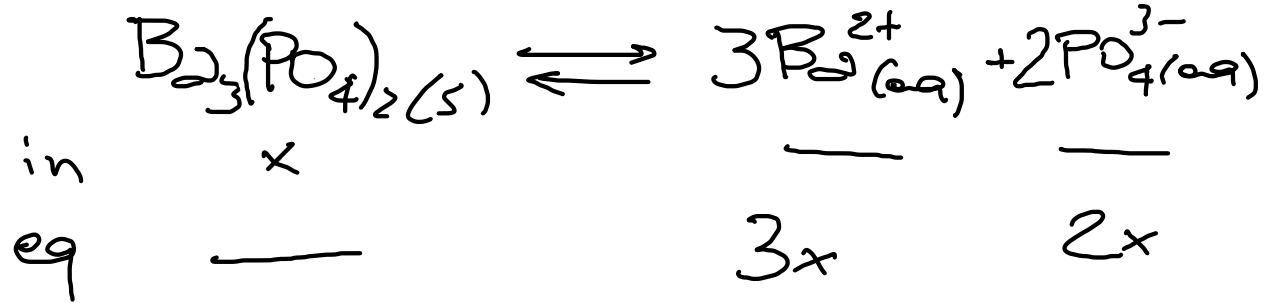


Es. 1

Sapendo che per $\text{Ba}_3(\text{PO}_4)_2$ si ha $1,3 \times 10^{-29}$, calcolare la solubilità di $\text{Ba}_3(\text{PO}_4)_2$.

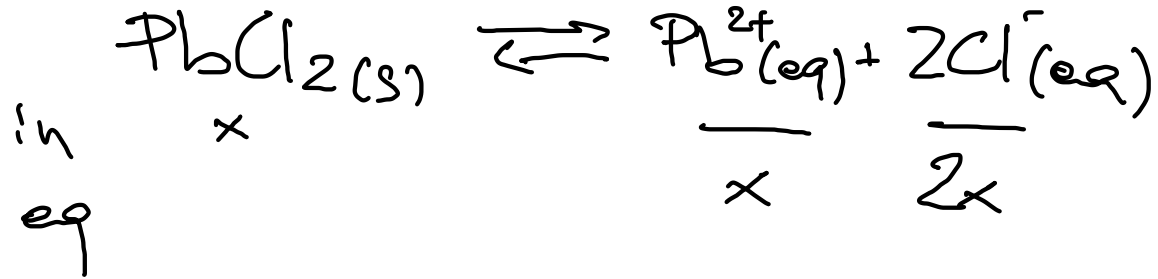


$$K_{ps} = [\text{Ba}^{2+}]^3 [\text{PO}_4^{3-}]^2 = (3x)^3 (2x)^2 = 108x^5 = 1,3 \cdot 10^{-29}$$

