3.091 Fall Term 2004

Homework #11

November 18, 2003 (to be tested 11/23)

from Module Chapter 4 "Solubility Equilibria": 4, 8, 10, 16, 26, 29

from Main Text Chapter 11 "Acids and Bases": 5, 6, 13, 35, 50, 52, 64, 85, 89

plus the following problems.

1. (a) Identify the conjugate acid-base pairs in the following reactions:

(i) $HI\,(aq) + H_2O\,(l) \rightarrow H_3O^+\,(aq) + I^-\,(aq)$

(ii) $CH_3COOH\,(aq) + OH^-\,(aq) \rightarrow CH_3COO^-\,(aq) + H_2O\,(l)$

(iii) $NH_3(aq) + H_2O\,(l) \rightarrow NH_4^+\,(aq) + OH^-\,(aq)$

(b) Identify which of the following cannot be a Brønsted base and give a reason for your choices: H_3O^+, $AlCl_4^-$, CN^-, O^{2-}, SiH_4, AsH_3.

(c) Estimate the *p*H and *p*OH of a 0.03091 M solution of hydroiodic acid ($K_a \cong 10^9$).

2. Bi_2S_3 dissolves in water according to the following reaction:

$$Bi_2S_3\,(s) \Leftrightarrow 2\,Bi^{3+}\,(aq) + 3\,S^{2-}\,(aq)$$

for which the solubility product, K_{sp}, has the value of 1.6×10^{-72} at room temperature.

(a) At room temperature how many moles of Bi_2S_3 will dissolve in 3.091×10^6 liters of water?

(b) How many Bi^{3+} ions will be found in the solution described in part (a)?

3. Calculate the volume of 0.25 M NaI that would be needed to precipitate all the Hg^{2+} ion from 45 mL of a 0.10 M $Hg(NO_3)_2$ solution according to the following reaction:

$$2\,NaI(aq) + Hg(NO_3)_2(aq) \rightarrow HgI_2(s) + 2\,NaNO_3(aq)$$

4.(a) Strontium fluoride, SrF_2, has a K_{sp} value in water of 2.45×10^{-9} at room temperature. Calculate the solubility of SrF_2 in water. Express your answer in units of molarity.

(b) Calculate the solubility of SrF_2 in 0.03 M NaF (*aq*). Express your answer in units of molarity. Assume that NaF is completely dissociated in water.