Prodotto di solubilità: esercizi

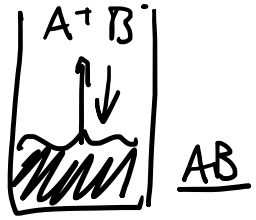
H_2O pura

$BaSO_{4(s)} \rightleftharpoons Ba^{++}_{(aq)} + SO_4^{=}{}_{(aq)}$

Kps

i /

e / s (s) → SOLUBILITÀ



$Kps = [Ba^{++}][SO_4^{=}] = s^2$ $\quad s = \sqrt{Kps}$

$BaSO_{4(s)} \rightleftharpoons Ba^{++}_{(aq)} + SO_4^{=}{}_{(aq)}$

i / 1M

e / 1M + s s

$Kps = [Ba^{++}][SO_4^{=}] = (1+s)(s)$ $\quad s = \frac{Kps}{1}$

DIMINUZIONE di s

$BaCl_2$ 1M → $Ba^{++} + 2Cl^-$

LEX1

$PbCl_2$ $K_{ps} = 1.7 \cdot 10^{-5}$

a) H_2O pura

b) 0.1 M NaCl

$$PbCl_{2(s)} \rightleftharpoons Pb^{++}_{(aq)} + 2Cl^-_{(aq)}$$

i /

e / s 2s

$$K_{ps} = [Pb^{++}][Cl^-]^2 = s \cdot (2s)^2 = 4s^3$$

$$s = \sqrt[3]{\frac{K_{ps}}{4}} = \sqrt{\frac{1.7 \cdot 10^{-5}}{4}}$$

$$\boxed{s = 1.6 \cdot 10^{-2} \ M}$$

$$NaCl \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$$

0.1 M 0.1M 0.1M

$$PbCl_2 \rightleftharpoons Pb^{++}_{(aq)} + 2Cl^-_{(aq)}$$

i /

e / s 0.1+2s

$$K_{ps} = [Pb^{++}][Cl^-]^2 = s\,(0.1+2s)^2$$

$2s \simeq 3.2 \cdot 10^{-2}$

$$s\,(0.1+2s)^2 = 1.7 \cdot 10^{-5}$$

$$s \simeq 1.65 \cdot 10^{-3}\ M$$

effetto ione comune

Ex2

1L 10^{-2}M NBr

9.10^{-3} mol $PbBr_2$

Calculare K_{ps} = ?

$$PbBr_{2(s)} \rightleftharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$$

i	/	/	10^{-2}
e	/	s	$2s + 10^{-2}$

$$NBr \rightarrow N^+ + Br^-$$

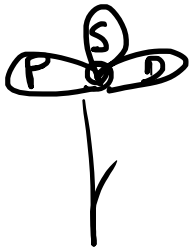
10^{-2} 10^{-2} 10^{-2}

$$s = 9.10^{-3}\ \frac{mol}{L}$$

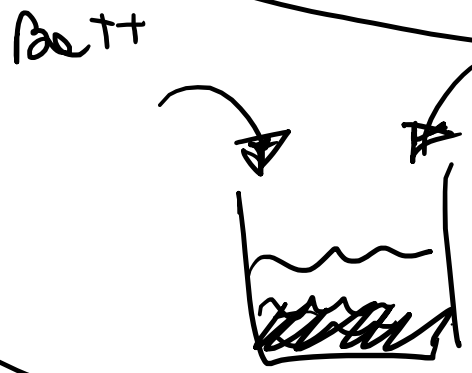
$$K_{ps} = s(2s + 10^{-2}) = 9.10^{-3} \cdot (2 \cdot 9.10^{-3} + 10^{-2})$$

$$\boxed{K_{ps} = 7,06 \cdot 10^{-6}}$$

- $Q < K_{ps}$
- $Q > K_{ps}$
- $Q = K_{ps}$



$BaSO_{4(s)} \rightleftharpoons Ba^{++}_{(aq)} + SO_4^{=}{}_{(aq)}$



SATURAZIONE

SOVRASATURAZIONE

↓

PRECIPITAZIONE

Es3

100 mL Na_2SO_4 1 M

50 mL $BaCl_2$ 1 M

$Kps_{BaSO_4} = 1.07 \cdot 10^{-10}$

$T = 25°C$

$$Na_2SO_4 + BaCl_2 \rightarrow 2NaCl + BaSO_{4(s)}\downarrow$$

	Na_2SO_4	$BaCl_2$	$2NaCl$	$BaSO_{4(s)}$
i	0.1	0.05		
f	0.1 − 0.05	/	2 · 0.05	0.05