$$x = \sqrt[5]{\frac{K_{ps}}{108}} = 6,55 \cdot 10^{-7} \text{ M}$$

Es. 2

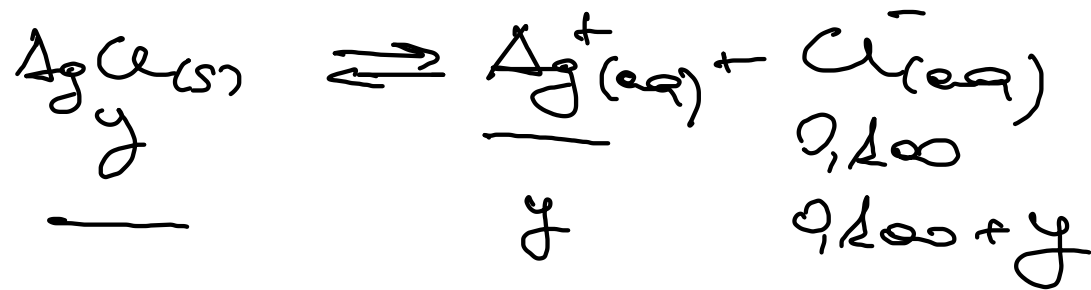
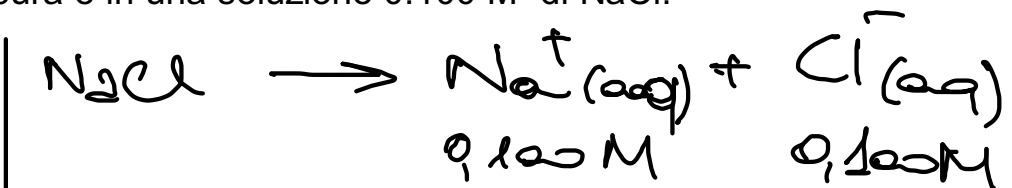
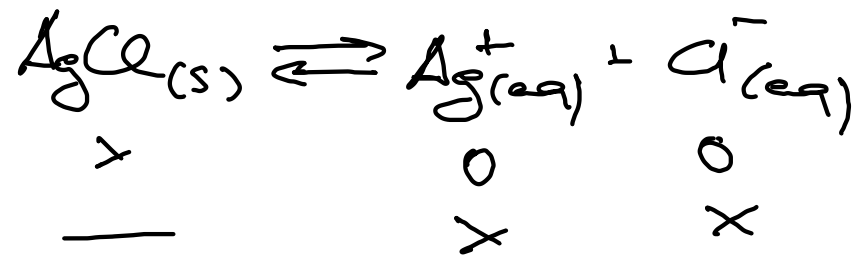
Sapendo che in una soluzione satura di PbCl_2 si ha $[\text{Pb}^{2+}] = 1.62 \times 10^{-2} \text{ M}$, calcolare K_{ps} per PbCl_2 .



$$K_{\text{ps}} = [\text{Pb}^{2+}][\text{Cl}^{-}]^2 = x(2x)^2 = 4x^3 = 4(1,2 \cdot 10^{-2})^3 = 6,91 \cdot 10^{-6} \text{ M}$$

Es. 3

Confrontare la solubilità di AgCl ($K_{ps} = 1.8 \times 10^{-10}$) in acqua pura e in una soluzione 0.100 M di NaCl.



$$K_{ps} = [\text{Ag}^+][\text{Cl}^-]$$

$$K_{ps} = x^2 = 1.8 \cdot 10^{-10}$$

$$x = \sqrt{K_{ps}} = \sqrt{1.8 \cdot 10^{-10}} = 1.34 \cdot 10^{-5} \text{ M}$$

$$K_{ps} = y(0.100 + \cancel{y}) = 1.8 \cdot 10^{-10}$$

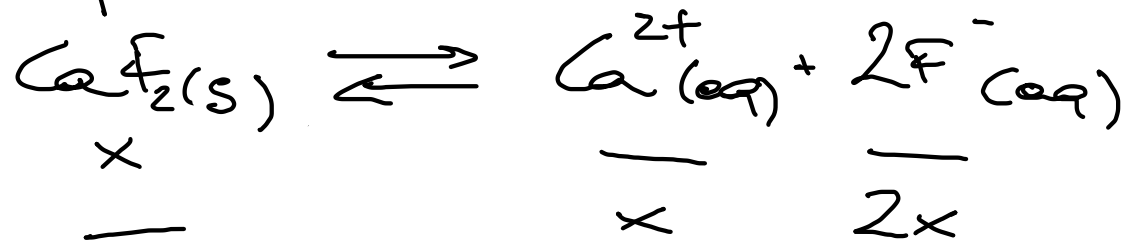
$$y \ll x$$

$$y = \frac{1.8 \cdot 10^{-10}}{0.100} = 1.8 \cdot 10^{-9} \text{ M}$$

Es. 4

Confrontare la solubilità di CaF_2 in acqua pura e in una soluzione tampone a $\text{pH} = 1$. Per CaF_2 si ha $K_{ps} = 3.9 \times 10^{-11}$, per HF si ha $K_A = 6.8 \times 10^{-4}$.

