Exam Study Questions
Chemistry 20L
Spring 2005

During the exam you will be allowed to use a calculator, your lab notebook, your lecture guides and any hand-written materials that you want. Printed study questions and/or answers are not allowed.

Review the pre-lab study questions even if they were not assigned. You should be able to answer all these questions now.
Review the sidebar questions in the experiments.
Review the experimental procedures.

Error Analysis

1. Calculate the percent error for the following quantities
   (a) $\dfrac{(20.54 \pm 0.02)(0.254 \pm 0.003)}{3.21 \pm 0.05}$
   (b) $(30.078 \pm 0.003) - (20.174 \pm 0.001) + (9.813 \pm 005)$
   (c) $[(0.642 \pm 0.002)\ (2.413 \pm 0.004)] - (0.501 \pm 0.002)$
   (d) $\dfrac{12.635 \pm 0.005}{(5.967 \pm 0.003) + (0.478 \pm 0.004)}$
2. Calculate the absolute errors for the quantities in question 1.

3. Calculate the percent relative average deviation for the following set of data:
   20.96, 20.85, 20.89, 20.92

Concentrations

4. Define the concentration terms molarity, normality, weight percent (w/w and w/v), PPM, pH.

5. When would it be appropriate to use each of the concentrations in question 1. What limitations are there with any of these concentrations?

6. An ethanol (C_2H_5O in water) solution was labeled as 1.00×10^{-3} M. What is this concentration in PPM, weight %, volume %? (Assume the density of water is 1.00 g/1.00 mL and the density of ethanol is 0.880 g/1.00 mL.)

7. A sulfuric acid solution was prepared by transferring 0.0196g of acid to a 1-L volumetric flask and diluting the solution to the mark. Calculate the concentration of acid in the solution. in all of the units in question 5. (Assume the sulfuric acid dissociates completely.)

8. A sodium hydroxide solution was prepared by transferring 0.4063g to a 100-mL volumetric flask and diluting the solution to the mark. A 10-mL aliquot of this solution was transferred

to a 50-mL volumetric flask and the solution we diluted to the mark. Calculate the concentration of the final sodium hydroxide solution in all of the units in question 5. (Pay attention to significant figures. Remember the name of the flask does not designate its precision.)

9. A student made a standard solution by transferring 0.1037g of $CuSO_4 \cdot 5H_2O$ into a 100-mL volumetric flask, dissolving the salt and diluting to the mark. He then withdrew a 5-mL aliquot with a volumetric pipet and transferred it to a 100-mL volumetric flask. The solution was diluted to the mark and mixed well. Calculate the concentration of copper in parts per million. Since this is an aqueous solution you can assume a mL of solution weighs 1g.

10. If the tolerance of the balance is ±0.2 mg, the volumetric flask is ± 0.08 mL, and the pipet is ±0.01 mL, calculate the percent inherent error in the final diluted solution.

Beer's Law

11. Beer's Law is summarized by the equation

$$A = \varepsilon bc$$

Name and define each of the symbols in this equation.

12. Calculate the percent transmittance of a solution if its absorbance is 0.352.

13. The following set of data was obtained for the calibration curve for a Beer's Law experiment.

Molarity	Absorbance
blank solution	0.0
9.80×10^{-5}	0.240
1.96×10^{-4}	0.475
3.10×10^{-4}	0.741

Plot the data.

(a) Calculate the slope of the line.

(b) Calculate the inherent error in the slope of this line by determining the error bars on one of the points that was used to draw the line. Assume the error in the concentration is consistent with the rules outlined in Sec. III.1a and the error in the meter reading is ±1% *(absolute)* transmittance.

(c) Calculate the concentration of a solution of this same compound if its absorbance were 0.500.

(d) Calculate the inherent error in the concentration determined in (c) by considering the range of possible slopes from (b) above and the error in the meter reading for the measured absorbance of the unknown.

Definitions

14. Define the following terms being careful to identify any differences or relationships between them.

(a) End point and equivalence point

(b) Volumetric and non-volumetric glassware

(c) "Weak" coffee and "weak" acid

(d) Absorbance and transmittance

(e) Accuracy and precision

Techniques

15. Briefly write a procedure for

- preparing a 100-mL volumetric solution that contains 1.500 g of a primary standard.
- transferring a 5-mL aliquot of a solution using a volumetric pipet.
- reading a buret.
- calibrating a pH meter

Acid-Base and Buffer Chemistry

16. How many milliliters of 0.0400 M $Ba(OH)_2$ are required to reach the equivalence point with 15.0 mL of 0.100 HCl?

17. What volume of 0.250 M H_2SO_4 is required to reach the equivalence point with 38.40 mL of 0.200 M NaOH?

18. What volume of 0.120 N H_2SO_4 is required to reach the equivalence point with 24.0 mL of 0.200 N NaOH?