BROUILLON (For Rough Work)

2) Sol 2 ..

$$Na_3PO_4 \rightleftharpoons 3Na^+ + PO_4^{3-}$$
$$\quad\quad\quad\quad 3c' \quad\quad c'$$

$$I = \frac{1}{2}\left([Na^+]z^2_{Na^+} + [PO_4^{3-}]z^2_{PO_4^{3-}}\right)$$

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

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

$$[PO_4^{3-}] = C' = 0{,}318 \cdot 10^{-2}$$

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

$$I = 0{,}02\ M$$

$$\gamma_{Na^+} = 10^{\frac{-0{,}51\sqrt{I}\cdot|zNa^+|^2}{1+\sqrt{I}}} = 0{,}865$$

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

Pour PO_4^{3-}

$$\gamma = 10^{\frac{-0{,}51\sqrt{I}\cdot[z\ PO_4^{3-}]}{1+\sqrt{I}}} = 0{,}267$$

SM CHM 202 : 2017/20

Exo 1

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

$AH \begin{cases} V_1 = 20\,ml \\ C_1 = 5 \cdot 10^{-2}\,M \end{cases}$ $pKa = 4{,}19$

$OH \begin{cases} C_2 = 0{,}1\,M \\ V_2 = ? \end{cases}$

1-1- Calcul de pH à $V_2 = 5$

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

$$AH + OH^- \rightleftharpoons A^- + H_2O$$

n_1	n_2	—	ex
	—	n_2	ex
$n_1 - n_2$			

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

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

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

$$pH = 4{,}19 + \log\left(\frac{5 \cdot 10^{-4}}{\cdot^{-3}}\right)$$

BROUILLON (For Rough Work)

$MgCl_2 + 2OH^- \rightleftharpoons Mg(OH)_2 + 2Cl^-$

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

C_1 — excès — —

$C_1 - x$ — excès — x — x

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

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

$x = [OH^-]$ or $K_b = \frac{K_e}{K_a} = \frac{10^{-14}}{10^{-pK_a}} = 10^{pK_a - 14}$

$x = [OH^-] = 3,88 \cdot 10^{-3}\ M$

$Mg^{2+} + 2OH^- \rightleftharpoons Mg(OH)_2$

C_1' — x

$K_s = [Mg^{2+}]\cdot[OH^-]_2^2$

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

$[OH]_2 = \sqrt{\frac{1,82 \cdot 10^{-11}}{0,01}} = 4,26 \cdot 10^{-5}\ M$

OH^- est le reactif limitant

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

or $[OH^-] = x + [OH]$ car on considère les équilibres acido-basique et de precipitation

$m = \frac{(3,88 \cdot 10^{-3} + 4,26 \cdot 10^{-5}) \times 200 \cdot 10^{-3} \times 58}{2}$

$m = 0,023\ g$

Rep) A ou E

3) Calcul de $m'_{NH_4^+}$

$Mg(OH)_2 + NH_4^+ \rightleftharpoons 2OH^-$

$m_{NH_4^+} = CVM_{NH_4Cl}$ or

$C = [Mg^{2+}]_{melange}$

AN $m_{NH_4^+} = 0,01 \times 200 \cdot 10^{-3} \times 53,5 = 0,107\ g$

Rep) A ou E

4) Calcul du pH

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

$pH = 14 + \log(3,88 \cdot 10^{-3} + 4,26 \cdot 10^{-5})$

$pH = 11,6$

Rep A ou E

Exo 4

$Na_3PO_4 \rightleftharpoons 3Na^+ + PO_4^{3-}$

C — $3C$ — C

$t = 5\%$ $d = 1,043$

$t = \frac{CM \times 100}{d\rho} \Rightarrow C = \frac{t\, d\rho}{100\, M}$

$C = \frac{5 \times 1,043 \times 10^3}{100 \times 164} = 0,318$

$[Fe(SCN)^{2+}] < 10^{-5,5} = 3,162 \cdot 10^{-6}$

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

$[Fe^{3+}] = C_1 - \varepsilon'$

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

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

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

$Fe^{3+} + F^- \rightleftharpoons FeF^{2+}$

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

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

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

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

$[Fe^{3+}] = \dfrac{3,16 \cdot 10^{-6}}{91 \times 10^{2,95}}$

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

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

$=$

- Cas du calcul du pH

$\beta_2 = \dfrac{[FeF^{2+}]}{[F^-] \cdot [Fe^{3+}]} \Rightarrow [F^-] = \dfrac{[FeF^{2+}]}{\beta[Fe^{3+}]}$

