

Take-Home Portion of Exam 1
CHEM 120
Fall 2009

Name: _____

Instructions:

Answer the questions in the space provided. All final numerical answers and all essay-type questions must be hand-written in complete sentences. If a question requires a graph or spreadsheet output, tape the item in the provided space; do not use staples.

You may not consult with anyone, except the instructor, about specific questions regarding this exam. You may ask other faculty members general questions about topics and methods on this exam, but not about any specific question on the exam. You may not work on this portion of the exam with any one else.

Write your answers neatly and legibly in ink. Answers in pencil will be accepted, but you will not be able to appeal any apparent grading errors (except simple addition errors).

Give a brief description of what you are doing in each numerical problem. This description should give the reader an idea of what you are doing and some justification for your approach. You do not need to justify simple mathematical manipulations.

Problem	Possible Points	Points Received
1	30	
2	8	
3	11	
4	14	
Total	63	

1. A sample that is purported to be pure calcium carbonate is analyzed for % calcium by mass. The analysis is repeated seven times with the following results: 39.51, 39.69, 39.70, 39.71, 39.77, 39.84 and 39.85% Ca by mass.

a. (6 Points) Can any point be eliminated by Q-test? If so, which one is it? Show your work below.

b. (9 Points) Using Excel, calculate the average % Ca by mass, determine the standard deviation and determine the uncertainty at the 95% confidence limit. Write your answers in the appropriate spaces below and attach a printout of your spreadsheet in the space provided on the next page. In your spreadsheet be sure to label the cells as to what they contain and indicate the units for the number in the cell (hint: look at the spreadsheets that you were asked to prepare for the *Determination of Density* exercise for guidance). Please indicate, by typing it in your Excel worksheet, the Excel equation that you used to calculate the average, the standard deviation and the uncertainty.

Average % Ca by Mass:

Standard Deviation in % Ca by Mass:

Uncertainty in the % Ca by Mass at the 95%
Confidence Interval:

Tape a copy of your Excel worksheet here.

c. (6 Points) Determine the true value for the % calcium by mass in calcium carbonate.

d. (5 Points) Calculate the percent error for the analysis described in this problem.

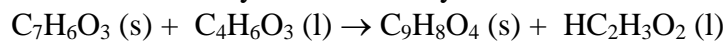
e. (4 Points) Is there any evidence for systematic error in this analysis? Explain.

2. (8 Points) A 0.622-g sample of a pure metal oxide with the chemical formula M_2O_3 , where M is an unknown metal, is converted to 0.685 g of the corresponding sulfide, MS . Identify the metal.

3a. (8 Points) Iron exists naturally as four isotopes, but it is possible to prepare a sample that is predominantly one isotope. You have a sample that has been enriched in ^{57}Fe so that it contains 99.270% ^{57}Fe , but which contains another isotope as an impurity. Identify the other isotope, given that the apparent atomic weight of the sample is 56.943 amu and that the atomic mass of ^{57}Fe is 56.9354 amu.

b. (3 Points) With the enriched sample described in part *a*, iron (III) carbide is prepared with a carbon source that is 100.000% ^{12}C . What is the chemical formula of iron (III) carbide, and what is the formula weight of the enriched sample?

4a. (8 Points) Aspirin ($C_9H_8O_4$) is produced by the reaction of salicylic acid ($C_7H_6O_3$) and acetic anhydride ($C_4H_6O_3$), according to the chemical reaction shown below. If you need 10.00 g of aspirin, how much of each reactant do you theoretically need?



b. (6 Points) In recent years the amount of products other than the desired products in industrial chemical reactions have become the focus of much attention. In this reaction, acetic acid is the byproduct, how much acetic acid would theoretically be formed when 10.00 g of aspirin is produced?