In acqua pura:



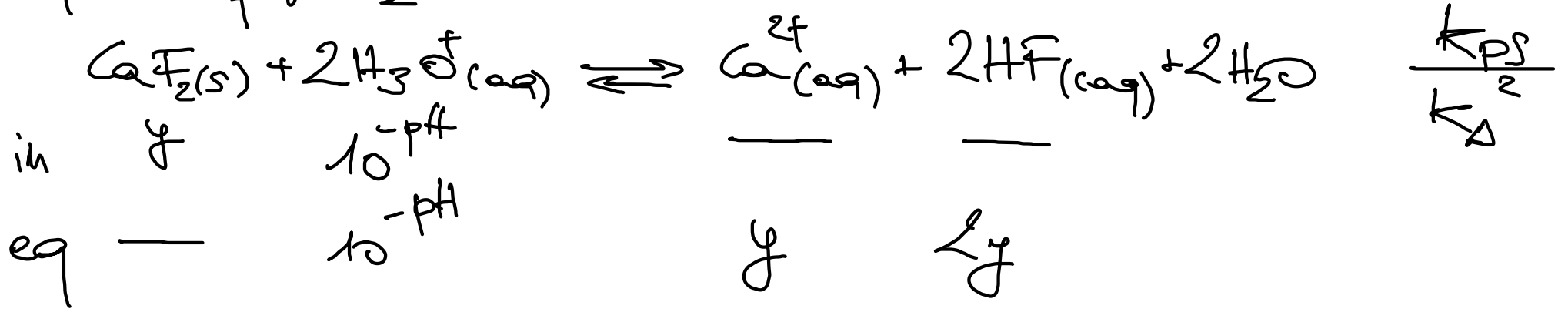
$$K_{ps} = [\text{Ca}^{2+}][\text{F}^{-}]^2 = 4x^3 = 3.9 \cdot 10^{-11}$$

$$x = \sqrt[3]{\frac{3.9 \cdot 10^{-11}}{4}} = 2.14 \cdot 10^{-4} \text{ M}$$

Es. 4

Confrontare la solubilità di CaF_2 in acqua pura e in una soluzione tampone a $\text{pH} = 1$. Per CaF_2 si ha $K_{ps} = 3.9 \times 10^{-11}$, per HF si ha $K_A = 6.8 \times 10^{-4}$.

In tampone $\text{pH} = 1$



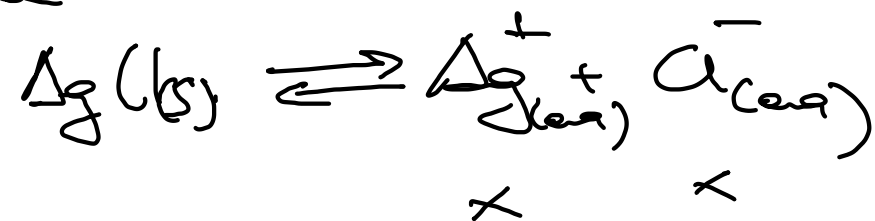
$$K = \frac{K_{ps}}{\Delta^2} = \frac{[\text{Ca}^{2+}][\text{HF}]^2}{[\text{H}_3\text{O}^+]^2} = \frac{4\gamma^3}{10^{-2\text{pH}}}$$

$$\gamma = \sqrt[3]{\frac{K_{ps} \cdot 10^{2\text{pH}}}{K_{\Delta}^2 \cdot 4}} = \sqrt[3]{\frac{3.9 \cdot 10^{-11} \cdot 10^{-2}}{(6.8 \cdot 10^{-4})^2 \cdot 4}} = 2.76 \cdot 10^{-2} \text{ M}$$

Es. 5

Confrontare la solubilità di AgCl in acqua pura e in una soluzione contenente NH_3 0.150 M. Per AgCl si ha $K_{ps} = 1.8 \times 10^{-10}$, per $\text{Ag}(\text{NH}_3)_2^+$ si ha $K_{inst} = 1/K_f = 6.0 \times 10^{-8}$.

