

EXAM II – October 27, 2005

Name _____

WRITE YOUR NAME ON EACH EXAM PAGE NOW. THERE ARE 7 QUESTIONS AND 104 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 on a question unless you need to have a numerical value for the next part of a question, *as long as the answer is expressed in its final form and all algebraic manipulations have been made.* Very little will be subtracted for routine *arithmetic* errors, but all numerical answers must be shown to the proper number of significant figures. Programmable calculators must have all memory erased. A calculator may be used, but not shared with anyone else. Tables of data and other information that may be useful are appended to the back of the exam. Use the backs of the pages as scrap paper. Anything written on the *backs* of pages is totally irrelevant to the grading process.

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

QUESTION 1 _____ / 24

Question 7 _____ /12

QUESTION 2 _____ /10

Question 8 _____ /

QUESTION 3 _____ /12

Question 9 _____ /

QUESTION 4 _____ /5

Question 10 _____ /

QUESTION 5 _____ /12

Question 11 _____ /

QUESTION 6 _____ /29

TOTAL _____ /104

1. (24 Points) You wish to calculate the solubility (S) of silver phosphate, Ag_3PO_4 , taking into account all possible reactions. Silver phosphate is relatively insoluble, it has a K_{sp} . The hydrogen phosphate ion is one of the acid-base forms originating from phosphoric acid, H_3PO_4 , which has three acid dissociation constants. Designate them as K_{a1} , K_{a2} , and K_{a3} .
- (a) (10 Points) Write out **all** the relevant chemical equilibrium reactions for this system, along with the appropriate equilibrium constant for each equation.
- (b) (9 Points) Write the mass-balance equation(s) for this system
- (c) (5 Points) Write the charge-balance equation for this system.

2. (10 points) The experimental molar solubility, S , of Ag_3PO_4 in water is 4.8×10^{-5} M. Calculate the numerical value for the K_{sp} of silver phosphate. *Assume that no hydrolysis or complexation of the dissolved ions occurs.*
3. (12 Points) Calculate the solubility, S , of PbI_2 in 0.10 M NaI if the K_{sp} for lead iodide is 7.1×10^{-9} .
4. (5 points) The ferric ion, Fe^{3+} , can be complexed by up to three chloride ions to form soluble complexes. The three **stepwise** formational constants have been measured to be $K_{f1} = 30$, $K_{f2} = 135$, and $K_{f3} = 98$. Calculate the value for the **overall** formational constant, β_3 , for the reaction

