

CERAMIC AND COLLOIDAL PROCESSING - EXERCISES

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Exercises 5 – Solutions

1. Calculate the ionic strength (I) of an aqueous solution of electrolytes. Then determine the γ activity coefficients of the ions present in the solution.

Examples

a) Aqueous solution of AlCl_3 0.050 [mol / L] at 25 ° C ($\text{AlCl}_3 \rightarrow \text{Al}^{3+}$ and Cl^-).

b) Aqueous solution of CaSO_4 0.025 [mol / L] at 25 ° C ($\text{CaSO}_4 \rightarrow \text{Ca}^{2+}$ and SO_4^{2-}).

The ionic strength I of the solution is calculated using Eq. (1.6.18)

$$I = \frac{1}{2} \sum_i z_i^2 c_i$$

a) Aqueous solution of AlCl_3 0.050 [mol / L] at 25 ° C ($\text{AlCl}_3 \rightarrow \text{Al}^{3+} + 3 \text{Cl}^-$).

$$I = 0.05 \times [3^2 + 3 \times (-1)^2] / 2 = 12 \times 0.025 = 0.300 \text{ [mol / L]}$$

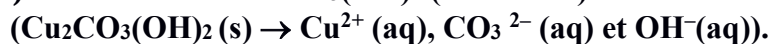
b) Aqueous solution of CaSO_4 0.025 [mol / L] at 25 ° C, ($\text{CaSO}_4 \rightarrow \text{Ca}^{2+} + \text{SO}_4^{2-}$).

$$I = 0.025 \times [2^2 + (-2)^2] / 2 = 8 \times 0.0125 = 0.100 \text{ [mol/L]}$$

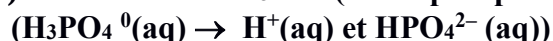
2.. Establish the stoichiometric equation for the dissolution or dissociation of an electrolyte, and formulate an expression for the equilibrium constant K_d .

Examples

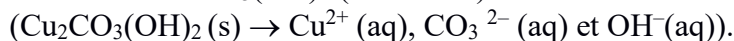
(a) Dissolution of $\text{Cu}_2\text{CO}_3(\text{OH})_2$ (Malachite)



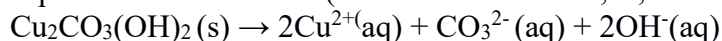
(b) Dissociation of H_3PO_4 (ortho-phosphoric acid)



(a) Dissolution of $\text{Cu}_2\text{CO}_3(\text{OH})_2$ (Malachite)



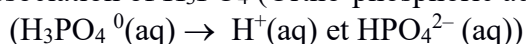
Equation stoichiometric (balance elements Cu, C, O and H, as well as charges) :



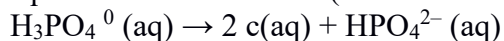
From which we obtain K_d :

$$K_d = (\text{Cu}^{2+})^2 (\text{CO}_3^{2-}) (\text{OH}^-)^2$$

(b) Dissociation of H_3PO_4 (Ortho-phosphoric acid)



Equation stoichiometries (balance elements P, O et H, as well as charges) :



From which we obtain K_d :

$$K_d = (\text{HPO}_4^{2-}) (\text{H}^+)^2 / (\text{H}_3\text{PO}_4^0)$$