

# INTRODUCTION TO ANALYTICAL CHEMISTRY

## CHEM. 210 SEC. 001, 002

### EXAM I

Answer all the questions. **DO NOT** write on this examination paper, use the blank sheets at the end of the exam for your answers. Credit will not be given for numerical questions unless all relevant calculations are shown. Please give answers to numerical question to **3** significant figures unless asked otherwise.

FALL, 2004

1. a) 5.64g of calcium nitrate are dissolved in water to produce 150 mLs. of solution whose density is  $1.0021\text{g}\cdot\text{mL}^{-1}$ . Calculate:
- i) The weight % of calcium ions in the solution.
  - ii) The weight % of nitrate ions in the solution.
- 10 points
- b) I need to make up a 1.50L of a solution whose potassium ion concentration is 10ppm. What weight of potassium chloride do I need to weigh out to prepare this solution?
- 10 points
- c) 0.0124g of magnesium sulfate are dissolved in water to produce 250mL of solution. Calculate:
- i) The concentration in solution of magnesium ions in ppm.
  - ii) The concentration in solution of sulfate ions in ppm.
- 10 points
2. a) Define or explain the following terms:
- i) Analyte
  - ii) Sample
  - iii) Precision
  - iv) Accuracy
  - v) Indeterminate Error
  - vi) Gross Error
  - vii) Real True Value
  - viii) Constant Error
- 16 points
- b) In theory we would like to make as many replicate determinations as possible. However, as a practical matter we can generally only make a small number of replicate determinations. Explain why this is so.
- 6 points

3. The following data were obtained for the analysis of sugar in the blood.

<u>Determination</u>	<u>Sugar mg/dL</u>
1	101
2	105
3	98

Calculate:

- i) The average of the data set 5 points
- ii) The medium of the data set 5 points
- iii) The absolute deviation from the mean of the second determination. 5 points
- iv) The relative average deviation from the mean of the data set. 5 points
- v) If the real true value of sugar in the blood is 100mg/dL, calculate the absolute error of the mean. 5 points
- vi) Calculate the standard deviation of the data set. 10 points
- vii) Calculate the confidence interval of the data set at the 95% confidence level. 5 points
- viii) If the standard deviation calculated in (vi) was for a large data set, what would the confidence interval of the data set at the 95% confidence level be? 5 points
- ix) Why is there difference in the confidence intervals calculated in (vii) and (viii)? 3 points

**EXTRA CREDIT:** In question 3 what does dL mean?

3 points

## ANSWERS

1. a) i) 0.918%  $\text{Ca}^{2+}$   
ii) 2.83%  $\text{NO}_3^-$   
  
b) 28.6 mg KCl  
  
c) i) 10.0 ppm  $\text{Mg}^{2+}$   
ii) 39.6 ppm  $\text{NO}_3^-$
  
2. a) i) The analyte is the material in a sample that we are analyzing for.  
ii) The sample is the material that is undergoing analysis.  
iii) Precision is a measure of how close a set of data points are to each other.  
iv) Accuracy is a measure of how close our value is to the “real true value”.  
v) Indeterminate error are errors for which we can find no cause. They fluctuate in value, can be positive or negative and are random.  
vi) Gross errors are errors that are caused by carelessness lack of attention and are easily eliminated.  
vii) “Real true value” is the ‘real; answer to an experiment and is a theoretical value and it is unknowable.  
viii) Constant errors are errors that do not vary with sample size.  
  
b) In general we are limited by:  
  
i) Time – we do not have an infinite amount of time to perform the analysis.  
ii) Cost – we are always limited by cost  
iii) Amount of sample – we always have a finite amount of sample
  
3. i) 101 mg.dL<sup>-1</sup>  
ii) 101 mg.dL<sup>-1</sup>  
iii) 4.00 mg dL<sup>-1</sup>  
vi) 2.42%  
v) 1.00 mg. dL<sup>-1</sup>  
vi)  $\pm 3.51$  mg. dL<sup>-1</sup>  
vii)  $101 \pm 9$  mg. dL<sup>-1</sup>  
viii)  $101 \pm 4$  mg. dL<sup>-1</sup>  
ix) For a large data set the mean  $\bar{x}$  is much closer to the ‘real true value’ and hence our uncertainty as to the ‘real true value’ is reduced. Hence our confidence interval is smaller for a large data set at a given confidence level.

Extra Credit – deciliter.