

Name: \_\_\_\_\_

**Introduction to Analytical Chemistry**  
**Chem 210 Sections 001 and 002**  
**Exam I**

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Spring 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. Answers written on the exam will not be graded. Credit will not be given for numerical problems unless all relevant calculations are shown. Please give answers to numerical questions to 3 significant figures unless indicated otherwise.

1. A sample of bread was analyzed for its calcium content with the following results.

<u>Determination</u>	<u>Ca ppt</u>
1	10.1
2	10.5
3	9.9
4	10.2

Calculate:

- i) The average of the data set. 4 points
  - ii) The medium of the data set. 4 points
  - iii) The absolute deviation of the 3<sup>rd</sup> determination from the mean. 4 points
  - iv) The relative average absolute deviation from the mean of the data set. 4 points
  - v) If the 'real true value' of the calcium content of the bread was 10.0 ppt calculate the absolute error of the mean of the data set. 4 points
- 2 a) 10.16g of Barium Chloride was dissolved in water to produce 250 mL of solution.
- i) Calculate the Formal concentration of the solution. 7 points
  - ii) The molar species or equilibrium concentrations of the solution. 3 points

b) 5.64g of iron(II) nitrate are dissolved in water to produce 200mL of solution. Calculate the weight % of nitrate ions in solution given the density of the solution is  $1.0213\text{g.mL}^{-1}$ .

5 points

c) You need to prepare 1.5L of a solution whose potassium ion concentration is 20.0ppm. If your source of potassium ions is potassium chloride how much potassium chloride must you weigh out?

10 points

3 a) Give the reasons why we normally can only perform a small number of replicate determinations.

3 points

b) What are the four main sources of determination error?

3 points

c) In any analysis of data we would always prefer to use  $\sigma$  (the standard deviation of a large data set). Suggest two practical means that we can obtain a good estimate of  $\sigma$ .

4 points

d) Explain or define the following

- i) Accuracy
- ii) Analyte
- iii) Indeterminate error
- iv) 'Real true value'
- v) Precision
- vi) Sample
- vii) Constant errors

14 points

4. The following data were obtained for the analysis of caffeine in coffee.

<u>Determination</u>	<u>ppm Caffeine</u>
1	100
2	95
3	167
4	90
5	97

i) Determine the confidence interval for the data set at the 95% confidence level.

25 points

ii) Explain what the confidence interval is telling you.

5 points

## ANSWERS

1.
  - i)  $\bar{x} = 10.2$  ppt Ca
  - ii) median = 10.1<sub>5</sub> ppt Ca
  - iii) 0.275 ppt Ca
  - iv) 1.72%
  - v) 0.175 ppt Ca
  
2.
  - a)
    - i) 0.195 M
    - ii)  $[\text{Ba}^{2+}] = 0.195\text{M}$   
 $[\text{Cl}^-] = 0.390\text{M}$
  
  - b) 1.90 w/w %
  
  - c) 57.2 mg KCl
  
3.
  - a)
    - i) The cost involved in doing many replicates
    - ii) The time involved in doing many replicates
    - iii) The limited amount of sample available
  
  - b)
    - i) Instrument errors
    - ii) Method errors
    - iii) Personal errors
    - iv) Gross errors
  
  - c)
    - i) Perform many replicates
    - ii) If you have available many analyses of samples for the same analyte using the same method you can calculate a pooled 's' which will approach 'σ' in the limit
  
  - d)
    - i) This is a measure of the nearness of a value to its 'real true value'
    - ii) This is the particular material one is performing the analysis for in a sample
    - iii) These are errors whose size and source we cannot know. They can be both positive and negative and occur randomly.
    - iv) This is the actual value of a measurement and is generally not knowable
    - v) This is a measure of how close a set of data are to each other
    - vi) This is the material that contains the analyte we are interested in
    - vii) These are errors that do not change with sample size
  
4. Perform a Q-Test on determination '3'
  - i)  $\mu = 95 \pm 7$  ppm Caffeine
  - ii) This means that we will be correct 95 times in a 100 is saying that the 'real true value' is in the range 87 to 102 ppm caffeine. 5 times in a 100 we will be incorrect.