$$mol\ Na_2SO_4 = 1\ \frac{mol}{L} \cdot 0.1\ L = 0.1\ mol$$

$$mol\ BaCl_2 = 1\ \frac{mol}{L} \cdot 0.05\ L = 0.05\ mol$$

$$BaSO_{4(s)} \rightleftharpoons Ba^{++}_{(aq)} + SO_4^{=}{}_{(aq)}$$

$Qps > Kps$

$[Ba^{++}]\,[SO_4^{=}] > Kps$

$$[Ba^{++}] = \frac{0.05\ mol}{0.150\ L} = 0.333\ M \quad \checkmark$$

$$[SO_4^{=}] = \frac{0.05}{0.150} + 1 \simeq 0.333\ M \longrightarrow$$

EX 4

50 mL 0,110 M $AgNO_3$ + 50 mL 0.065 M H_2CrO_4

$[Ag^+]$

$[CrO_4^{2-}]$

$Kps\ Ag_2CrO_4 = 1.9 \cdot 10^{-12}$

$$2AgNO_3 + H_2CrO_4 \longrightarrow Ag_2CrO_4\downarrow_{(s)} + 2HNO_3$$

	$5.5 \cdot 10^{-3}$	$3.3 \cdot 10^{-3}$			
i					
f	/	$(3.3 \cdot 10^{-3} - 2.75 \cdot 10^{-3})$	$\frac{5.5 \cdot 10^{-3}}{2}$	=	$5.5 \cdot 10^{-3}$

$mol\ AgNO_3 = 0.05L \cdot 0.110 \frac{mol}{L} = 5.5 \cdot 10^{-3}\ mol\ (Ag^+)$

$mol\ H_2CrO_4 = 0.05\ L \cdot 0.065 \frac{mol}{L} = 3.3 \cdot 10^{-3}\ mol\ (CrO_4^{2-})$

$2 : 1 = 5.5 \cdot 10^{-3} : X_{Ag_2CrO_4}$

$5.5 \cdot 10^{-3} : X_{H_2CrO_4} = 1 : 1$

$2.8 \cdot 10^{-3}$ V

$[Ag^+] = ?$

$[CrO_4^{=}] = ?$

$$Ag_2CrO_4(s) \rightleftharpoons 2Ag^+(aq) + CrO_4^{=}(aq) \qquad K_{ps} =$$

$$5.5 \cdot 10^{-3}$$

i

e $\qquad\qquad 2s \qquad\qquad s + 5.5 \cdot 10^{-3}$

$$[CrO_4^{=}] = \frac{(3.3 \cdot 10^{-3} - 2.75 \cdot 10^{-3})\ mol}{0.1\ L} = 5.5 \cdot 10^{-3}\ M$$

$$K_{ps} = 1.9 \cdot 10^{-12} = (2s)^2 \left(s + 5.5 \cdot 10^{-3}\right)$$

$$s = 2 \cdot 10^{-5}\ M = [Ag^+]$$

$$\Rightarrow [CrO_4^{=}] = 5.5 \cdot 10^{-3}\ M$$

ex 5

30 mL KI 0.10M + 25 mL $AgNO_3$ 0.10M

$[Ag^+] = ?$ $[I^-] = ?$

$[NO_3^-] = ?$ $[H^+] = ?$

$K_{ps}\ AgI = 8.3 \cdot 10^{-17}$

$$KI + AgNO_3 \rightarrow AgI_{(s)}\downarrow + HNO_3$$

$3 \cdot 10^{-3}$ $2.5 \cdot 10^{-3}$

$(3 - 2.5) \cdot 10^{-3}$ / $2.5 \cdot 10^{-3}$ $2.5 \cdot 10^{-3}$

$(+ 5 \cdot 10^{-4}\ mol)$

$[H^+] = 2.5 \cdot 10^{-3}\ mol / 0.055\ L$

$[NO_3^-] = 2.5 \cdot 10^{-3}\ mol / 0.055\ L$

$mol\ KI = 0.03\ L \cdot 0.1 \frac{mol}{L} = 3 \cdot 10^{-3}\ mol$

$mol\ AgNO_3 = 0.025\ L \cdot 0.1 \frac{mol}{L} = 2.5 \cdot 10^{-3}\ mol$

$$AgI_{(s)} \rightleftharpoons Ag^+_{(aq)} + I^-_{(aq)}$$

$5 \cdot 10^{-4}\ mol / 0.055\ L$

$\rightarrow$ s s

$$K_{ps} = s \cdot \left(\frac{5 \cdot 10^{-4}\ mol}{0.055\ L} + s \right)$$

$[I^-] = 10^{-2} + s$

$[Ag^+] = s$

$8.3 \cdot 10^{-17} = s\,(10^{-2} + s)$

$s = \dfrac{8.3 \cdot 10^{-17}}{10^{-2}} = \boxed{8.3 \cdot 10^{-15}\ M}$

$[Ag^+] = 8.3 \cdot 10^{-15}\ M$

$[I^-] = 10^{-2}\ M$