le nombre de moles minimal de NaF =  $N_{NaF} = N_{OH^-} + F^-$

$$n_F = ([F^-]_{libre} + [F^-]_{liée})$$

$$\text{or } \left\{ \begin{aligned} [F^-]_{libre} &= 10^{-pH} \\ [F^-]_{liée} &= \frac{[FeF^{2+}]}{[Fe^{3+}]} \end{aligned} \right.$$

$$[F^-]_0 = [F^-] + [FeF^{2+}] + [FH]$$

$$[FH] = [F^-]_0 - [F^-] - [FeF^{2+}]$$

Samedi, 21 Juin 2025

Suite SM

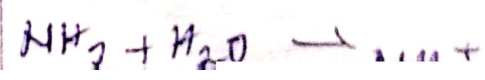
2023 / 2024

Exo 2

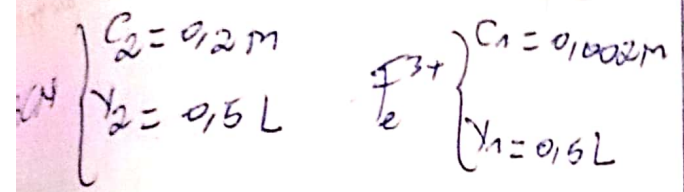
2 - Données :

mélange  $n_1$  }  $MgCl_2$   $C_2 = 902 M$   
 $\sqrt{2} \approx 1,414$

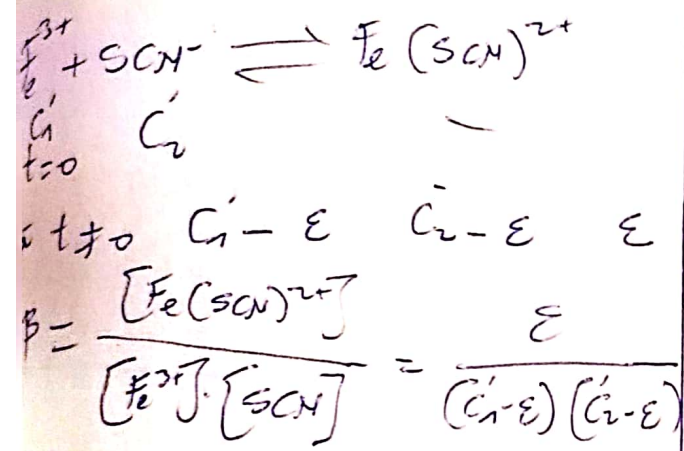
+  $NH_3$  }  $C_1 = 2 M$   
 $n_1 \approx 100 ml$



- Nature  
- 1st  
- 1st



Calculer  $[Fe^{3+}]$ ,  $[SCN^-]$  et  $[Fe(SCN)^{2+}]$



or  $C_2 = \frac{C_2 \gamma_2}{\gamma_1 + \gamma_2} = \frac{0,2 \times 0,5}{(0,5 + 0,5)} = 0,1$

$C_2' = \frac{C_2 \cdot \gamma_2}{\gamma_1 + \gamma_2} = \frac{0,002 \times 0,5}{(0,5 + 0,5)} = 10^{-3}$

$C_2 - \epsilon = C_2'$

$$P = \frac{\epsilon}{C_2'(C_1 - \epsilon)} = \frac{\epsilon}{C_1 C_2' - \epsilon C_2'}$$

$P(C_1 C_2' - \epsilon C_2') = \epsilon$

$P C_1 C_2' - P \epsilon C_2' = \epsilon$

$\Rightarrow \epsilon(1 + P C_2') = P C_1 C_2'$

$$\epsilon = \frac{P C_1 C_2'}{(1 + P C_2')}$$

Ans  $\epsilon = \frac{2,95 \cdot 10^{-1} \cdot 10^{-3}}{1 + 2,95 \cdot 10^{-3}}$

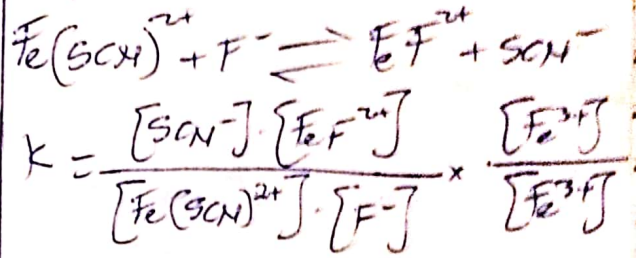
do formation of products of iron  
 $= 9,89 \cdot 10^{-4}$

$[Fe^{3+}] = C_1 - \epsilon = 10^{-3} - 9,89 \cdot 10^{-4} M$   
 $= 9,11 \cdot 10^{-2} M$

$[SCN^-] = C_2' = 10^{-1} M$

REP E

2) Calculer les constantes d'équilibre



$$K = \frac{[SCN^-] \cdot [FeF^{2+}]}{[Fe(SCN)^{2+}] \cdot [F^-]} \times \frac{[Fe^{3+}]}{[Fe^{3+}]}$$

$$K = \frac{[SCN^-] [Fe^{3+}]}{[Fe(SCN)^{2+}]} \times \frac{[FeF^{2+}]}{[F^-] [Fe^{3+}]}$$

$$K = \frac{1}{P_1} \times P_2 = \frac{P_2}{P_1} = \frac{10^{5,3}}{10^{2,95}}$$

$= 10^{2,35} = 10^{2,35}$

REP B

2) Calculer  $[Fe^{3+}]$ ,  $[SCN^-]$  et  $[Fe(SCN)^{2+}]$

$[Fe(SCN)^{2+}] = 10^{-1,5}$

