

Chem 232
Exam #3
3/17/08

Name _____

In-class portion (1-5):

Pledge:

When you have completed this portion of the exam, please consider the following:

I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this portion of the exam.

Signed _____

Answer the following on separate sheets of paper. All work must be shown for full credit.

- (10 pts) The value of K_a for nitrous acid (HNO_2) is 1.03×10^{-3} . Without neglecting activities, calculate the pH of a 0.120 M solution of HNO_2 that is also 0.100 M in NaCl. ($\alpha_{\text{NO}_2^-} = \alpha_{\text{Cl}^-} = 300$ pm; $\alpha_{\text{H}^+} = 900$ pm; $\alpha_{\text{Na}^+} = 450$ pm)
- (18 pts) Briefly answer any **three (3)** of the following:
 - Describe the separation mechanism in size exclusion chromatography.
 - Describe the two methods for injecting samples in capillary electrophoresis.
 - What do we mean by “gradient elution” and why is it useful?
 - What is a flame ionization detector used for and how does it work?
- (8 pts) HClO is a weak acid. Give both the charge balance and the mass balance expressions when a solution is prepared that is 0.0500 M in HClO and 0.100 M in NaClO.
- (14 pts) The K_{sp} value for lead(II) chloride is 1.7×10^{-5} . Without neglecting activities, calculate the value of pCl ($-\log A_{\text{Cl}}$) for the solution that results when 50.0 mL of 0.100 M $\text{Pb}(\text{NO}_3)_2$ is added to 100.0 mL of 0.100 M NaCl. ($\alpha_{\text{NO}_3^-} = \alpha_{\text{Cl}^-} = 300$ pm; $\alpha_{\text{Pb}^{2+}} = \alpha_{\text{Na}^+} = 450$ pm)
- (34 pts) A chromatographic separation of two compounds is attempted on a 15.0-cm column. A solvent peak is seen 31 s after injection, while compound A shows a peak maximum at 119 s, and compound B shows a maximum at 123 s.
 - Calculate the capacity factors for A and B.
 - What would the width of each peak be if the column contains 2000 theoretical plates?
 - What is the resolution of the separation?
 - Complete baseline separation of the peaks will occur at a resolution of 1.50. Assuming the plate height stays the same, how long would the column have to be for complete baseline separation to occur?
 - Calculate the new retention times of A and B when a column of the length calculated in part d is used.

Name _____

Take-home portion (6), due Wednesday (3/19) at 5:00pm:

Pledge:

When you have completed this portion of the exam, please consider the following:

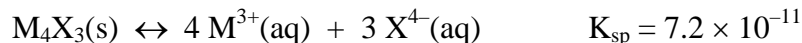
I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this portion of the exam.

Signed _____

This portion of the exam is open-book. Use any reference material available to you. Where applicable, let a spreadsheet do as much work for you as possible, then turn in a hard copy of the spreadsheet. I ask only that you do not consult with another person regarding any of the following questions, and that you do not use material from anyone who has taken this class in a previous semester.

To receive any credit for this problem you must answer it correctly. Each time you turn in the exam with an incorrect answer, 2 points will be deducted from your score.

6. (20 pts) Consider a solution of the hypothetical salt M_4X_3 which dissociates as follows:



H_4X is a weak tetraprotic acid with the following K_a values:

$$K_{a1} = 4.3 \times 10^{-3}$$

$$K_{a2} = 6.1 \times 10^{-6}$$

$$K_{a3} = 8.5 \times 10^{-9}$$

$$K_{a4} = 4.8 \times 10^{-12}$$

Calculate the pH of a saturated solution of M_4X_3 .