

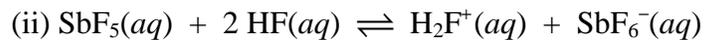
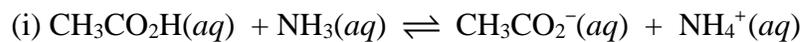
3.091 OCW Scholar

# **Self-Assessment Aqueous Solutions**

## **Supplemental Exam Problems for Study**

## Problem #1

- (a) Identify the conjugate acid-base pairs in each equilibrium by drawing a line connecting each acid with its conjugate base, and identify the acid of each acid/base pair:



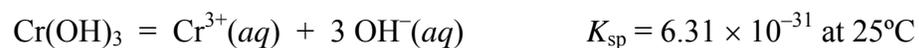
- (b) A 1.11 M solution of fluoroacetic acid,  $\text{FCH}_2\text{CO}_2\text{H}$ , is 5% dissociated in water.

(i) Calculate the value of the  $pK_a$  of  $\text{FCH}_2\text{CO}_2\text{H}$ .

(ii) Calculate the value of the  $pH$  of the solution.

## Problem #2

Chromium hydroxide ( $\text{Cr}(\text{OH})_3$ ) dissolves in water according to



Calculate the solubility of chromium hydroxide in 3.091 nM ( $3.091 \times 10^{-9}$  M)  $\text{NaOH}(\text{aq})$ . Express your answer in moles of  $\text{Cr}(\text{OH})_3$  per liter of solution.

## Problem #3

Comment on the solubility of iodine ( $\text{I}_2$ ) in each of these *liquids*: (1) carbon tetrachloride ( $\text{CCl}_4$ ); (2) hydrogen fluoride ( $\text{HF}$ ). State whether at room temperature you expect  $\text{I}_2$  to be *highly soluble* or *almost insoluble*, and explain why.

(1)  $\text{I}_2$  in  $\text{CCl}_4(\ell)$

(2)  $\text{I}_2$  in  $\text{HF}(\ell)$

### Problem #4

- (a) The water dissociation equilibrium constant,  $K_w$ , expresses the relationship between hydronium ( $\text{H}_3\text{O}^+$ ) and hydroxyl ( $\text{OH}^-$ ) concentrations by the expression

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

Owing to the presence of dissolved salts the value of  $pK_w$  for seawater is 13.776 (not 14.00 as it is for pure water), where  $pK_w$  is defined as  $-\log_{10}K_w$ . Calculate the concentration of hydroxyl ions ( $\text{OH}^-$ ) in seawater at a  $pH$  value of 7.00. Express your answer in moles  $\text{OH}^-$  per liter of solution (M).

- (b) Would seawater at a  $pH$  value of 7.00 be classified acidic, basic, or neutral? Explain.

- (c) Give an example of a dissolved salt that would cause the shift in the value of  $pK_w$  for seawater to 13.776 from the commonly accepted value of 14.00 which is valid for pure water. Justify your choice of salt.

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