$pH = pKa + \log \dfrac{[F^-]}{[HF]}$ (1)

5) En déduire le nbre de moles minimal de $NaF = Na^+ + F^-$
$C \quad C \quad C$

$n_F = ([F^-]_{\text{com}} + [F^-]_{\text{libre}})$

or $\begin{cases} [F^-]_{\text{libre}} = 10^{-pH} \\ [F^-]_{\text{complexe}} = \dfrac{[FeF^{2+}]}{[Fe^{3+}]} \end{cases}$

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

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

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Suite SM
2023 / 2024

Exo 2

2- Données :

mélange M_1 $\begin{cases} MgCl_2 \; C_2 = 0,02M \\ V_2 = 100 \text{ mL} \end{cases}$

$+ NH_3 \begin{cases} C_1 = 2M \\ V_1 = 100 \text{ mL} \end{cases}$

$NH_3 + H_2O \longrightarrow$ ...

- Nature
- le pH
- transport { environnements de formation des gisements de min...

$SCN^- \begin{cases} C_2 = 0,2\ M \\ V_2 = 0,5\ L \end{cases}$ $\quad Fe^{3+} \begin{cases} C_1 = 0,002\ M \\ V_1 = 0,5\ L \end{cases}$

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

$$Fe^{3+} + SCN^- \rightleftharpoons Fe(SCN)^{2+}$$

$t=0$	C_1'	C_2'	—
$t \neq 0$	$C_1' - \varepsilon$	$C_2' - \varepsilon$	ε

$$\beta = \frac{[Fe(SCN)^{2+}]}{[Fe^{3+}]\cdot[SCN^-]} = \frac{\varepsilon}{(C_1'-\varepsilon)(C_2'-\varepsilon)}$$

or $C_2' = \dfrac{C_2 V_2}{V_1+V_2} = \dfrac{0,2 \times 0,5}{(0,5+0,5)} = 0,1$

$$C_1' = \frac{C_1 \cdot V_1}{V_1+V_2} = \frac{0,002 \times 0,5}{(0,5+0,5)} = 10^{-3}$$

$$C_2' - \varepsilon \simeq C_2'$$

$$\beta = \frac{\varepsilon}{C_2'(C_1-\varepsilon)} = \frac{\varepsilon}{C_2'C_1' - \varepsilon C_2'}$$

$$\beta(C_2'C_1' - \varepsilon C_2') = \varepsilon$$

$$\beta C_2' C_1' - \beta \varepsilon C_2' = \varepsilon$$

$$\Rightarrow \varepsilon(1+\beta C_2') = \beta C_2' C_1'$$

$$\varepsilon = \frac{\beta C_2' C_1'}{(1+\beta C_2')}$$

AN $\varepsilon = \dfrac{10^{2,95} \times 10^{-1} \times 10^{-3}}{\ldots}$

$= 9,89 \cdot 10^{-4}$

$[Fe^{3+}] = C_1 - \varepsilon = 10^{-3} - 9,84 \cdot 10^{-4}\ M$
$= 9,14 \cdot 10^{-2}\ M$

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

Rep E

2) Calculer la constante d'équilibre

$$Fe(SCN)^{2+} + F^- \rightleftharpoons FeF^{2+} + SCN^-$$

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

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

$$K = \frac{1}{\beta_1} \times \beta_2 = \frac{\beta_2}{\beta_1} = \frac{10^{5,3}}{10^{2,95}}$$

$$= 10^{5,3-2,95} =$$

Rep B

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

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

$$Fe^{3+} + SCN^- \rightleftharpoons Fe(SCN)^{2+}$$

C_1'	C_2'	
$C_1' - \varepsilon$	$C_2' - \varepsilon$	ε