Form 2016

CHEM 122
LABORATORY SKILLS EXAMINATION

Prepared by **Ross S. Nord** and colleagues, Eastern Michigan University

---

PURPOSE

Assess each student's ability to work independently in the lab using the techniques developed during the course. Assess each student's ability to perform routine laboratory calculations.

INSTRUCTIONS

1. Work individually, this is a test. You are not allowed to help, or solicit help from, any other student. You are expected to know how to operate the equipment and perform the calculations. *Once the lab period starts*, the instructor will clarify the instructions and help if there are equipment malfunctions, but no other help will be provided.

2. Perform only the parts assigned by your instructor. At the beginning of the lab period the instructor will tell you which parts of this exam are to be done. Typically, three parts are assigned. They may be done in any order. *If parts II, III, or VI are assigned*, i*t's a good idea to use a computer whenever one is free.*

3. Follow all safety rules. If the instructor observes you working without safety goggles, improperly disposing of waste, or violating any other safety rule, he/she may choose to deduct one or more points for each offense.

4. Supplemental written materials are allowed. You may bring **any** written instructions or reference materials to the lab (including old labs, data sheets or equation setups).

5. Work in a timely fashion. You may repeat any part where you are uncertain of your results (if you have unknown left); but, be sure to leave sufficient time to perform all of the assigned parts at least once. ALL REPORT SHEETS MUST BE TURNED IN TEN MINUTES BEFORE THE END OF THE PERIOD (to allow for cleanup)!!

6. You will have access to all necessary equipment. As well as the equipment in the drawers, interfaces, spectrometers, temperature and conductivity probes will be available.

7**. Unknowns should be used wisely**. *If you ruin or use up any unknown sample, you may receive a second sample of that unknown, but you will lose 1 point. You will not be given a third sample of any unknown*. Therefore, be careful not to ruin your unknowns.

For each part you will receive the following unknown:

Part I: 40 mL of unknown salt solution.
Part II: 70 mL of unknown acid solution
Part III: 70 mL of unknown solution.
Part IV: a vial of unknown monoprotic acid.
Part V: no unknown.
Part VI: 15 mL of unknown.

8. Turn in the Report Sheet and the items specifically listed below. Record all values in ink. Unless told otherwise by your instructor, you may append *clear, well-organized* additional materials (data, calculations, …). In certain circumstances they may be considered when the report is graded. *Very significant deductions will be made for incorrect calculations.*

If part II was assigned, the graph for the calorimetric run must be turned in.

Points will be deducted if something is missing.

EXPERIMENTAL SECTION

Do only those parts assigned by your instructor

Part I. (10 points) Determination of Density.

The objective of this part is to test your ability to do a routine lab analysis using basic equipment.

Reagents provided:

Unknown salt solution.

Tasks to be accomplished:

1. Obtain about 40 mL of unknown salt solution from your instructor.

2. Using a pipet, transfer 10.00 mL of the salt solution into a tared beaker or flask. Record the mass.

3. Repeat step 2 until you are confident of your results.

4. Calculate the density of your solution (by taking the average of your good trials).

This waste solution can go down the drain.

Results to report:

1. The mass of 10 mL of salt solution for each good trial performed (7 pts).

2. The density of your unknown salt solution, in g/mL (3 pts).

Part II. (10 points) Calorimetry.

The objective of this part is to measure ΔT for a neutralization reaction. This tests your ability to measure volumes, use the computer software, and perform graphical analysis on your data.

Reagents provided:

$NH_4OH(aq)$, approximately 1 M.

Unknown acid solution.

Tasks to be accomplished:

1. Obtain approximately 70 mL of an unknown acid solution from the instructor.

2. React 50.0 mL of your acid with 50.0 mL of the $NH_4OH(aq)$ following the procedure in the Solution Calorimetry experiment (steps 1-11). Assume the acid is the limiting reactant.

3. Determine ΔT for your reaction (to the nearest 0.1°C) following procedure steps 12-14.

4. Print a copy of your (properly labeled and titled) graph (step 15).

Your waste solutions can go down the drain.

Results to report:

1. Turn in the graph of your run (5 pts).

2. Your measured value of ΔT (5 pts).

Part III. (10 points) Conductivity.

The objective of this part is to test your ability to measure conductivity and use it to determine if a chemical reaction has occurred.

Reagents provided:

Unknown solution.
Standardized NaOH, approximately 0.05 *M*.

Tasks to be accomplished:

1. Obtain about 70 mL of unknown solution from the instructor in a 100-mL beaker.

2. Set up and calibrate a conductivity probe and then measure the conductivity of your unknown.

3. Measure 50 mL of the provided 0.05 M NaOH into another 100-mL beaker and measure its conductivity.

4. Pour 50 mL of your unknown into a 250-mL beaker, add the 50 mL of 0.05 NaOH, and measure the conductivity of the mixture.

The waste solution can go down the drain.