In acqua pura:



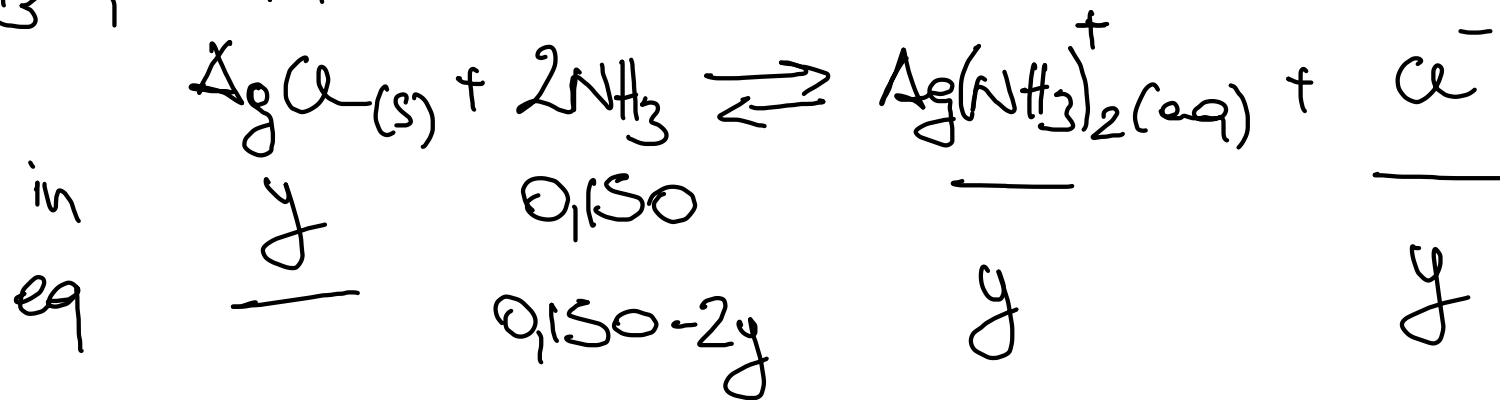
$$K_{ps} = [\text{Ag}^+][\text{Cl}^-] = x^2 = 1.8 \cdot 10^{-10}$$

$$x = \sqrt{K_{ps}} = 1.34 \cdot 10^{-5} \text{ M}$$

Es. 5

Confrontare la solubilità di AgCl in acqua pura e in una soluzione contenente NH₃ 0.150 M. Per AgCl si ha $K_{ps} = 1.8 \times 10^{-10}$, per Ag(NH₃)₂⁺ si ha $K_{inst} = 1/K_f = 6.0 \times 10^{-8}$.

In NH₃ 0,150 M :

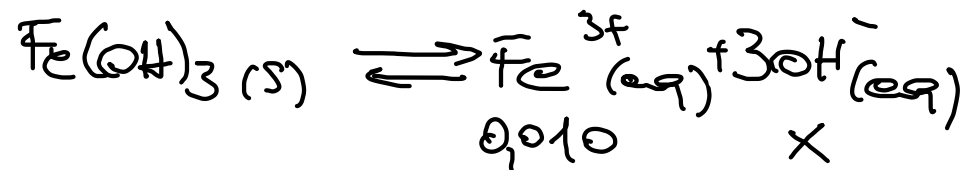


$$K = \frac{K_{ps}}{K_{inst}} = \frac{[\text{Ag(NH}_3)_2^+][\text{Cl}^-]}{[\text{NH}_3]^2} = \frac{y^2}{(0,150 - 2y)^2} = \frac{1,8 \cdot 10^{-10}}{6,0 \cdot 10^{-9}} = 0,030$$

