CHE 226 **ANALYTICAL CHEMISTRY** **Fall 2003**

EXAM II -- October 30, 2003

Name _____

WRITE YOUR NAME ON EACH EXAM PAGE NOW. THERE ARE 7 QUESTIONS AND 105 PERCENT TOTAL IN THIS EXAM.

Show clearly all work on these pages. Use the proper number of significant figures and the correct units in all final answers. You must show your calculations and/or reasoning, **including equations**, on a question to obtain any credit; no credit for answers appearing out of the blue. Your work must be understandable at the time it is being graded to obtain any partial credit.

You do not have to do the *final* arithmetic, as long as the answer is expressed in its final form and all algebraic manipulations and numerical substitutions have been made. Little will be subtracted for routine *arithmetic* errors. A calculator may be used, but not shared with anyone else.

A sheet of scrap paper is at the back of the exam booklet. Tear it off now.

Unless otherwise stated, assume all solutions are aqueous, density = 1.0000 g/mL; activity coefficients are unity (i.e., activity = concentration); temperature, $T = 298$ K; $K_w = 1.008 \times 10^{-14}$.

QUESTION 1	_____ /28	Question 7	_____ /13
QUESTION 2	_____ /8	Question 8	_____ /
QUESTION 3	_____ /8	Question 9	_____ /
QUESTION 4	_____ /24	Question 10	_____ /
QUESTION 5	_____ /10	Question 11	_____ /
QUESTION 6	_____ /14	TOTAL	_____ /105

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1. (28 points) Barium iodate, $Ba(IO_3)_2$, is relatively insoluble, $K_{sp} = 1.57 \times 10^{-9}$. Iodic acid, HIO_3, is a fairly strong "weak acid", with $K_a = 1.7 \times 10^{-1}$. You wish to calculate the solubility of barium iodate in a solution that is also 0.01 M in iodic acid. Because it is such a strong "weak acid", you must use the full systematic approach to solving this problem. [Set the problem up, do *not* try to solve it numerically.]

   (a) (10 points) Accurately write all the equilibrium reactions for this problem along with their associated equilibrium constant expressions.

   (b) (5 points) List all the solution concentrations that are not known.

   (c) (8 points) Write the mass balance equations for this system. Let the solubility of barium iodate be called *S*.

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(d) (5 points) Write the charge-balance expression for this solution.

2. (8 points) A 0.7406-g sample of impure magnesite, $MgCO_3$ (84.31 g/mol), was decomposed with HCl; the liberated CO_2 (44.01 g/mol) was collected on calcium oxide and found to weigh 0.1881 g. Calculate the percentage of magnesium (24.305 g/mol) in the sample.

3. (8 points) A 0.3367 g sample of primary standard grade Na_2CO_3 (105.99 g/mol) required 28.66 mL of H_2SO_4 to reach the endpoint in the neutralization reaction below. Calculate the molarity of the H_2SO_4 solution.

$$CO_3^{2-} + 2\,H^+ \rightarrow H_2O + CO_2$$