

GEORGE MASON UNIVERSITY
CHEMISTRY DEPARTMENT
CHEM 321 - MIDTERM EXAM
FALL 2003

TIME 12:30 - 1:20

NAME _____

Honor code pledges:

On my honor, I have neither given nor received aids in this examination

Signed _____

Show complete work to receive full credits.

a) (15 points)

Sodium benzoate ($\text{NaC}_7\text{H}_5\text{O}_2$) is the salt of a monoprotic acid, benzoic acid ($\text{HC}_7\text{H}_5\text{O}_2$). Calculate the pH and concentrations of all the species present in a 0.15 M solution of $\text{NaC}_7\text{H}_5\text{O}_2$. What is the fraction of benzoic acid in solution? ($\text{pK}_a \text{HC}_7\text{H}_5\text{O}_2 = 4.202$)

2. (15 points)

A mixture of 0.050 M each of KCl and KI is titrated with standard AgNO_3 . If 25.0 mL of 0.050 M Ag^+ is added to 25.0 mL of the mixture of Cl and I, calculate the concentration of Ag^+ , Cl, and I in the resulting solution. ($K_{\text{sp, AgCl}} = 1.8 \times 10^{-10}$, $K_{\text{sp, AgI}} = 1.0 \times 10^{-16}$)

3. (15 points)

A solution is prepared by mixing 50.0 mL 0.25 M ammonia with 150.0 mL 0.10 M ammonium chloride. Calculate the pH of the solution. What is the change in pH if 1.0 mL 0.55 M HCl is added to this solution? (pK_b of NH_3 is 4.756)

4. (55 points)

a) Calculate the pH of 10^{-10} M LiOH in water at 50 °C. ($K_w = 2.0 \times 10^{-14}$ at 50 °C)

b) Write the self-protonation (or autoionization) reaction for perchloric acid.

- c) Calculate the pH of a solution prepared by mixing equal volumes of strong acid or strong base of pH = 3 and pH = 7.
- d) Why does the surface charge of a silver halide precipitate change sign at the equivalence point?
- e) The solubility product of CuCl(s) is 1.9×10^{-7} . The equilibrium constant for the reaction: $\text{Cu(s)} + \text{Cu}^{2+} \rightleftharpoons 2\text{Cu}^+$ is 9.6×10^{-7} . Calculate the equilibrium constant for the reaction:
$$\text{Cu(s)} + \text{Cu}^{2+} + 2\text{Cl}^- \rightleftharpoons 2\text{CuCl(s)}.$$
- f) An aqueous solution is labeled '0.1 M NH_4F '. ($\text{pK}_a \text{NH}_4^+ = 9.244$, $\text{pK}_a \text{HF} = 3.17$). Identify all the species present in the solution. Write all pertinent hydrolysis reactions.