ES 202

Environmental Chemistry

Indian Institute of Technology Bombay

Assignment 2

1. The following quantities of salts were added to a volume of water to make 1 liter of solution:

   1×10^{-2} moles of NaCl

   2×10^{-2} moles of $CaCl_2$

   2×10^{-2} moles of $BaCl_2$

   a.) What is the ionic strength of the solution?

   b.) A small amount of phosphate salt is added to the same solution with negligible change in ionic strength. Given $K = 10^{-7.2}$ for the reaction

   $H_2PO_4^- \leftrightarrow H^+ + HPO_4^{2-}$

   Calculate $[H^+][HPO_4^{2-}]/[H_2PO_4^-]$, called ${}^cK$, using the Guntelberg approximation of the DeBye-Huckel law.

   c.) Calculate the "salting out" coefficient of, k_s, for a nonelectrolyte in the same solution if its activity is 10^{-3} M and its concentration is 9.5×10^{-4} M. (10 marks)

2. Thiourea solution is ($S=C(NH_2)_2$) an excellent lixiviant for extracting silver, mercury, gold etc. from their ores. There are two distinct groups, thiol (S-based) and amine ($-NH_2$), within a thiourea molecule which can donate electrons and form bonds with silver, mercury or gold atoms. Suppose you need to extract mercury from its ore cinnabar using thiourea, which of the two groups would bond with mercury predominantly and why? (5 marks)

3. Write proton condition for the following (5x2 marks = 10 marks)
   a) Sodium bicarbonate is dissolved in pure water
   b) Sodium carbonate is dissolved in pure water
   c) NH_4Cl and $NaHCO_3$ is dissolved in pure water
   d) NaH_2PO_4 is dissolved in pure water.
   e) Sodium acetate is dissolved in pure water