$$y = 0,0434 \text{ M}$$

Es. 6

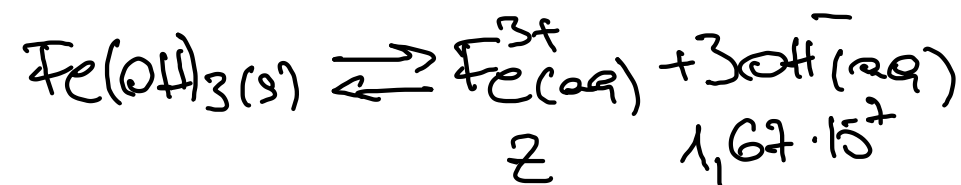
Verificare se sia possibile separare per precipitazione gli ioni Fe^{3+} e Ni^{2+} come idrossidi poco solubili, quando entrambi gli ioni sono presenti in soluzione 0.010 M. Per $\text{Fe}(\text{OH})_3$, $K_{ps} = 6.3 \times 10^{-38}$, per $\text{Ni}(\text{OH})_2$ $K_{ps} = 2.8 \times 10^{-16}$.



$$K_{ps \text{ Fe}(\text{OH})_3} = [\text{Fe}^{3+}][\text{OH}^{-}]^3 = 0,010 \cdot x^3$$

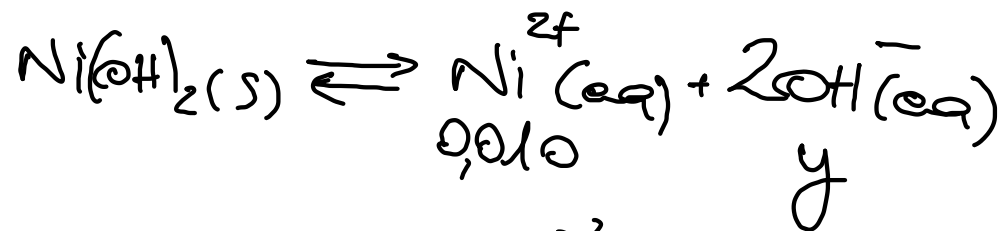
$$x = \sqrt[3]{\frac{6,3 \cdot 10^{-38}}{0,010}} = 1,85 \cdot 10^{-12} \text{ M}$$

$[\text{Fe}^{3+}]$ residua



$$(1,67 \cdot 10^{-7})^3 \cdot z = 6,3 \cdot 10^{-38}$$

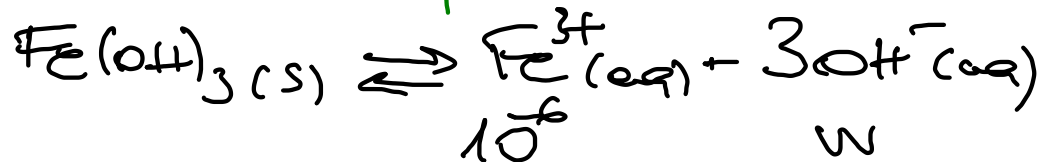
$$z = \frac{6,3 \cdot 10^{-38}}{(1,67 \cdot 10^{-7})^3} = 1,35 \cdot 10^{-17} \text{ M} \ll 10^{-6} \text{ M}$$



$$K_{ps \text{ Ni}(\text{OH})_2} = [\text{Ni}^{2+}][\text{OH}^{-}]^2 = 0,010 \cdot y^2$$

$$y = \sqrt{\frac{2,8 \cdot 10^{-16}}{0,010}} = 1,67 \cdot 10^{-7} \text{ M}$$

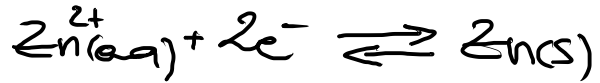
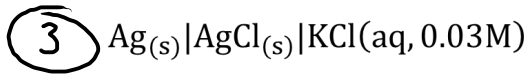
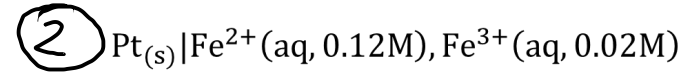
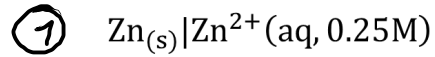
$[\text{OH}^{-}]$ fine prec. $\text{Fe}(\text{OH})_3$



