NAME: _____

INTRODUCTION TO ANALYTICAL CHEMISTRY
CHEM210 SECTIONS 001 & 002

EXAM II

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Fall, 2005

Answer all the questions. **DO NOT** write on this examination paper, use the blank sheets at the back of the exam for your answers. Credit will **NOT** be given for numerical calculations unless all relevant calculations are shown. For all statistical questions, give your answers to the correct number of significant figures for all other numerical questions give your answers to 3 significant figures.

1. a) For gravimetric and titrimetric analysis, what is the typical relative error.

2 points

b) For gravimetric analysis, what is typically the smallest amount of analyte in a sample that can be determined?

2 points

c) What properties would we like to have in a precipitation reagent for use in a gravimetric analysis?

6 points

d) The aluminum in a 1.200g sample of impure ammonium aluminum sulfate was recipitated with aqueous ammonia to give the hydrous oxide $Al_2O_3 \cdot xH_2O$. The precipitate was filtered, washed, and then heated to a 1000°C to give Al_2O_3. What was the percentage of aluminum is the original sample?

10 points

2. A new nitrogen analyzer was introduced into a laboratory to analyze nitrogen. The analyzer was checked for determinate error by analyzing a standard sample of orchard leaves known to contain 5.14% nitrogen. The following results were obtained:

Determination	% N
1	5.03
2	8.19
3	5.01
4	5.08
5	5.03

Determine if there is a determinate error present in the analyzer.

20 points

3. a) In a gravimetric analysis, what experimental steps would you take to try and make sure you obtained a crystalline precipitate rather than a colloidal suspension?

5 points

b) Why in gravimetric analysis are crystalline precipitates preferred over colloidal suspensions?

5 points

c) Explain or define the following terms:

i. Non-Stoichiometric compounds
ii. Digestion
iii. Crystalline precipitate
iv Coagulation
v. Isomorphic Inclusion

15 points

4. a) Silver (I) carbonate is a sparingly soluble material. Calculate the concentration of silver ions and carbonate ions in aqueous solution at equilibrium.

15 points

b) Strontium fluoride is a sparingly soluble material. Calculate the concentration of strontium ions in a 0.05M sodium fluoride solution at equilibrium.

10 points

5. A colloidal suspension of tin (II) sulfide is produced by adding an excess of sodium sulfide to a solution of tin (II) nitrate. Draw a carefully labeled diagram of the structure of a tin (II) sulfide colloidal particle in solution.

10 points

ANSWERS

1. a) ~ 3ppt
   b) 1.5%
   c)
      i) High molecular weight
      ii) Low solubility
      iii) Stoichimetric material
      iv) High specificity
      v) Non-hydroscopic
      vi) Ease of filtration

   d) 14.2%

2. Perform a Q-test at 90% confidence level on determination 2 – value is rejected

   Null hypothesis “There is no significant difference between the mean and the “real true value”

   At 90% confidence level the null hypothesis fails

$$\mu - \bar{x} > \frac{ts}{\sqrt{N}}$$

   At 99.5% confidence level the null hypothesis is true

$$\mu - \bar{x} < \frac{ts}{\sqrt{N}}$$

   We therefore concluded that we are somewhere between 90% and 99.5% sure that a determinate error exists in the analysis

3. a)
      i) Use dilute solutions
      ii) Stir the solution
      iii) Heat the solution
      iv) Add precipitating solution slowly

   b) They are easier to filter

c)

i) These are compounds that have no set reproducible stoichiometry

ii) This is the process of gently heating a solution containing a crystalline precipitate in order to remove impurities from the precipitate

iii) These are precipitates in which the particle size is > 10^{-4}mm in diameter and are easy to filter

iv) This is the process of bringing colloidal particles together to form 'large clumps' of material

v) This is where a foreign ion becomes incorporated into the crystal structure of a material at a lattice site

4. a) $[Ag^+] = 2.53 \times 10^{-4}M$
$[CO_3^{2-}] = 1.27 \times 10^{-4}M$

b) assumption passes
$[Sr^{2+}] = 1.16 \times 10^{-6}M$