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 ($AlCl_3 \rightarrow Al^{3+}$ and Cl^-).
b) Aqueous solution of $CaSO_4$ 0.025 [mol / L] at 25 ° C ($CaSO_4 \rightarrow Ca^{2+}$ 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 (($AlCl_3 \rightarrow Al^{3+} + 3\ Cl^-$).
$I = 0.05 \times [3^2 + 3 \times (-1)^2] / 2 = 12 \times 0.025 = 0.300$ [mol / L]

b) Aqueous solution of $CaSO_4$ 0.025 [mol / L] at 25 ° C, ($CaSO_4 \rightarrow Ca^{2+} + SO_4^{2-}$).
$I = 0.025 \times [2^2 + (-2)^2]/2 = 8 \times 0.0125 = 0.100$ [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 $Cu_2CO_3(OH)_2$ (Malachite)
($Cu_2CO_3(OH)_2$ (s) → Cu^{2+} (aq), CO_3^{2-} (aq) et OH^-(aq)).
(b) Dissociation of H_3PO_4 (ortho-phosphoric acid)
($H_3PO_4^0$(aq) → H^+(aq) et HPO_4^{2-} (aq))

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($Cu_2CO_3(OH)_2$ (s) → Cu^{2+} (aq), CO_3^{2-} (aq) et OH^-(aq)).

Equation stoichiometric (balance elements Cu, C, O and H, as well as charges) :
$Cu_2CO_3(OH)_2$ (s) → $2Cu^{2+}$(aq) + CO_3^{2-} (aq) + $2OH^-$(aq)
From which we obtain K_d :
$K_d = (Cu^{2+})^2\ (CO_3^{2-})\ (OH^-)^2$

(b) Dissociation of H_3PO_4 (Ortho-phosphoric acid)
($H_3PO_4^0$(aq) → H^+(aq) et HPO_4^{2-} (aq))
Equation stoichiometries (balance elements P, O et H, as well as charges) :
$H_3PO_4^0$ (aq) → 2 c(aq) + HPO_4^{2-} (aq)
From which we obtain K_d :
$K_d = (HPO_4^{2-})\ (H^+)^2\ /\ (H_3PO_4^0)$