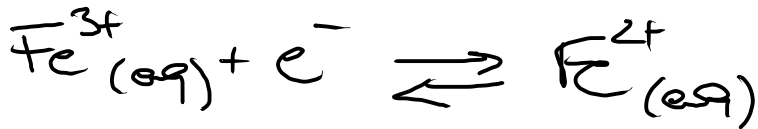
$$10^{-6} \cdot w^3 = 6,3 \cdot 10^{-38}$$

$$w = \sqrt[3]{\frac{6,3 \cdot 10^{-38}}{10^{-6}}} = 3,98 \cdot 10^{-11} \text{ M} \ll 1,67 \cdot 10^{-7} \text{ M}$$

• Calcolare il potenziale dei seguenti elettrodi:



$$\begin{aligned} \text{① } E_{\text{Zn}^{2+}/\text{Zn}} &= E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} + \frac{0,0591}{2} \log [\text{Zn}^{2+}] = \\ &= -0,7618 + \frac{0,0591}{2} \log(0,25) = -0,780\text{V} \end{aligned}$$



$$\text{② } E_{\text{Fe}^{3+}/\text{Fe}^{2+}} = E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^{\circ} + 0,0591 \log \frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}]} = +0,77 + 0,0591 \cdot \log \frac{0,02}{0,12} = 0,724\text{V}$$

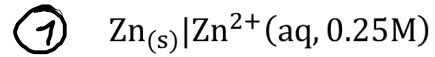
$$E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0,7618\text{V}$$

$$E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^{\circ} = +0,77\text{V}$$

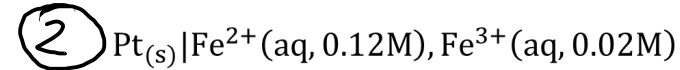
$$E_{\text{Ag}^+/\text{Ag}}^{\circ} = +0,7996\text{V}$$

$$K_{\text{PS AgCl}} = 1,8 \cdot 10^{-10}$$

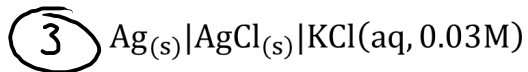
• Calcolare il potenziale dei seguenti elettrodi:



$$E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0,7618 \text{ V}$$



$$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0,77 \text{ V}$$



$$K_{ps} = [\text{Ag}^+][\text{Cl}^-]$$

$$E^\circ_{\text{Ag}^+/\text{Ag}} = +0,7996 \text{ V}$$

$$K_{ps \text{ AgCl}} = 1,8 \cdot 10^{-10}$$

$$E_{\text{Ag}^+/\text{Ag}} = E^\circ_{\text{Ag}^+/\text{Ag}} + 0,0591 \log [\text{Ag}^+] = E^\circ_{\text{Ag}^+/\text{Ag}} + 0,0591 \log \frac{K_{ps}}{[\text{Cl}^-]} = E^\circ_{\text{AgCl}/\text{Ag}} + 0,0591 \log \frac{1}{[\text{Cl}^-]}$$

$$E^\circ_{\text{AgCl}/\text{Ag}} = E^\circ_{\text{Ag}^+/\text{Ag}} + 0,0591 \log K_{ps} = +0,7996 + 0,0591 \log (1,8 \cdot 10^{-10}) = 0,2237 \text{ V}$$

$$\textcircled{*} = 0,3137 \text{ V}$$

