Chapter 8 - Solutions

1. As the ionic strength increases, the charge density of the ionic atmosphere around ionic species increases as well. This reduces the attraction between the oppositely charged ionic species. Thus the tendency of ions to come together and precipitate out decreases, i.e. solubility increase.

8. Dissolution as any other process is an equilibrium process, in this case the K = $\gamma_{ether} \cdot$[ether(aq)]. Because [ether(aq)] becomes smaller by 'salting out', (salting out = ether dissolved in water lowers) γ_{ether} must become larger to maintain the equilibrium described by K = $\gamma_{ether} \cdot$[ether(aq)] a constant. This is the case for dissolution of nonpolar molecules like ether in polar water solutions.

12. ionic atmosphere comes from HCl and $KClO_4$.

$C_H := 0.010$ $\mu := 0.050$ from the table; $\gamma_H := 0.86$ (direct reading)

$pH := -\log(\gamma_H \cdot C_H)$ $pH = 2.066$

13. $\mu := 0.022$ by interpolation from table data $\gamma_{OH} := 0.873$

Ion product of water:

$K_W := 1.0 \cdot 10^{-14}$

$C_{OH} := 0.010$

$a_H := \dfrac{K_W}{C_{OH} \cdot \gamma_{OH}}$ $pH := -\log(a_H)$ $pH = 11.94$

Without considering activities: $pH := -\log\left(\dfrac{K_W}{C_{OH}}\right)$

$pH = 12.00$

14. $T := 273.15 + 50.00$ $z_i := -2$ $\alpha := 400$ $\mu := 0.100$

(Note the Extended DHE in its full form)

$\varepsilon := 79.755 \cdot e^{\left(-4.6 \cdot 10^{-3}\right) \cdot (T - 293.15)}$

$$\log(\gamma) = \frac{\left(-1.825 \cdot 10^{6}\right) \cdot (\varepsilon \cdot T)^{-\frac{3}{2}} \cdot z_i^{2} \cdot \sqrt{\mu}}{1 + \dfrac{\alpha \cdot \sqrt{\mu}}{2.00 \cdot \sqrt{\varepsilon \cdot T}}}$$

solving the above yield,

$$\gamma := \exp\left[-7.3\cdot 10^{25}\cdot z_i^{\,2}\cdot\frac{\sqrt{\mu}}{\left[1.737\times 10^{19}\cdot\varepsilon^{\left(\frac{3}{2}\right)}\cdot T^{\left(\frac{3}{2}\right)}+8.686\times 10^{18}\cdot\varepsilon\cdot T\cdot\alpha\cdot\sqrt{\mu}\right]}\right]$$

$\gamma = 3.292\times 10^{-1}$ (from table γ is 0.355).

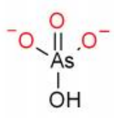
18. charge balance equation:

$$C_H + 2\cdot C_{Ca} + C_{CaHCO3} + C_{CaOH} + C_K = C_{OH} + C_{HCO3} + 2\cdot C_{CO3} + C_{ClO4}$$

20. charge balance equation:

$$C_{OH} + C_{H2AsO4} + 2\cdot C_{HAsO4} + 3\cdot C_{AsO4} = C_H$$

Structure of $HAsO_4^{-2}$:



24. mass balance equation (balancing mass of Y) Y exist in four forms:

$$2\cdot C_{X2Y2} + C_{X2Y} + 3\cdot C_{X2Y3} + C_Y = C_{totalY}$$

balancing mass of X, X exist in three forms;

$$2\cdot C_{X2Y2} + 2\cdot C_{X2Y} + 2\cdot C_{X2Y3} = C_{totalX}$$

because, overall $C_{totalY} = \frac{3}{2}\cdot C_{totalX}$

$$2\cdot C_{X2Y2} + C_{X2Y} + 3\cdot C_{X2Y3} + C_Y = \frac{3}{2}\cdot\left(2\cdot C_{X2Y2} + 2\cdot C_{X2Y} + 2\cdot C_{X2Y3}\right)$$

simplifies to

$$2\cdot C_{X2Y2} + C_{X2Y} + 3\cdot C_{X2Y3} + C_Y = 3\cdot C_{X2Y2} + 3\cdot C_{X2Y} + 3\cdot C_{X2Y3}$$

has solution(s)

$$C_Y = C_{X2Y2} + 2\cdot C_{X2Y}$$