Results to report:

1. The conductivity of your unknown (4 pts).

2. The conductivity of the 0.050 M NaOH (2 pts).

3. The conductivity of your mixture (2 pts).

4. Did a chemical reaction occur when the unknown was mixed with the NaOH (1 pt)? Explain how you know (1 pt).

Part IV. (10 points) Weighing and Titrating.

The objective of this part is to test your ability to perform a titration and to do routine lab calculations involving molar mass, molarity, and volume.

Reagents provided:

Vials containing unknown monoprotic acids.
Standardized NaOH, approximately 0.05 *M*.
Phenolphthalein, 1% in ethanol.

Tasks to be accomplished:

1. Obtain a vial containing a solid unknown monoprotic acid.

2. Weigh out approximately 0.3 g (± 0.02 g) of your unknown into a suitable container. Add water and indicator to the container, as appropriate, following the directions provided in the *Ttiration of an Unknown Acid* experiment.

3. Titrate your sample using the NaOH provided (note the actual concentration of the NaOH provided).

4. Repeat steps 2 & 3 (as time allows) until you are confident of your results.

5. Calculate the molar mass of your unknown.

The waste from the titration and excess NaOH can be flushed down the sink with lots of water.

Results to report:

1. The actual mass of acid used (1 pt).

2. The volume of base used (5 pts).

3. The molar mass of your unknown monoprotic acid (4 pts).

Part V. (10 points) Simple Synthesis.

The objective of this part is to test your ability to carefully mix and filter. Additionally, you must demonstrate that you can calculate the yield of a reaction.

Reagents provided:

Reactant A 0.100 M
Reactant B 0.200 M
Spray bottles with 95% alcohol

Caution: Oxidants and Irritants – do not touch or breath in dust from the product.

Reaction that occurs: $A + 2\ B \rightarrow C$

Tasks to be accomplished:

1. Mix together 50.0 mL of reactant A and 40.0 mL of reactant B. Stir for several minutes.

2. Collect the product via suction filtration. Use a spray bottle with ice-cold distilled water to help transfer the precipitate to the filter flask. Once the product is all in the filter, rinse it with ethanol (to remove the water). Draw air through the product for at least 10 minutes to dry it.

3. Calculate the theoretical yield of C (in grams) assuming the molar mass of C is 225 g/mol. (This may be done before lab.)

4. Weigh the solid product.

5. Calculate the percent yield.

Dispose of all excess reactants, solutions, and products in the designated waste containers.

Results to report:

1. The theoretical yield (4 pts).

2. The mass of product obtained (4 pts).

3. The percent yield (2 pts).

Part VI. (10 points) Use of a Spectrometer.

The objective of this part is to determine the wavelength of maximum absorbance and concentration of an unknown solution. This tests your ability to use a spectrometer.

Reagents provided:

Unknown solution.

Tasks to be accomplished:

1. Obtain approximately 15 mL of an unknown aqueous solution from the instructor.

2. Measure the absorbance spectrum of the unknown in order to determine the wavelength of maximum absorbance, λ_{max}.

3. Record the absorbance at λ_{max}.

4. Use the following information and your measured absorbance to calculate the concentration of your unknown. A standard curve of absorbance vs. concentration was generated for the species in your unknown at λ_{max}. The slope and intercept of that plot were $1.146 \times 10^4\ M^{-1}$ and 4×10^{-3}, respectively.

Your waste solutions can go down the drain.

Results to report:

1. The number of the spectrometer used.

2. The wavelength of maximum absorbance, λ_{max}. (3 pts).

3. The absorbance at λ_{max} (4 pts).

4. The calculated concentration of your unknown (3 pts).

Name _____

Chemistry 122 Lab Final Report Sheet Form 2016

All values should be reported to the proper number of significant figures and with appropriate units.

Part I:

Salt Solution Unknown Number: _____

Solution Mass (good trials only) (7): _____ _____ _____

(There is no minimum or maximum number of trials that must be performed. So you do not need to use every line and you can add lines if more than three trials are done.)

Density of Unknown (3): _____

(Report the average density if multiple trials are performed.)

Part II:

Acid Unknown Number: _____

Graph (5)

ΔT (5): _____

Part III:

Unknown Number: _____

Conductivity of Unknown (4): _____

Conductivity of NaOH (2): _____

Conductivity of Mixture (2): _____

Did a reaction occur when the unknown and NaOH were mixed (1)? _____

Explain how you determined whether or not a reaction occurred (1)?

Part IV:

Acid Unknown Number: _____

Actual Mass of Acid Used (1): _____
(Add lines if multiple trials are performed.)

Volume of Base Used (5): _____
(Add lines if multiple trials are performed.)

Molar Mass of Unknown (4): _____
(Report the average molar mass if multiple trials are performed.)

Part V:

Theoretical Yield (4): _____

Mass of Product Obtained (4): _____

Percent Yield (2): _____

Part VI:

Unknown Number: _____

Spectrometer Number: _____

Wavelength of maximum absorbance, λ_{max} (3): _____

Absorbance at λ_{max} (4): _____

Concentration of Unknown (3): _____